July 3, 2023

Request for Bids
Lansing School District
Purchasing Department
519 West Kalamazoo
Lansing, MI 48933

This is not an order

Sealed proposals for the furnishing of items and services listed on the sheets attached to the bid proposal documents that are available on our web-site will be received in the Lansing School District Purchasing Office, 519 W. Kalamazoo St., Lansing, Michigan 48933 until
August 3, 2023 2:00 PM local time.
At this time and place bids will be opened publicly and read aloud.

One (1) original and Two (2) copies of the bid are to be submitted on the forms furnished by the Lansing School District in a sealed envelope and clearly marked:
Bid SB-0055 New Mount Hope
BID DOCUMENTS WILL BE POSTED BY July 10, 2023
To obtain a copy of this request for bid please visit our web site at:
www.lansingschools.net.
(Click on Quicklinks at the top and click on Vendors (Bid Info), scroll down to Current Requests for Bids or Proposals) or the bid documents are also posted on the State of Michigan's procurement system SIGMA.
If you need assistance, please contact the Lansing School District Purchasing Department at 517-755-3030.

No faxed, telephone or e-mailed bids will be accepted. Late submittals will not be considered.
All questions must be in writing and should be directed to Jon Laing, Chief Financial Officer at: projects@lansingschools.net, no later than 5:00 PM on Tuesday, July 25, 2023. Addendums will be posted on the Lansing School District's web-site and SIGMA as they are issued.

All bids/proposals must be accompanied by a 5% bid bond and a sworn and notarized statement disclosing any familial relationship with the Board of Education and selected staff. Bids must include the completed statement to be accepted or considered.

All bids shall be submitted in accordance with the attached instructions and shall remain firm for a period of ninety (90) days after the opening of bids.

A bid bond is required with this bid in the amount of 5% of the total bid amount. Certified payrolls are required with each invoice or pay application. A performance, labor and materials bond will be required to cover 100% of the project.

The Lansing School District reserves the right to reject any or all bids in whole or in part and to accept the proposal or portion of the proposal that, in their opinion, best serves the interests of the Lansing School District.

Lansing School District

_____

Jon Laing
Chief Financial Officer

PRE-BID INFORMATION
There will be a VIRTUAL Pre-Bid Meeting held Thursday, July 13, 2023 at 1:00 PM. This meeting will be held on Microsoft TEAMs using meeting ID: 285 576 889 072 and passcode: LsRPy2.
Attendance is HIGHLY RECOMMENDED.

Due to file size restrictions on the State of Michigan's procurement web site (SIGMA) please see the Lansing School District web site for the bid documents related to this project:

https://www.lansingschools.net/departments/purchasing/

Open the section titled "2022 Bond Projects" and locate the project you are interested in to view the bid documents.

The bid documents are also available on The Christman Company file share site:

221125-140 - Mt. Hope - Bid Package 2; New Build

PROJECT MANUAL

Mt. Hope School
Lansing, Michigan

VOLUME I

Bid Package No. 2

Monday, July 10, 2023

New Build

CONSTRUCTION MANAGER

The Christman Company
208 N. Capitol Avenue
Lansing, MI 48933-1357
517-482-1488

Architect
C2AE
106 W. Allegan St. Suite 500
Lansing, MI 48933

Mechanical & Electrical Engineer
Stantec
2338 Coolidge Hwy
Berkley, MI 48072

Site Engineer
C2AE
106 W. Allegan St. Suite 500
Lansing, MI 48933

Structural Engineer
C2AE
106 W. Allegan St. Suite 500
Lansing, MI 48933

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SECTION 00025

Project: **Mt. Hope School**

Owner: **Lansing School District**
519 W Kalamazoo St
Lansing, MI 48933

Architect/Engineer: **C2AE**
106 W. Allegan St. Suite 500
Lansing, MI 48933

Construction Manager: The Christman Company
208 N. Capitol Avenue
Lansing, MI 48933-1357
517-482-1488

Sealed proposals for all work categories as described in the Project Manual for the above project will be received no later than **Thursday, August 3, 2023 at 2:00 PM**. Proposals must be received at the Lansing School District Purchasing Office, ATTN: Jon Laing, 519 W, Kalamazoo St., Room 208, Lansing, MI. The Lansing School District will not consider any late, faxed or electronic mail bids. Bids will be opened publicly and read aloud. All bids must be presented on the forms provided in the construct documents.

Duplicate proposals shall be submitted on the proposal form provided, in a sealed envelope clearly marked **WORK CATEGORY NO._____**, and shall be identified with the project name and the bidder's name and address.

There will be a **virtual pre-bid conference on Thursday, July 13, 2023 at 1:00 PM** conducted by the Construction Manager. It is strongly recommended that contractors attend the pre-bid conference. The link to the virtual pre-bid conference is below.

Microsoft Teams meeting

Join on your computer, mobile app or room device
Click here to join the meeting
Meeting ID: 285 576 889 072
Passcode: LsRPy2

Contract documents can be obtained by visiting the School District's Purchasing website (www.lansingschools.net), the State of Michigan's SIGMA Vendor Self Service website (https://sigma.michigan.gov) or the Builder's Exchange website (www.bxlansing.com).

All questions are to be directed to the Construction Manager. No direct contact with the Owner or Architect is requested. **All questions need to emailed to projects@lansingschools.net no later than 7/25 at 5:00pm.**

All bids must be accompanied by a sworn and notarized Familial Relationship Affidavit and a certified check, cashiers' check, money order, or bid bond made payable to The Christman Company in an amount not less than five percent (5%) of the base bid as a bid security. The Bid Security of Bidders under consideration will be returned immediately after award of contracts by the Construction Manager. The amount of the guarantee shall be forfeited to the Owner if the successful Bidder fails to enter into a contract and furnish required bonds and insurance within 30 days after award of contracts.

All proposals submitted shall remain valid for a period of sixty (60) days after the bid date. The Owner, Architect and Construction Manager reserve the right to waive any irregularities, reject any or all proposals, or accept any proposal, which, in their opinion, will serve their best interest.

All contractors bidding on work must be bondable and must include in their bid the cost for furnishing a Co-Obligee Labor and Material Payment Bond and a Co-Obligee Performance Bond. On the proposal form the contractor will identify a cost to be **added** to their base bid should bonds be required.

END OF SECTION 00025

ARTICLE 1, SCOPE OF PROPOSALS

1.1 This is a "Construction Manager Project" for which The Christman Company is the "Construction Manager" For this portion of this project the successful bidders will become "Trade Contractors" and will enter into "Trade Contracts" with the Construction Manager. The Construction Manager will administer separate Trade Contracts for all Work Categories involved in the project. The project will be controlled, coordinated, and scheduled by the Construction Manager on behalf of the Owner.

1.2 Provisions shall be such that the Trade Contractor will assume the Construction Manager's obligations to the Owner for the portion of the work performed by each Trade Contractor.

1.3 Proposals: Separate proposals for the Work Categories included in this phase of the construction will be received by the Construction Manager. The time and place where proposals shall be received and a listing of the Work Categories included in this phase of the work are included in the Advertisement for Bids.

ARTICLE 2, BIDDER'S REPRESENTATION

2.1 Each Bidder by making his bid, represents that he has read and understands the bidding documents, and that they visited the site and familiarized himself with the local conditions under which the work is to be performed. No plea of ignorance of conditions that exist, or of any other relevant matter concerning the work to be performed in the execution of the work will be accepted as justification for failure to fulfill every detail of all the requirements of the Contract Documents. The Bidder, if awarded the Contract, shall not be allowed any extra compensation by reason of any matter or thing concerning which such Bidder did not fully inform himself prior to the bidding.

ARTICLE 3, BIDDING PROCEDURES

3.1 Proposals shall be submitted in duplicate, only on the forms provided by the Construction Manager, all blank spaces shall be fully filled in, including Addenda, Alternates, Price Breakouts, Unit Prices and Bidder's Certificate where applicable. All designations and prices shall be fully and clearly set forth with the amount of the bid stated in words and repeated in numerical figures. In cases of variations, the worded amount shall prevail. Erasures or other changes in the bid shall bear the signature of the Bidder. Insert N/A in those blanks on the Proposal Form that are not applicable. Separate Proposal Forms shall be prepared for each Work Category.

3.2 The bids shall be on the basis of a Lump Sum. Proposals shall not contain any added recapitulation of the work to be done as otherwise the proposal may be declared irregular. Oral, telegraphic or telephonic modifications of the work and/or the bid amounts shall not be considered.

3.3 The Architect or Construction Manager will make clarifications and corrections by the issuance of an addendum to all Bidders recorded in the Construction Manager's office as having in their possession a set of bidding documents. Addenda shall also be issued to all plan rooms in which bidding documents are on file.

3.4 It shall be the responsibility of the Bidders on record to provide all of their prospective sub-bidders with the information contained in any addenda.

3.5 Duplicate proposals shall be submitted in an opaque envelope, clearly marked "PROPOSAL FOR WORK CATEGORY NO. _____, and shall be identified with the Project Name and the Bidder's name and address.

3.6 Proposals for this phase of the work will be received at the time and place indicated in the "Advertisement for Bids".

3.7 An award of Contracts: Each Work Category or combination of Work Categories will be awarded based on the dollar value of the proposal, qualifications of the Contractor, his ability to perform the work, and in the best interest of the Owner.

ARTICLE 4, EXAMINATION OF THE SITE

4.1 Each Bidder shall carefully examine the site of the project and surrounding territory; the means of approach to the site, and the structure of the ground, and make all necessary investigations required to inform himself thoroughly and fully as to facilities for delivering, storing, placing and handling of materials and equipment, and to inform himself fully as to all difficulties that may be encountered in the complete execution of all work in accordance with the Contract Documents.

4.2 Should a bidder find apparent discrepancies in, or omission from the Contract Documents, or should he be in doubt as to their true meaning, or should he have any questions regarding any work or material intended, then such Bidder, either Trade Contractor or Trade Subcontractor, shall submit to the Architect, through the Construction Manager, a written request for an interpretation thereof. The person submitting the request shall be responsible for its prompt delivery and such request must be delivered to the Architect by the Construction Manager at least five days before the opening of proposals.

4.3 Any verbal information obtained from, or statements made by a representative of the Owner, Architect, or the Construction Manager at the time of examination of the Contract Documents or Site shall not be construed as in any way amending the Contract Documents. Only such corrections or addenda as are issued in writing to all Bidders shall become a part of the Contract. Neither the Owner, the Architect, nor the Construction Manager shall be responsible for verbal instructions.

ARTICLE 5, MODIFICATION OR WITHDRAWAL OF BID

5.1 Bids submitted prior to the time and date designated for receipt of Bids may be modified or withdrawn only by notice to the party receiving Bids. Such notice shall be in writing over the signature of the Bidder, and must be received prior to date and time set for receipt of Bids. Any modification shall be so worded as not to reveal the amount of the original Bid.

ARTICLE 6, REJECTION OF BIDS

6.1 The Bidder acknowledges the right of the Construction Manager, Architect, and Owner to reject any or all bids, and to waive any informality or irregularity in any bid received, or to accept any bid which in the opinion of the Construction Manager, Architect, and Owner shall serve their best interests. In addition, the Bidder recognizes the right of the Construction Manager, Architect, and Owner to reject a bid if the Bidder failed to submit on the date and time required by the bidding documents, or if the bid is in any way incomplete or irregular, including a bid security, if required, is not received with the bid proposal.

ARTICLE 7, PERFORMANCE CO-OBLIGEE BOND AND LABOR & MATERIAL PAYMENT CO-OBLIGEE BOND OWNER AND CONSTRUCTION MANAGER

7.1 The Construction Manager may, prior to the execution of the Contract, require the successful Bidders to furnish Co-obligee bonds, written in favor of the Owner and the Construction Manager, covering the faithful performance of the Contract and the payment of all obligations arising thereunder in an acceptable form to the Owner and the Construction Manager, and with such sureties secured through the Bidder's usual sources as long as the surety is licensed to do business in the State of Michigan and holds a minimum "A.M. Best" rating of A. Bonds shall be in the amount of 100% of the Contract sum. The premium for such bonds shall be paid by the Bidder. A space has been provided on the Proposal Form for the Bidders to indicate the amount that shall be deducted from their proposals if Bonds are not required. Should they be required, the Bidder shall deliver the bonds to the Construction Manager not later than the date of execution of the Contract.

7.2 The Bidder shall require the attorney-in-fact who executes the bonds on behalf of the surety, to affix thereto a certified and current copy of his power of attorney indicating the monetary limit of such power.

ARTICLE 8, VARIATIONS FROM MATERIALS SPECIFIED

8.1 Wherever materials are specified using names of specific manufacturers, the purpose is to establish a standard of quality and design, and not to limit competition. Contractors desiring to use materials of manufacturers other than those specified, shall indicate such material, manufacturer, and change of price, if any, in the space provided under the heading "Variations from Materials Specified" on the Proposal Forms. BASE BID PROPOSALS SHALL INCLUDE ONLY MATERIALS SPECIFIED. Variations, if accepted, shall be incorporated in the Contract, and the Contract Price adjusted accordingly, and no other materials shall be allowed accept upon written authorization of the Architect, Construction Manager, and Owner.

ARTICLE 9, THE CONTRACT FORM

9.1 Unless otherwise provided in the Bidding Documents, the Agreement for the Work shall be between the Trade Contractor and the Construction Manager on the contract form referenced in the Standard form section of the Project Manual (The Christman Company

subcontract agreement). By submitting your bid the Trade Contractor fully agrees to accept **ALL** terms and conditions of The Christman Company Subcontractor Agreement without modification.

ARTICLE 10, TIME OF COMPLETION

10.1 Each Bidder, as evidenced by submitting a proposal, shall agree to abide by the construction schedule dates as indicated in the Contract Documents, as developed during the post bid interview, scheduling meetings, and as required by Construction Manager. **The completion schedule for this project shall be met without exceptions.**

ARTICLE 11, QUALIFICATION OF BIDDER

11.1 The Owner, Architect, and Construction Manager may make such investigations as they deem necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish all such information and data for this purpose as the Construction Manager may request within 24 hours, including a list of projects completed, a financial statement, organization of the firm, etc. The Owner reserves the right, based on the advice of the Construction Manager and Architect, to reject any bid if the evidence submitted by, or investigation of such Bidder fails to prove that such Bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein.

ARTICLE 12, TAXES AND CONTRIBUTIONS

12.1 It is understood that the bid prices stated shall include all applicable Federal, State or other Governmental Division taxes and assessments. Also, all contributions for unemployment compensation, health and welfare, old age benefits or other purposes now or hereafter effective during the term of the contract, and the Owner and Construction Manager shall not be liable for any additional charges therefore.

ARTICLE 13, WARRANTY

13.1 All work shall be guaranteed for a period of at least two (2) years and/or as more specifically stated in the contract documents after final payment but not earlier than substantial completion as determined by the Architect, and all service within that period shall be rendered without charge to the Owner.

END OF SECTION

00201 - The Construction Manager will be located at 208 N. Capitol Avenue, Lansing, MI 48933-1357 for questions regarding this Bid Package. Any questions regarding information contained in this Project Manual will be answered following a written request to the Architect through the Construction Manager, and clarified in an addendum. **Under no circumstances should any prospective bidder call the Owner or Architect for clarification of the Bidding Documents.**

00202 - AIA CONTRACT FORMS

Sample AIA Documents are available for review and reference in the Construction Manager's Main Office.

00203 - AIA STANDARD FORM FOR GENERAL CONDITIONS

AIA Document A201\2007, "General Conditions of the Contract for Construction as modified for this project," is available for review at the Construction Managers Main Office.

00204 - GEOTECHNICAL INVESTIGATION

1. A geotechnical investigation report has been prepared for the site by a geotechnical consultant.

2. Copies of the geotechnical investigation report are available for review at the offices of the Construction Manager.

3. The Contractor is cautioned that the geotechnical investigation report was prepared during early preliminary design stages, and as such, references to elevations, dimensions, loadings, quantities and the like, may not coincide with the building as designed. The Contractor shall coordinate between the geotechnical investigation report and the contract documents.

4. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner and Architect will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data are made available for convenience of the contractor.

5. Additional test borings and other exploratory operations may be made by Contractor at no cost to the Owner.

00205 - PRELIMINARY CONSTRUCTION SCHEDULE NARRATIVE

1. Time is of the essence on this project. The Project sequencing will be scheduled by the Construction Manager and must be adhered to by all Trade Contractors. Time, labor, material, equipment and possible cost implication of this sequencing and others not fully conceived or described prior to the time of bidding, shall be included in base bid.

   A preliminary schedule is included for reference only. It is emphasized that start dates for work may shift. The bidder shall familiarize himself with expected

maximum durations and shall include in his proposal sufficient manpower to meet these requirements. All milestone dates are approximate and are to be used as guidelines for the Trade Contractor’s basis for bid.

3. It is the Trade Contractor's responsibility to establish which items of work within the scope of his work category will be affected by the Owner's or other Trade Contractors operations and coordinate and schedule completion of his work accordingly at no cost to the Owner.

END OF SECTION 00200

The Work Category (W.C.) Description is included as a guide for Prospective Bidders to summarize the scope of work involved with the work category. The description included is **not** a final summary of the scope of work and should not be construed as such. **All** Contract Documents should be used, as a reference in preparing the Bid Proposal and any omissions in the proposal does not relieve the successful bidder of the responsibility to perform this work.

W.C. No.	Category Description	Specification Reference
02	Earthwork / Site Utilities	Division 00, Division 01, 024119, 111200, 311000, 312000, 329113, 329200, 330500, 331415, 334200, 334600
05	Site Concrete, Curbs & Paving	Division 00, Division 01, 031000, 032000, 033000, 079200, 321313, 321373, 321726
06	Bituminous Paving	Division 00, Division 01, 079200, 321216, 321723
08	Landscaping	Division 00, Division 01, 329113, 329200, 329300
10	Structural Concrete	Division 00, Division 01, 031000, 032000, 033000, 033543, 071113, 072100, 079200
11	Masonry & Stone	Division 00, Division 01, 042000, 071113, 072100, 072119, 078413, 079200, 079219, 083113
12	Structural Steel, Deck, Stairs/Misc Steel	Division 00, Division 01, 051200, 051213, 052100, 053100, 055000, 055213
13	Waterproofing	Division 00, Division 01, 072500, 072726
14	Roofing & Sheetmetal	Division 00, Division 01, 072100, 075423, 077100, 077200, 079200
15	Metal Siding/Roofing	Division 00, Division 01, 074213.13, 074213.23, 079200, 084523, 089119
18	Glass/Glazing & Aluminum Entrances	Division 00, Division 01, 078413, 079200, 083613, 084113, 084413, 084523, 085113, 087100, 088000, 088716, 088813, 089119
20	General Carpentry/Millwork/Doors	Division 00, Division 01, 024119, 035113, 061000, 061700, 061800, 062023, 066400, 078413, 079200, 081113, 081416, 083323, 087100, 101100, 101200, 101416, 101419, 101450, 102113.19, 104413, 104416,

		105113, 107500, 116623, 116643, 122413, 123216, 123661.16, 126600, 323300
21	Plaster/Drywall/Acoustical/Insulation	Division 00, Division 01, 054000, 072100, 072413, 074210.11, 078413, 079200, 079219, 083113, 092216, 092900, 095113, 098400, 098433, 116000,
22	Hard Tile	Division 00, Division 01, 079200, 093013
23	Carpet & Resilient Tile	Division 00, Division 01, 079200, 096513, 096516, 096543, 096566, 096813,
24	Painting & Vinyl Wall Covering	Division 00, Division 01, 079200, 099114, 099124, 099300
25	Food Service Equipment	Division 00, Division 01, 078413, 079200, 083113, 113013, 114000
26	Fire Protection	Division 00, Division 01, 078413, 079200, 083113, Division 21, 312000, 330500, 331415
27	Plumbing & HVAC Systems	Division 00, Division 01, 024119, 078413, 079200, 083113, 089119, 102800, Division 20, Division 22, Division 23, 312000, 330500, 331415
28	Electrical Systems	Division 00, Division 01, 024119, 078413, 079200, 083113, Division 26, Division 27, Division 28, 312000, 330500

Work Category No. 00 – General Requirements for All Subcontractors

Work Included:

1. All permits, fees, inspections and approvals required by governing jurisdictions are included within base bid. Coordinate well in advance (at least 24 hours), required inspections and testing with the Construction Manager. This will include liaison between state and local agencies to ensure code compliance and for securing approval for the facility.
2. Excessive noise and vibration creating equipment shall be prohibited within close proximity of existing Structures/Buildings or occupied spaces. All proposed equipment scheduled for project shall be reviewed with the Construction Manager prior to delivery onsite.
3. Cleanup is required on a daily basis, and/or as directed by the Construction Manager. Cleanup dunnage, shipping materials and associated materials/debris generated from installation and dispose of properly. At no time will shipping containers, crates, materials, piles of debris, tarps, boxes, etc. be left on site, un-attended and unsecured, subject to unsafe conditions (i.e. access, fire and slip hazards and wind blown debris).
4. At least two (2) weeks prior to starting on-site, meet with the Construction Manager, Architect and Engineer to discuss and resolve any issues relating to status of material procurements, site conditions, access, staging/storage requirements, safety, testing, sequencing and scheduling of work.
5. Any work that could interfere with existing owners operation, i.e. use of certain roads, parking lots, access to buildings, shall require pre-task planning with the Construction Manager and shut-down notification requests shall be prepared (72) hrs in advance of any work being scheduled. Pre-task planning shall review and discuss scheduling, coordination with Owner operations, working durations, safe practices and procedures.
6. Protect existing structures, equipment, and finishes, including new work in place, from damage during the performance of this work category. Any protection removed to facilitate other work shall be reinstalled / replaced by the trade needing access.
7. Include all layout and engineering for each work category. Unless otherwise indicated in Section 00210, two control lines and one bench mark will be provided by the Construction Manager for Trade Contractor use.
8. Prior to commencing with installation, verify all field conditions and measurements and report any discrepancies to the Construction Manager.
9. Whenever possible all embeds to be furnished to other trades shall be fabricated / modified by the providing contractor with holes / tabs, etc to allow easy for installation by the installing contractor.
10. Provide full-time on-site supervision during the performance of your work. Supervision will be responsible for coordination, scheduling, safety, manpower, and other activities necessary to achieve safety, quality and scheduling requirements set forth under this work category. Supervision shall not be removed from this project without prior written consent and approval of the Construction Manager.
11. Full compliance with all site specific rules and regulations, including (but not limited to) OSHA, State Authorities, Local Authorities, and the Construction Manager. This subcontractor shall submit, prior to performing any work on-site, a copy of their site specific safety program/manual.

12. Attend Construction Manager's daily morning huddles. All trades on site will be required to have their foreman attend. Huddles will take place at the beginning of each workday. Huddles are mandatory and will last approximately 15 minutes each day.

13. Should Subcontractor require on-site trailer or storage units, Subcontractor shall obtain approval from the Construction Manager on size, count and where to locate, prior to delivery on-site. Subcontractor to arrange and pay for service to trailers, including (but not limited to) electrical, phone, etc.

14. For material deliveries, if traffic control is required, Subcontractor to arrange manpower accordingly and provide signage, barricading, flagman etc., necessary for the safe performance of own work and protection of the public. Staging, storage on-site, and all deliveries required to support this installation must be reviewed and approved in advance by the Construction Manager.

15. Furnish and receive all required materials and deliver FOB jobsite. All deliveries shall be closely coordinated with the Construction Manager and 72 hour advance notice shall be given prior to delivery. Unless noted otherwise, deliveries must be coordinated to be complete with unloading during normal working hours.

16. This subcontractor will receive and handle all respective material and properly store/protect before, during and after installations. Excessive and out-of-sequence deliveries will be prohibited and subject to re-handling and removal offsite as directed by the Construction Manager.

17. Unless noted otherwise in Section 00210, furnish all hoisting, lifting, scaffolding, and handling to complete your own work.

18. Hoisting of materials and equipment over occupied areas will not be permitted, unless areas below are vacated or occupancy access is controlled during lifting. Each subcontractor will be required to notify Construction Manager seven (7) days in advance of required hoisting over occupied areas. Pre-Task planning and shut-down notifications will be required to assure minimum interruptions to Owner operations. In general, any hoisting equipment required to be used on-site must be reviewed in advance with Construction Manager for coordination of site logistics, safety procedures (including FAA approvals if required), access, lift swing areas, duration and overall activities relating to this hoisting equipment.

19. Approved O&M manuals are required at least 2 weeks prior to equipment start-up, start of warranty, and Owner training, but no later than thirty (30) days prior to substantial completion.

20. In the event of any jurisdictional or labor issues, the subcontractor assigned the work shall arrange to complete all work as required to avoid any interruptions/continuity of work on this project at no additional cost. All labor requirements pertaining to the project will be met.

21. Cooperate fully with representatives from Architect, Engineer, Owner, Construction Manager and independent testing agency, and allow for in progress inspections, including providing access to areas of work, when required.

22. This project may require multiple phases, which will require re-mobilization. All costs for multiple phasing shall be included.

23. Each Trade Contractor shall assume full responsibility for all pre-ordered products after their arrival at this designated location. This includes transportation, storage, start-up, warranty services, and installation in accordance with the General Conditions unless otherwise specified.

24. Critical Scheduling and Sequencing of Work:

    The Construction Manager shall provide overall scheduling and coordination for the entire project. All Trade Contractors shall acknowledge the Construction Manager's right to establish and set up, or subsequently modify the sequencing and scheduling of all work on this project for the earliest completion and/or benefit to the Owner. More restrictive sequencing to coordinate the Owner's on-going operations and/or for the coordination of the various trades shall be spelled out by the Work Category descriptions or as otherwise directed by the Construction Manager. All Trade Contractors agree to cooperate and alter their operations to maintain these more specified restrictions and sequences of the work.

    A. Subcontractor agrees to work concurrently with other subcontractors and the Construction Manager, according to the Master Project Schedule.

    B. Subcontractor shall confirm fabrication lead times, installation durations and sequencing for their Work in writing within two weeks of award, and report any discrepancies to Construction Manager.

    C. Scheduling updates and proper coordination and communication with other trades shall be accomplished as follows:

    - Weekly sub-progress meetings
    - Safety meetings, BIM meetings, scheduling meetings, pre-installation meetings, etc.

25. Construction Waste Management And Disposal – Review Spec Section 017419 Construction Waste Management And Disposal
26. General Commissioning Requirements – Review Spec Section 019113 General Commissioning Requirements.
27. Indoor Air Quality Management Plan – During Construction. Comply with site specific IAQ Management Plan for this project.
28. The worksite is a tobacco free site, including inside any personal or company vehicles/trailers on Lansing School District property.
29. No food or drink will be permitted within the building once concrete has been installed. Drinking water is an exception and will be allowed.
30. Site fencing, gates, etc. must remain closed at all times. If utilized for deliveries it must be closed after each delivery.
31. Gang boxes will not be allowed in any area where finish flooring, ceramic tile and/or painting is in progress.
32. All materials within the footprint of the building (after the building has been enclosed and concrete floor poured) must be stored on pallets or movable rubber wheeled carts. The intent is all materials, equipment, etc. to be easily movable at all times.
33. Reference Scope Clarification Diagrams which can be found directly after the Work Category descriptions.

End of Work Category No. 00

Work Category No. 02 – Earthwork and Site Utilities

Work Included:

The subcontractor shall timely perform all Earthwork and Site Utility work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Demolition and clearing/grubbing of the entire site, including, but not limited to, the removal of trees, tree roots, stumps, topsoil removal, vegetation and deleterious materials as shown or specified, hard surfaces, fences, handrails, retaining walls, posts, gates, signs, etc. Includes all labor, material, accessories, and equipment for a complete installation.
2. Provide all utility demolition as shown or specified including, but not limited to water lines, fire lines, concrete pipe, hydrants, backflow preventors, sewer and storm cleanouts, pipe, and manholes, irrigation pumps, monitoring wells, access ports, etc.
3. Provide all necessary items for complete construction and relocation of the water systems to within 5' of the building as shown or specified including all associated structures, manholes, pressure testing, bacteria testing, flushing, drain basins, meters, backflow preventors, wet taps, temporary piping, valving and capping in existing piping for permanent and final connections, demolition and re-working of existing (as called out per the plans), concrete thrust blocks and restraints, inspections, testing and certifications, and all agency fees and agency work as required.
4. Furnish and install all piping, structures and accessories required for the performance of the storm and sanitary work to within 5' of the building as shown or specified including all associated structures, as required. Clean the systems upon completion of the work and prior to acceptance by the Owner. Include final adjustment of structures to match final grades. Include underground basin.
5. Provide all mass excavation, grading, compaction, backfill, berms and off-site borrowed fill to final subgrade elevations as shown or specified, including backfill required around the building foundations, foundation walls, retaining walls, sidewalks, curb and gutters, drives, asphalt paving, etc. This is to include all rough and final grading to +/- 0.1'. All unsuitable soils and materials shall not be permitted to be stockpiled and must be removed on a daily basis.
6. Coordinate and develop soil erosion plan with the Construction Manager for submission to appropriate jurisdiction. Furnish and install soil erosion control measures as shown and/or specified. Maintain soil erosion control measures during the course of this project. Remove erosion control and clean all catch basins and/or pipe as required at completion of project. All inspection logs to be copied directly to the Construction Manager and copies shall be kept within a soil erosion control manual, located within the Construction Manager's trailer.
7. Provide all cutting, patching and repairs by a qualified person as required of existing roadways, landscape areas, paving, hardscape, etc. disturbed by this scope of work.
8. Provide all required tree protection, sedimentation and water pollution control shown, specified or necessary to perform the work in this package or the work of others, including maintenance and removal upon completion and acceptance of work by the governing agency.

9. Provide all dewatering (ground and rain water) as necessary until final grade and complete and operational storm system is available. All ground water will be diverted so as not to interfere with construction or public traffic flow and the operations of the existing facility. All drainage inlets shall be protected as specified. Maintenance of dewatering system to be considered a 24 hour/7 day week assignment.

10. This subcontractor shall participate in all coordination meetings (internal and meetings with local agencies and those having jurisdiction) concerning the relocation of existing utilities so as not to impact the existing facility operations. Include temporary utilities and provisions as necessary to allow relocation of existing utilities without interruption of service to existing facilities. This contractor to provide for temporary support and protections for any existing utility or other piping encountered during performance of this work. Include verification of existing utility locations prior to excavations, and monitoring during excavation and backfill.

11. Provide all right-of way permits/bonds, etc. as required by city, county, and state agencies relative to the work within this package.

12. Prior to any imported soils entering project site, provide material analytical soils reports and documentation that material is free of contaminants/hazardous materials.

13. Clean roads and staging areas of any tracking dirt or debris generated during site clearing, excavation, earth retention, foundations/slab-on-grade and caisson activities as necessary or as directed by the Construction Manager. Dust control and street cleaning on a regular basis as job conditions require.

14. Furnish and install all under-drain/foundation/footing drainage systems as shown and specified.

15. Strip and stockpile topsoil for re-use. Re-spread topsoil to within specified tolerances, upon completion of rough grading. Large clumps of dirt and stones shall be removed from topsoil.

16. Where existing asphalt paving is removed for new utilities, place compacted aggregate base to bottom of asphalt for asphalt patch by others. If asphalt cannot be patched immediately, place aggregate to top of adjacent asphalt. Remove additional aggregate at such time when asphalt can be placed.

17. Final tie-ins of all water/storm/sanitary sewer mains will be the responsibility of this Work Category. Hydro excavating is required at tie in points to utilities.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Some SESC measures will already be in place from building demolition contractor. This WC to maintain existing SESC measures already in place. Provide and install any additional SESC measures needed including any new permits needed.

    A. C-101 calls for new silt fence to be provided and installed behind existing curb prior to removal and construction of perimeter sidewalk.

2. Getting the SE parking lot installed as soon as possible is a high priority as this will be used for trailers, laydown, and parking. Intent is to install subbase and use that for temporary parking lot/laydown. The WC will need to come back before asphalt is installed to replace, regrade and add any additional subbase needed as a result of the temporary parking/laydown. Reference logistics plan.

3. Protect existing utility structures, underground utilities and property corners as shown.

4. Sidewalk demo around the perimeter of the site along with road, curbs, etc. demo will be outside the

construction fencing. This WC responsible to provide barricading as needed to perform this demo and will leave barricading in place until installation is complete.

5. Provide and install drain tile and gravel fill at freezer and cooler slabs.

6. Provide and install barrier gates including but not limited to operator, concrete footing, gate, controller, vehicle detector, etc. for a complete installation.

7. Provide and install subgrade base under asphalt and concrete including but not limited to aggregate, 21AA crushed limestone, class II sand, granular backfill, etc.

8. Provide and install chain link fence including all accessories needed for a complete installation. Multiple mobilizations will be needed as posts are to be installed prior to maintenance strip and fencing installed after. Concrete footings for fencing by WC 05.

9. Provide excavation and backfill for mockup wall foundation/footing (roughly 10-15' long). This WC is responsible for demoing the mockup foundation/footing at end of the project.

10. Provide and install temporary crane pads and drives. Remove drive and crane pad when directed by Construction Manager and restore grades to their original grades or as shown on drawings. The crane pad shall be constructed and maintained as a flat level work platform suitable for heavy cranes. Confirm size, length and location with trades utilizing cranes.

11. This subcontractor will establish a concrete wash out area, maintain, remove and properly dispose of concrete washout materials offsite periodically or as directed by the Construction Manager.

12. Provide and install yard hydrant vault, hydrant, supply line, drain, and hose for a complete installation (Detail 33/C-503).

Related Work by Others:

1. Landscaping by WC 08.

2. Sythetic turf, sand infill, aquaflow backing, aggregate base and nailer board per detail 10/L-500 by WC 08. This WC (02) responsible for "natural soil surface".

3. Boulder retainage walls including perforated pvc and aggregate base by WC 08.

4. Refer to Sections 00210 and 01019 for testing requirements and responsibilities.

5. Imported topsoil to be furnished and placed by WC 08. Topsoil will be raked by WC 08 as required. This WC (02) is responsible for getting topsoil grading to +/- 0.1' before WC 08 takes over.

6. Final connection of utilities (sewer, water and gas) from 5' outside of building and all work inside of the building by W.C. 26, 27, and 28.

7. Mechanical and electrical contractors will perform excavation, backfill, compaction and removal of spoils within the building, as needed.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$50,000**. Reference Section 01020 for specific instructions on allowances. Intent of this allowance is to relocate existing SESC measures as needed and replacing unsuitable soils if necessary.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work,

insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 02

Work Category No. 05 - Site Concrete

Work Included:

The subcontractor shall timely perform all Site Concrete work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all cast-in-place concrete as shown and/or specified including but not limited to sidewalks, curbs and gutters, concrete stairs, concrete paving, concrete planters, bollards, frost walls, and supported slabs. Includes all labor, material, accessories, and equipment for a complete installation.
2. Furnish and install joint sealants, curing agents, sealers, and/or expansion joints at curbs, sidewalks, and concrete paving. Protect work until sealants have cured.
3. Complete fine grading and compaction under all walks, curbs, and gutters.
4. This work is to be coordinated during the same time period with Bituminous Paving and Landscaping.
5. Include all layout and engineering for this work category's scope. Two control lines and one bench mark will be provided by the Construction Manager for Trade Contractor use.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Furnish and install concrete sphere bollards and all accessories for a complete installation including but not limited to steel pipe, threaded inserts, caulking, and foundations.
2. Install slabs at entrance slabs. WC 10 will install slab foundation walls including vertical rebar.
3. The curbs around the parking lot will be installed early on in the project so the parking lot can get gravel right away to use for laydown and trailer.
4. Provide and install tactile/detectable warning surfaces.
5. Provide and install concrete foundations for all site features including but not limited to bike racks/loops, benches, lights, signs, retaining walls, canopies, fences, shade structures, owner furnishings, bollards, etc?

Related Work by Others:

1. Refer to section 00210 and 01019 for testing requirements and responsibilities.
2. Subbase material installed to +/-0.1' by W.C. 02.
3. Parking lot light pole foundations by LBWL.
4. Structural Concrete by W.C. 10.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$20,000.** Reference

Section 01020 for specific instructions on allowances. Intent of the allowance is to remove and replace sections of curb that get damaged in the parking lot that is installed early on in the project and used for laydown.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 05

Work Category No. 06 – Asphalt Paving

Work Included:

The subcontractor shall timely perform all Asphalt Paving, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Including, but not limited to the following:

1. Furnish and install all bituminous paving including, sealers, joint filler, etc. as indicated on the drawings and specifications. Includes all labor, material, and accessories for a complete installation.
2. Furnish all layout and controls for this work category by a qualified surveyor. This work category will be responsible for coordinating with WC 02 and WC 05 on all layouts, for this work category, throughout the duration of this project.
3. Saw cut and prepare edge for patch work/new work. Complete all patching of asphalt paving to match existing conditions in surrounding streets necessary for the curb cuts at new entrances and exits.
4. Coordinate installation of manhole and catch basin covers prior to installation of asphalt work, including all final adjustments of manhole and catch basin castings by WC 02.
5. Provide final grading and proof roll aggregate base for approval and acceptance prior to installing base course. Identify soft spots and bring to the attention of the construction manager. All repairs will be performed by WC 02.
6. Broom cleaning will be required between base and final course of paving.
7. Provide line striping and markings for finished project; complete all cleaning and layout required for pavement markings. This includes all site markings on asphalt and concrete (four square, basketball court, etc.). Include cleaning of hard surfaces before installing markings.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Furnish and install parking signage.
2. Provide any flagging, signage and permit requirements for road work.

Related Work by Others:

1. Refer to Sections 00210 and 01019 for testing requirements responsibilities.
2. Gravel base material installed, including compaction, to within +/- 0.1' by WC 02
3. Final adjustment of catch basin castings by WC 02.
4. Concrete sidewalks, concrete paving, curb and gutters by WC 05.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$10,000**. Reference Section 01020 for specific instructions on allowances. Intent is for additional striping and signage the owner might want.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 06

Work Category No. 08 - Landscaping

Work Included:

The subcontractor shall timely perform all Landscaping work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all fine grading, plants, trees, irrigation system, stone, pavers, sub-base, topsoil, soil amendments, fertilizers, seeding, geogrid material, edging, and site furnishings. Includes all labor, material, accessories, and equipment for a complete installation.
2. Lawn cutting and maintenance until Satisfactory Turf has been established per specifications.
3. Backfill and compact all excavations created by this work.
4. Furnish and install all drain piping, pre-fabricated assemblies, sleeves, etc.
5. Field verification of underground piping, electrical conduit, site utilities, etc., prior to digging, trenching, plowing or spading operations.
6. Provide all necessary staking and anchoring of trees and plants and remove at the end of the warranty period.
7. Furnish and install protective fencing as required for all existing trees as shown and/or required.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Furnish, install, and grade topsoil. Include necessary preparation of the soil (plowing, disking, rototilling, additives, etc.) for planting, seeding, etc. Initial placement to within +/- 1" is by WC 02. Prior to importing material, follow specifications and obtain required approvals for topsoil, trees, etc. Provide all raking, leveling and removal of miscellaneous stones and debris necessary to obtain final grades. This contractor is responsible for the removal and legal disposal of debris.
2. Provide and install synthetic turf including sand infill, aquaflow backing composite nailer board and aggregate base. WC 02 will install and grade "natural soil surface" per detail 10/L-500, this WC will take over from there.
3. Furnish and install 12" planting mix in perennial and groundcover beds.
4. Perform V-cut natural edging with mulch backfill. Remove all spoils.
5. Provide and install boulder retaining wall system for a complete installation including but not limited to boilers, perforated PVC in geotextile fabric, and aggregate base.

Related Work by Others:

1. Refer to section 329113 for soil testing requirements.

2. Subbase and topsoil material installed to +/-0.1' by W.C. 02.
3. Irrigation sleeves installed by WC 02. Furnish and layout is by this work category.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$10,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 08

Work Category No. 10 - Structural Concrete

Work Included:

The subcontractor shall timely perform all Structural Concrete work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Refence Work Category Index

Work Category Notes:

1. Furnish and install all cast-in-place concrete as shown and/or specified including but not limited to foundations, slab-on-grade, elevated slabs, elevated slabs on metal decks, tank structures, mud mats, caisson caps, equipment pads, and stair treads and landings.
2. Includes re-steel, waterstops, pre-molded joint filler, bonding agents, vapor barriers, perimeter foundation and below slab rigid insulation, grouting of structural steel leveling & base plates, expansion and control joints, floor sealers and hardeners, curing compounds, drilling and grouting of dowels, fine grading under slabs-on-grade.
    a. Coordinate footings/foundation re-steel layout with WC 11.
3. All grouting as shown and specified including pump/equipment bases, steel base plates, and grouting of steel beam floor reinforcing.
4. Includes installation of anchor bolts, embeds, dovetail anchors, floor doors, unitstrut, and sleeves embedded in structural concrete supplied by others. Coordinate and assist other trades in setting sleeves in formwork. WC 12 will perform an anchor bolt survey – complete timely repair any deficiencies found prior to mobilization of the structural steel contractor.
5. Includes all forming, placing, finishing, reinforcement, finishing as required, setting, shoring, recesses for other work, dowels, manhole steps, epoxy adhesives.
6. Includes all required layouts for the performance of this W.C. All surveying necessary to establish proper layout and elevations are the responsibility of this work category.
7. Provide block outs for other trades as shown in contract documents and approved by the construction manager.
8. Furnish, install and maintain temporary winter protection/enclosures and heat for this work categories work activities. This includes fuel, equipment, maintenance and safety provisions to continue and complete this work in an uninterrupted manner, despite weather conditions.
9. Floor finish tolerances (i.e. flatness and levelness requirements) to be installed to meet requirements of specifications. Provide a concrete survey to confirm pours are within the specified tolerances prior to demobilization.
10. This contractor is responsible for the subgrade protection from frost, water, etc. once excavation for concrete is complete and forming is to proceed. This includes dewatering.
11. Furnish and install column isolations in slab-on-grade as shown. Remove form work, backfill and pour concrete around the columns after steel erection is complete. Provide temporary covers at each of these locations until the concrete is poured.

12. Provide engineered shoring system for supported cast in place concrete walls and formed supported slabs as specified, including all engineering of and installation of any required reshoring.
13. Provide safety guardrails for all formed supported elevated slab edges/openings and provide covers for all floor openings as required.
14. All concrete embedded items, which are furnished by others, shall be installed, received, inventoried, unloaded, handled and protected by this work category, i.e. Steel, Pre-cast and Curtain wall embedded items, inserts, anchor bolts, Elevator embeds, misc. iron embeds etc., shall be clearly marked and labeled per approved and previously provided erection drawings, and be appropriately delivered (FOB jobsite) to this subcontractor for installation.
15. Any saw cutting, grinding, chipping and patching work etc. generating concrete dust, shall be approved in advance by the Construction Manager. Dust control and safety procedures will be reviewed and enforced during this activity.
16. Clean metal deck of unidentifiable debris prior to placement of concrete.
17. Drill and epoxy dowels into existing concrete structures as required.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. This WC responsible for foundation walls at entrance slabs including vertical rebar that sticks out and will be bent into the slab. WC 05 will install entrance slabs.
   A. This WC responsible for rigid insulation if required between slabs (example in detail 20/S-501 and 1/A-506).
2. Furnish and install all isolation material between this WC's concrete and WC 05's concrete (example is isolation material at entrance slabs on detail 6/S-501).
3. Provide and install insulated slabs including rigid insulation, vapor barrier, and blocking.
4. All interior slabs scheduled to be poured after masonry walls are installed. The roofing will be done after concrete slabs are poured to allow access from above for a concrete pump crane. The intent of this is to prevent the exposed slabs from being damaged during masonry construction and not done during winter months. This WC to protect walls from concrete splatter and clean concrete off walls if needed.
5. Include grading and compaction of sub-grade before concrete slabs are poured.
6. Provide and install all concrete at the exterior monument sign.
7. Provide and install concrete footings and foundations at the dumpster enclosures.
8. Provide and install polished concrete. A mockup is to be provided in a location TBD by Construction Manager of 3 different polish levels. Mock up sizing of each style to be 10'x10'. Include separate mobilization for polishing to be done at a later date than pouring operation.
   A. Furnish and install floor protection at all polished concrete floors after concrete floors have been polished. Remove floor protection upon project completion.
9. Provide and install footings and foundations for an exterior wall mockup of reading nook A (roughly 10-15' in length). WC 02 to excavate, backfill and demo.

10. Provide and install concrete benches.

Related Work by Others:

1. Furnish anchor bolts and leveling bases by WC 12.
2. Concrete materials testing and periodic "in progress" field inspections by Owner. However, if excessive re-testing is required, this subcontractor will be assessed re-testing costs.
3. Foundation sub- drainage system by WC- 02.
4. Site concrete pavements & curb/gutter by WC 05.
5. Utility thrust blocks and concrete encasement of site electrical by WC 26, 27, & 28.
6. Building pad, sub base and sand cushion for slab on grade and walks by WC 02.
7. Cavity wall insulation by WC 11.
8. Reinforcing steel contained entirely within unit masonry by W.C. 11.
9. Embedded items in concrete furnished by others.
10. De-watering of all excavations to be performed by WC 02 until forming begins.
11. Perimeter draining by W.C. 02.
12. Concrete walk pads on roof supplied and installed by W.C. 14.
13. Foundation water/damp proofing by WC 13.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$15,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 10

Work Category No. 11 - Masonry

Work Included:

The subcontractor shall timely perform all Masonry work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes, including, but not limited to:

1. Furnish and install all brick/masonry assemblies, stone assemblies, concrete masonry units, cast stone caps, necessary anchoring of unit masonry work to structural and miscellaneous steel, weeps, and vents. Includes all labor, material, accessories, and equipment for a complete installation.
2. Furnish and install horizontal and vertical masonry wall reinforcement, anchors, flashing, bond beams, drip edges, insulation, fire safing (including perimeter of walls), top of wall plates, weep vent, cavity mortar diverter system, sealants, caulking, expansion joints assemblies and covers, compressible fillers, expansion joint fillers, and isolation material.
3. All through wall flashings shall be inspected by local building authority (if applicable) and Construction Manager prior to being concealed.
4. Receive and install all metal embedded lintels, masonry wall angle supports, bearing plates, anchors, steel lintels, counter flashing reglets, roof counter flashing, etc. as supplied by others to be installed in masonry. Includes final adjustment of items including where masonry walls abut metal deck or steel members.
5. Receive, handle, set and grout all hollow metal doors frames at masonry walls provided by others. For door frames required to be left out for access, leave oversized opening and tooth in masonry when directed by Construction Manager.
6. Furnish and install access panels if shown in masonry walls. Install all access panels in masonry as may be provided by others.
7. Cooperate and coordinate masonry Work with other trades for proper locations of rough-ins and penetrations thru masonry walls. Coordinate with structural steel contractor regarding location and size of tie-in points for steel bearing on existing masonry walls. Required preparation of openings including cutting of block, grouting of walls, and installation of bearing plates by this contractor.
8. Include sawcutting and necessary patching where the removal of brick is required for structural tie-in or for corridor penetrations. All saw cutting needs to be wet cut to help reduce dust.
9. Include all masonry, toothing (including selective demolition), and patching as required for new openings / frames in existing masonry walls. Demolition contractor will leave a rough opening.
10. This work category will be responsible for review/coordination of approved shop drawings such as the curtain wall system, door and window openings, etc, prior to work taking place. These documents can be obtained for review from the Construction Manager.
11. Provide required brick and stone samples as well as a mock-up wall as indicated in the specifications, to be reviewed and approved by the architect and owner prior to construction starting for this work category.

12. Masonry wall cavities and top of walls shall be covered and protected each day.
13. Furnish, install and maintain temporary winter protection/enclosures and heat as required for proper installation of this contractor's work. This includes fuel, equipment, maintenance and safety provisions to continue and complete this work in an uninterrupted manner, despite weather conditions.
14. Clean and wash all masonry and stone as specified and in accordance with approved sample. Protect any finished products from the cleaning agents.
15. Protect any new and/or existing adjacent surfaces, including from overspray of insulation and mortar droppings.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Provide and install ALL spray foam insulation (even where not applied on masonry). This might require additional mobilizations.
2. Include masonry scope at monument sign.
3. Grout cavities solid below flashing at masonry walls.
4. Provide and install rigid insulation wedge at masonry walls (example detail 2/A-506).
5. Spacing between the building fascade and temporary fencing on the west and south sides of the building is minimal. This WC to account for that and include any measures needed for getting this work done within the space provided.

Related Work by Others:

1. Foundation insulation and damp proofing by WC 10.
2. Steel lintels and angles furnished by WC 12.
3. Water/Damp proofing by WC 13.
4. Installation of roof flashing (parapet caps) by WC 14.
5. Installation of Metal Coping by WC 14.
6. Hollow metal frames furnished by WC20.
7. Grouting of frames in metal stud walls by WC 20.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$10,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 11

Work Category No. 12 - Structural Steel

Work Included:

The subcontractor shall timely perform all Structural Steel, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes, including, but not limited to:

1. Furnish and install all structural steel, steel joists, floor decking, cellular floor decking, roof deck, miscellaneous metals, sump pans, ornamental metals, grating, steel stairs, ladders, cages, metal fabrications, sump pans, leveling plates, shear studs, pipe bollards, hand rails (interior and exterior), guardrails, etc., indicated by the contract documents (not just limited to the structural drawings) or as required for a complete installation, including labor, materials, equipment, adhesives, fasteners and accessories.
2. Furnish only all embedded items including, but not limited to, steel lintels, angles, stair nosings, anchor bolts, pipe bollards, etc., indicated by the contract documents (not limited to the structural drawings).
3. All specified coating for ferrous metals, galvanized metals, and aluminum are required and are the responsibility of this work category. Field touch up of shop paint as required. Shop preparation and painting of all structural and miscellaneous metals as indicated on the contract drawings.
4. Submittal of all required detailing to allow for architect/engineer review and approval, corrections, fabrication, and delivery without impacting the construction schedule.
5. Provide all necessary welding and mill certificates as required by the contract documents or as requested by the Construction Manager.
6. Field dimensions and measurements as required for this work. Prior to fabrication and erection contractor shall verify existing conditions and anchor bolt locations through means of a qualified surveying company to field survey the site and submit results to the construction manager for review. Any errors or discrepancies need to be identified in writing. Corrections will be made by the contractor responsible for the original installation. Cost for all field visits/surveying must be in proposal.
7. This contractor shall provide the construction manager with all necessary crane/hoisting information (size). This information will be used to prepare the site for the equipment mentioned by this contractor. Four weeks prior to site mobilization, meet with the Construction Manager, Architect and Engineer to discuss and resolve any issues relating to status of material procurements, site conditions, access, staging/storage requirements, material testing program and scheduling.
8. Temporary water and power will not be provided for the work of this subcontract. Subcontractors should make provisions for portable generators and welders as required to perform their work.
9. For areas shown to receive paint, intumescent paint, or spray-on fireproofing, this subcontractor shall ensure metal decking and steel framing is free of oils or any other materials that could jeopardize adhesion of spray-on fireproofing or paint.
10. Coordinate penetrations and related framing with other trades during detailing phase. Provide framing plans to mechanical for verification.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Furnish long lead item submittals within 2 weeks of contract award. Materials to be ordered within 24 hours of receipt of approved submittals. The items must be procured and installed to keep schedule. Notify the Construction Manager in writing with bid proposal if there are any concerns.
2. Furnish and install all structural steel for the screenwall (metal panels by WC 15).
3. At time structural steel is set, masonry walls will be built but concrete slab on grade will not be installed. Please note this when determining installation methods.
4. Aid in layout/elevations of bearing plates and anchor bolts. Perform an anchor bolt and leveling plate survey prior to mobilization. Communicate any deficiencies found prior to mobilization to allow for remediation.

Related Work by Others:

1. Grouting of leveling or base plates by WC 10.
2. Temporary roads and maintenance of roads, and for delivery trucks to move under their own power.
3. Reference Sections 00210 and 01019 for testing requirements and responsibilities.
4. Finish painting of steel by WC 24.
5. Light gauge framing by WC 21.
6. In-fill of stair treads and landings by WC 10.
7. Installation of embeds furnished by WC 12.
8. Roof and floor hatches by WC 14.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$10,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 12

Work Category No. 13 – Waterproofing

Work Included:

The subcontractor shall timely perform all Waterproofing work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all waterproofing, weather barriers, and air barriers. Includes all labor, material, accessories, and equipment for a complete installation including but not limited to surface conditioner or primers, liquid membranes, patching membranes, elastomeric sheets, metal termination bars, insulation, foam rods, tubes, protection board or fabrics, molded sheet drainage panels, insulation, joint sealants, tapes, sheet metal flashing and trim, moisture retention mat, and filter fabrics.
2. Prepare surfaces to receive waterproofing sealants as defined in the contract documents and in accordance with the manufacturers recommendations.
3. Cooperate and coordinate this work with other trades for a complete water, weather, and air tight assembly.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. This work category is responsible to seal all penetrations (i.e. pipe sleeves, duct banks, steel dowels, etc.) of the waterproofing membrane per manufactures recommendations.
2. Provide flexible flashing where blocking gets wrapped with it (example is detail 5/A-101A). WC 20 to install flexible flashing at these locations when installing blocking.
3. This work category is responsible for all mobilizations required for the duration of the structure construction.
4. This work category is responsible for proper winter protection of work when temperatures exceed limits of specified products in order to maintain project schedule and per manufacturer's recommendations.
5. This work category is responsible for the repair/replacement of work that is deemed deficient through inspection or testing.
6. Include foundation/footing waterproofing, damp proofing, etc..

Related Work by Others:

1. Concrete water stops by work category 10 concrete.
2. Concrete cants by work category 10 concrete.
3. Slab on grade vapor barrier by work category 10 concrete.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$10,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 13

Work Category No. 14 - Roofing & Sheet Metal

Work Included:

The subcontractor shall timely perform all Roofing & Sheet Metal work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all roof shingles, membrane roofing, metal roofing, built-up roofing, roof insulation, roof expansion joints, roof hatches and accessories, gutters and downspouts, overflow scuppers, walkway protection, ballast, flashings, copings, gravel stops, reglets, termination bars, trim, sealants, ice and water shield, etc., indicated by the contract documents (not just limited to the roof plan) or as required for a complete installation, including labor, materials, equipment, adhesives, fasteners and accessories.
2. Include removal of perimeter fall protection system in conjunction with roofing installation.
3. Where perimeter details cannot be completed until the building skin is complete, provide preliminary weather protection (i.e. extend and secure membrane over parapet walls, if required).
4. Coordinate with mechanical contractor and steel contractor for installation of roof curbs for mechanical equipment and roof hatches.
5. Furnish all hoisting, lifting, and handling, etc. of materials as required for this W.C.
6. Provide broom cleaning of concrete and metal deck roof areas, just prior to installation of roofing systems, i.e. tracked dirt, unidentifiable debris.
7. All fire stopping, flashings, roof termination details shall be inspected and documented by Construction Manager prior to being covered up and concealed.
8. All specified warranty requirements shall be met by this W.C., including all costs of inspection and observation by manufacturer's representatives as required.
9. Subcontractor and manufacturer's representatives shall attend a Pre-Roofing Conference at the project site at a time determined by Owner, Architect, and the Construction Manager.
10. All materials and equipment shall be secured at all times for wind loads.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Provide and install tectum decking. This WC to work closely with WC 20 on getting tectum deck installed and water tight as soon as possible after glulam beams are installed. Only so much tectum decking can get installed per day that can be made weather tight at end of the shift.
2. Provide and install roof hatch including all accessories for a complete installation. Ships ladder by WC 12.

3. Provide, install, and maintain safety flagging system on the roof per MIOSHA requirements for all contractors to use. Include two points of entry/egress (one from the roof hatch and one from the side of the building as directed by The Construction Manager). Remove flagging at project completion.
4. At time tectum decking is set, masonry walls will be installed but not concrete slab on grade. Take this into consideration when determining installation methods.

Related Work by Others:

1. Prefabricated roof curbs for mechanical equipment to be furnished and installed by W.C. 27.
2. Wood blocking and wood nailers by others.
3. Roof sump pans, roof drains, overflow roof drains, roof stairs and ladders – furnished and installed by others

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$15,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 14

Work Category No. 15 – Metal Siding

Work Included:

The subcontractor shall timely perform all Metal Siding work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all metal siding including but not limited to bent metal trim, drip edges, copings, furring, joint sealants, gaskets, integral louvers, gutters, downspouts, secondary support framing, shims, flashings, trim, and accessories.
2. Furnish and install pre-finished sheet metal closures, end panel extrusions, gravel stops, copings, panel flashings, stainless steel counter flashings, etc. Sheet metal copings over architectural pre-cast wall panels. Furnish and install above referenced sheet metal closures and trim that is in contact with metal wall panels & louvers for a complete watertight assembly, including required design and engineering.
3. This contractor to coordinate and cooperate with roofing subcontractor on locations of counter flashings, sheet metal closures & trim details, anchoring and other termination details, for a complete water tight installation.
4. Full coordination with other contractors to insure all penetrations through the metal siding are sealed completely.
5. Provide a color chart with the base bid to indicate which colors have been priced. Provide an alternate price for increased costs for custom colors and color samples for these colors.
6. All embedded items, i.e. masonry and pre-cast counter flashing reglets, shall be clearly marked/labeled per approved erection drawings, and appropriately delivered to assigned subcontractor responsible for installation of embedded items. 48-hour advance notification of embedded shipments will be required for proper coordination with others.
7. Promptly construct field mock-up sheet metal.
8. Properly protect adjacent roofing systems from damage, with rigid insulation and plywood, to avoid crushing tapered roof insulation. Coordinate temporary roof protection details with roofing subcontractor.
9. All flashings, roof termination details need to be inspected by the Construction Manager prior to being covered up and concealed.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Provide and install metal panel screen wall. Structural steel for screen wall system by WC 11.
2. All furring that is embedded in spray insulation needs to be installed before the insulation is sprayed.

Related Work by Others:

1. Independent Field Testing by Owner.
2. Steel frame and girts by WC 12.
3. Roof expansion joints and associated counter flashing by WC-14.
4. Flat roof by WC 14.
5. Wood blocking and plywood in contact with metal wall panels by WC 20.
6. Louvers not integral with metal wall panels, blank-off panels at louvers and metal louvers by WC 27.
7. Provide in advance, counter flashing reglets to pre-cast and masonry subcontractors, installation by others.
8. Roof sump pans, roof drains, overflow roof drains, lighting protection devices and cable, wall and roof anchors, davits, roof stairs and ladders furnished and installed by others.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$0**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 15

Work Category No. 18 – Glass, Glazing, and Aluminum Entrances

Work Included:

Complete all Glass, Glazing, and Aluminum Entrances work in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, etc.), Addenda, Specification Sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all aluminum entrance, storefront, curtain wall system, windows, interior and exterior glass/glazing, and window systems complete as shown and/or specified. Includes all labor, material, accessories, and equipment for a complete installation.
2. Furnish and install all required fasteners, angles and supports required for complete installation of these systems.
3. Include all sealants related to this work required for a complete installation, including glass to aluminum, aluminum to aluminum, aluminum to adjacent surfaces. Verify compatibility of sealants to surfaces.
4. Furnish and install aluminum covers, sills, mullions, trim, sill extensions, flashing and counter flashing etc. where aluminum systems abut other finishes and/or are shown to incorporate structural members or adjacent to the window/glazing systems.
5. Furnish and install all glazing at doors and lite frames provided by others. Includes removal, reinstallation, filler-putty and finish touch-up of glazing stops.
6. Furnish and install fire stop assembly where floors adjoin the curtain wall system and insulation incorporated into the curtain wall system.
7. Coordinate rigid insulation installation with roofing, floor firestopping, and floor anchors systems.
8. Coordinate flashing details with roofing subcontractor for water tight installation. All counter flashing details to be inspected and documented by Construction Manager, prior to being concealed.
9. Expansion joints integral with curtain wall systems are by Subcontractor.
10. Furnish and install metal panel in fills, integral with curtain wall & storefront systems.
11. Coordinate this work with structural, architectural and other related trades for thru-wall flashings, trim, closures, joint sealant work, and architectural finishes for a complete water tight assembly.
12. Complete shop drawings and sealed engineering calculations by licensed engineer showing compliance with specified design criteria.
13. Removal of all labels, stickers, markup, etc. from glass and final washing and cleaning of glass at or just prior to substantial completion. Replace glass damaged from heat absorption into glass from stickers not removed.
14. Construct field mock-up wall requirements. Expedite mock-up shop drawings and submittals for prompt review and installation, well in advance of installation. Field mock-up will be subject to independent air & water infiltration testing, performed by an Independent Testing Agency.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted

below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Furnish and install all window films and coverings.
2. Provide and install sectional doors including all accessories for a complete installation. Overhead coiling doors by WC 20.
3. A separate mobilization will be needed for the main entrance storefront framing, doors, hardware, etc. The goal is not install that system until the very end of the project to avoid possible damage as this will be the main way into the project site.
4. Provide and install all hardware associated with this WC's door assemblies including auto door operators. Manufacturer's rep is to review, approve and sign off on the installation of all door hardware before acceptance by TCC and the Owner.
5. Provide and install louvers at aluminum doors/frames.

Related Work by Others:

1. Independent Testing Agency by Owner.
2. Window sills, rough carpentry, and wood and metal framing below sills by others.
3. Framed mirrors by WC 20.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$0**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 18

Work Category No. 20 – General Trades

Work Included:

The subcontractor shall timely perform all work as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Complete all exterior and interior Carpentry/Millwork (rough and finish) and various General Trades Work as noted within this Work Category, including all labor, materials and equipment required for a complete installation.
2. All exterior and interior rough and finish carpentry including counters, cabinets, trim, nailers, blocking and plywood sheathing.
3. Furnish and install all roof nailers, plywood sheathing and blocking. Furnish and install rigid insulation in concealed locations created by Subcontractor.
4. Furnish all embedded anchors and bolts for rough carpentry to masonry and concrete to be installed by others.
5. Furnish and install wood blocking, FRT, sheets, boards, plywood, etc. for required materials that are to be installed by this work category.
6. If in-wall backing/blocking is required by a specific manufacturer for products included as part of this Work, though not specifically shown within the documents, i.e. architectural millwork, handrails, wall trim, wall mounted toilet partitions, visual display surfaces, metal lockers, fire extinguisher cabinets, misc. accessories, etc., Subcontractor to furnish and install blocking for a complete installation.
7. Provide non-combustible wood blocking in walls for wall mounted accessories and equipment installed by Owner/others shown or specified.
8. Furnish and install doors, frames, and hardware.
    - Provide and install automatic door operators at doors provided by this WC.
    - Electric strikes, magnetic hold-opens, power transfer units will be installed by others – WC-28. Coordinate deliveries, installation instructions & wiring diagrams directly with WC-28.
9. Include grouting of hollow metal door frames in gypsum wall. Hollow metal door frames in masonry walls to be installed as the wall is installed so WC 11 can grout the frames.
10. Manufacturer's rep is to review, approve and sign off on the installation of all door hardware before acceptance by TCC and the Owner.
11. All interior finish carpentry, architectural woodwork, casework, countertops, shelving and millwork. Provide all sealants to adjacent surfaces, including dissimilar materials. Coordinate counter top support spacing with WC 27 under lavatory guards and lavatory installation.
12. Furnish and install formed metal countertops and shelving.

13. Furnish and install wall protection systems.
14. Furnished and installed all window sills.
15. Furnish and install all solid-surface materials and grommets as indicated.
16. Furnish and install all wall protection, handrail, corner guards, and crash rail.
17. All architectural hardware for cabinets supplied by this Work Category.
18. Include all stainless steel required and associated with millwork.
19. Install all custom casework fabricated and furnished by others including cabinets, p-lam coat shelves, p-lam and solid surface vanity tops, and solid surface windowsills.
20. All fabricated materials are to be shop assembled to the greatest extent possible before shipping to the job site.
21. Furnish and install handrails, display case, wood counter top, transaction counters, crash rails, corner guards, wall hooks, adjustable shelves, wall protection, stainless steel shelves and projection screens.
22. Furnish and installation of specialties including but not limited to: lockers, benches, towel bars, shower curtain rods, stainless steel shelves, curtain tracks, specimen pass through boxes, coat rods, coat racks, mop holders, robe hooks, shelving, wall and corner guards, impact rails, fire extinguishers, fire extinguisher cabinets, impact resistant wall protection, brackets, associated signage, coat/clothes hooks, shelving, bulletin boards, broom / mop hooks, hand sanitizer & disposal, coat rods, visual display boards, marker boards, tackboards, window roller shades, tack strips, overhead coiling doors, etc., as well as all items mentioned in the above referenced spec sections.
23. Equipment items designated as Owner-Furnished/Contractor-Installed are a part of this scope of work. Owner furnished equipment isolated to an electrical connection "only" will be handled by the electrical subcontractor. Equipment requiring water, ducting, etc. will be handled by the mechanical subcontractor. All equipment that does not have any mechanical and/or electrical connection is the responsibility of this work category to receive, unload, distribute, and install.
24. Furnish and install sealants for all materials installed by this contractor such as cabinets, counters, sills, etc.
25. Furnish shop drawings, samples, product data, test reports, coordination drawings and other submittals as specified. Coordinate submittal schedule with the Construction Manager.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. A mockup of the reading nook Style A will be constructed prior to installation (see schedule). Once approved, this may be disassembled to be used for final construction if wanted.
   A. Provide and install wood and all accessories at reading nooks.
   B. This WC responsible to build, maintain, and remove temporary shelter over the reading nook mock up to prevent it from getting precipitation on it.
2. Provide and install glulam beams including all accessories for a complete installation. This WC will need to work closely with WC 14 Roofing to minimize the amount of time the glulam beams are exposed to

exterior elements. This WC is responsible to protect glulam beams until roofing is installed.

3. Provide and install all signage and plaque(s) including all accessories for a complete installation.
4. Furnish and install all athletic equipment including telescopic stands/bleachers, basketball equipment, volleyball equipment, scoreboards, and gymnasium safety wall pads, including all accessories for a complete installation.
5. Provide and install the monument sign including but not limited to LED screen, aluminum panels, and lettering/numbering.
6. Provide and install the dumpster enclosure gates including but not limited to trex boards, framing, hardware, steel, and all associated accessories. This WC responsible for the pipe sleeve in the concrete for the barn gate stop.
7. Provide, install, and maintain temporary plywood wall, double doors, and hardware at the main entrance to be used for the duration of the project. WC 20 to remove this at the end of the project when WC 18 will install the main entrance storefront system.
8. Provide and install temporary fire extinguishers (during construction) within a freestanding wood cabinet painted in red, labeled "fire extinguisher" as located by the Construction Manager. Removal following use included. Quantity for each area to match minimum required by MIOSHA.
9. Provide and install flag poles including but not limited to excavation, backfill, concrete, wedges, fill, foundation tube, lightning ground spike, etc for a complete installation.
10. Provide and install bike racks. Concrete footing by WC 05.
11. At time glulam beams are set, masonry walls will be built but concrete slab on grade will not be installed. Please note this when determining installation methods.
12. Provide and install steel shade structures (outdoor classrooms). Concrete footings/foundations by WC 05 as needed.
13. Provide and install exterior movable bleachers (detail 11/L-500).
14. Install flexible flashing where blocking gets wrapped with it (example is detail 5/A-101A). WC 13 to provide flexible flashing.
15. Furnish and install plywood backer at all electrical equipment indicated to receive plywood backer.

Related Work by Others:

1. Dumpsters
2. Temporary water and electrical
3. Benchmarks and column lines (one in each direction) by Construction Manager.
4. Concrete benches by WC 10.
5. Roof access doors, expansion joints and accessories by WC 14
6. Roof insulation by WC 14.
7. Plywood sheathing and shims at cafeteria platform steps by WC 21
8. Independent testing and inspections by Owner.
9. Roof mechanical equipment curbs by WC 27, installed by WC 14.

10. Temporary heat by Construction Manager.
11. Roof accessories furnished and installed by WC 14.
12. All aluminum door hardware provided by WC 18 and keyed by same.
13. All structural framing by WC 12 and WC 21.
14. Sectional doors by WC 18.
15. Acoustical wall panels by WC 21.
16. Bathroom accessories (toilet partitions, grab bars, mirrors, soap dispensers, sanitary napkin disposals, shower seats, and waste receptacles. Receive and install owner provided toilet tissue dispensers) by WC 27.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$30,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 20

Work Category No. 21 – Walls & Ceilings

Work Included:

The subcontractor shall timely perform all Walls & Ceilings work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all interior and exterior gypsum board, metal stud framing, cold-formed framing, insulation, ceiling grid, ceiling tile, as shown and/or specified. Includes all labor, material, accessories, and equipment for a complete installation.
2. Above ceiling support wires for ceiling grid, soffits and hard ceilings will be installed after MEP-above ceiling rough-ins. Hanger wires where required to support light fixtures, grilles, and registers, etc.
3. Furnish and install all expansion joints and covers in drywall, soffit assemblies and/or ceiling grid assemblies. Properly anchor, level and set, including fire barrier(s) under and beyond expansion joint areas. Installation of wall and ceiling expansion joints shall occur just prior to finish painting per floor. Fire barrier(s) within concealed locations shall be installed and inspected prior to being covered by architectural walls and ceilings.
4. All interior and exterior wall and ceiling fire stopping, thermal and acoustical insulation as it relates to this contractors work.
5. Furnish and install all fireproofing and per the drawings and specifications.
6. Acoustic sealants and caulking of work within this work category including bottom, sides and top of rated walls. Furnish and install all necessary fire caulking related to this W.C including all required fire taping of walls and ceilings. Subcontractor shall be required to fire-stop, smoke seal and sound seal, all other remaining penetrations, and schedule all Work of this type to completed and inspected just prior to ceiling grid installation.
7. Properly fire stop and seal all fire wall penetrations created by this work. Fire stop to mechanical, electrical, and plumbing sleeves furnished and installed by others.
8. Furnish and install all access panels shown on the drawings in stud partitions or ceilings including mechanical and electrical panels. It is your responsibility to review all drawings complete including the mechanical and electrical drawings. Install all access panels in metal stud walls and ceilings furnished by mechanical, fire protection, and electrical contractors (not shown on drawings).
9. All layout and control lines for wall, partitions, and ceilings related to this W.C.
10. Install shimming necessary to maintain true lines.
11. Furnish and install all ceiling surfaces per the drawings and specifications.
12. Install all light gauge metal framing including truss system & stiff clips.
13. Tape and sand joints to bottom of gypsum board to provide even, clean joints to receive vinyl base.
14. All cold-formed framing, fire-stopping, non-load bearing steel framing, gypsum board, glass-reinforced

gypsum fabrications, acoustical ceilings, including all labor, materials and equipment required for a complete installation.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Provide and install all acoustical ceiling panels, including the diffuser panels.
2. Furnish and install acoustical wall panels, tectum acoustical wall panels, sound seal wall panels, and fiberglass reinforced panels.
3. Provide and install all framing, sheathing, plywood, shims, etc. for a complete cafeteria platform steps system. WC 23 will install flooring over sheathing.

Related Work by Others:

1. Dumpsters by Construction Manager.
2. Temporary Water and electrical by Construction Manager.
3. Benchmarks and column lines (one in each direction) by Construction Manager.
4. Roof insulation by WC-14.
5. Independent testing and inspections by Owner.
6. Temporary heat by Construction Manager.
7. Exclude foundation and masonry insulation.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$20,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 21

Work Category No. 22 – Hard Tile

Work Included:

The subcontractor shall timely perform all Hard Tile work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all tile including but not limited to ceramic tile, porcelain tile, quarry tile, stone tile, and glass tile, as required (at floors, walls, sills, base, etc) including floor patching, preparation, joints, and sealing as shown and/or specified. Includes all labor, material, accessories, and equipment for a complete installation.
2. Furnish and install all transition strips between different floor types.
3. Provide additional temporary lighting as required for proper installation.
4. Protection of flooring shall be provided by this contractor until substantial completion. Provide final cleaning after floor protection is removed.
5. Coordinate elevations of floor sinks and drains with WC 27 for proper adjustment prior to installation of flooring, providing acceptable slope, patterns, and transitions.
6. Concrete floors have been placed to meet the flatness tolerances listed in WC 10 specifications. This WC shall provide all surface prep, including scraping, sanding, filling, feathering, etc. for a complete installation.
7. Broom sweep and prep floor as required for this work.
8. Verify curing compounds & sealers used on new and existing surfaces are compatible for flooring adhesives and materials.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Provide and install all trim accessories as needed for a complete installation of the hard tile including TR-1 through TR-4.
    a. TR-5 through TR-7 by WC 23.

Related Work by Others:

1. Resilient base by WC 23.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$5,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 22

Work Category No. 23 – Carpet and Resilient Flooring

Work Included:

The subcontractor shall timely perform all Carpet and Resilient Flooring work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all carpet, resilient flooring, linoleum flooring, hardwood flooring, as required for a complete installation, including resilient and carpet wall base, stair nosings, treads, or risers, adhesives, seam welding, seam sealing, floor patching, skim coating, floor leveling, feathering, final cleaning and/or vacuuming.
   a. Furnish and install all rubber base.
2. Furnish and install all transition and reducer strips between different floor types.
3. Provide additional temporary lighting as required for proper installation.
4. Furnish and install materials necessary to match finishes in existing tie-in areas and at different floor types.
5. Install and maintain protection of flooring until substantial completion. Remove and final clean after substantial completion.
6. Responsible for repairs for damage to wall finishes and other adjacent surfaces caused by flooring installation.
7. This contractor accepts condition of floor (flatness, moisture, finish, adhesion compatibility, etc.).
8. Concrete floors have been placed to meet the flatness tolerances listed in WC 10. Subcontractor shall provide all surface prep, including scraping, sanding, filling, feathering, etc. for a complete installation.
9. Verify curing compounds & sealers used on new and existing surfaces are compatible for flooring adhesives and materials.
10. Broom sweep and prep floor as required for this work.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. Provide and install all trim accessories needed for a complete installation of this WC's scope including TR-5 through TR-7.
   a. TR-1 through TR-4 by WC 22.
2. Provide and install game line markings in the gymnasium.
3. Provide and install bleacher block at all flooring locations shown.

Related Work by Others:

1. Concrete substrate has been installed in accordance with 33000 for flatness and levelness by WC 10.
2. Note any transition strips that may logically be furnished and installed by other flooring contractors, depending on materials and/or sequencing of installations.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$25,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 23

Work Category No. 24 – Painting & Wallcovering

Work Included:

The subcontractor shall timely perform all Painting and Wallcovering work as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish all labor and material to complete all interior and exterior painting and wall coverings as shown and/or specified, including but not limited to; exposed masonry, exposed steel, exposed unfinished wood materials, field painting of equipment, bollards, stairs, handrails, ladders, decorative columns, concrete walls, lintels, door frames, louvers, canopies, handrails, mechanical, electrical and fire protection piping (including protection of sprinkler heads) etc. including all labor, materials and equipment required for a complete installation.
2. All required surface prep for this work including touch up of steel primer as required.
3. Final wall preparation to include minor patching (scratches and small dents) and minor caulking in all areas which call out for paint. All areas should be reviewed by the painter prior to new finishes being applied.
4. Finishing of millwork/casework and trim items not furnished pre-finished, including wood filler, and putty if required. Light sanding may be necessary prior to applying finishes.
5. Temporary protection of all areas and clean up of paint overspray (if materials are outside of interior renovations) and drippings. Protect all new and existing finishes adjacent to painted areas prior to painting.
6. Protect fire suppression heads; promptly remove protection.
7. Sequence the work as follows: patching and priming, first finish coat, installation of cabinets, tops, etc, and then final coat. Multiple mobilizations will be required by this work category due to phasing of construction.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this Work Category.

1. This WC to paint exposed MEP items in areas with exposed ceilings (except ductwork). The intent to paint as much of this as possible before it gets installed as the tectum deck and glulam beams do NOT get painted. The MEP contractors will hand over their hangers, Unistrut, etc. for this WC to paint and then the MEP contractors will install. This WC will need to do touch up painting after installation.
2. Furnish and install concrete sealer.

Related Work by Others:

1. Labeling of piping system and fire rated partitions by others.
2. Traffic Marking by W.C. 06.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$20,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 24

Work Category No. 25 - Food Service Equipment

Work Included:

The subcontractor shall timely perform all Food Service Equipment work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Proposal Section, Contract Forms, General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Provide and install food service equipment and associated accessories for a complete installation.
2. Furnish and install fire protection system for food service equipment as necessary for a complete installation. Coordinate with WC 28 for connection to building fire alarm system.
3. Furnish drawings showing size and location of concrete recesses required for Food Service Equipment to Construction Manager. Installation of these recesses is by others.
4. Provide patching and repair for all damage to finish surfaces resulting from your work.
5. Provide sleeves and coring for remote compressors / condensers, line sets, start up.
6. This contractor to provide a separate, dedicated visit for owner training after all food services equipment has been commissioned and training manuals have been provided for owner training.
7. Schedule to receive, unload, erect, rig, hoist and place all equipment by own forces. Turn over to respective trades for final connections.
8. Provide full time onsite foreman to coordinate, instruct, facility installation and final connections for all food service equipment. Additionally, this person shall be present for the fire marshal and health department site inspections.
9. Include applicable Health Department permit(s) and fee(s) as necessary to obtain Approval Certificate from applicable Health Department for food service equipment. Coordination of inspections from the Health Department is the responsibility of this WC. This WC will also coordinate and ensure that the punch list items from the inspecting agency are completed by other effected trades and will call for a re- inspection (if necessary) and secure the certificate of occupancy for this area for the owner to occupy in the timeframe indicated in the construction documents.
10. This WC will be responsible to coordinate other trade contractors for corrections to equipment and reschedule final inspection(s) if necessary and obtain final approval from the Health Department consistent with the Construction Schedule.
11. Final cleaning and sanitization of all food service equipment, including floors, walls and ceilings as necessary to obtain Approval Certificate by appropriate Health Department.
12. Full compliance with all the safety regulations and requirements of OSHA, MIOSHA, State Authorities, Local Authorities and the Construction Manager.
13. Coordinate all blocking required for this trade work with WC 20 prior to wall construction. Blocking will be installed by WC 20.

14. All components of food service equipment shall be completely wired and piped up to the point of final connection with electrical and piping systems.

15. Food service equipment contractor shall provide inventory by equipment item and furnish loose to Mechanical and Electrical Systems contractors all hardware required for food service equipment final connections.

16. Receiving of all food service equipment, uncrating and proper disposal of packing materials, and inspection of equipment and replacement of damaged units during the time specified in the project schedule are the responsibility of this WC.

17. Complete assembly of all shelving and storage rack systems.

18. Supply and install equipment, tables, racks, carts, etc., as specified.

19. Compliance with local codes for Health Department approval.

20. Include all layout required for the performance of this work category. Coordinate locations of all floor mounted and under floor electrical devices with WC 28 and floor sinks/drains with WC 27.

21. This WC will make periodic site visits as requested by the Construction Manager to review and coordinate work provided by other trades that is in conjunction with the food service equipment. This will include, but is not limited to trade coordination meetings and health department application submissions. This includes a preinstall drywall visit and a visit prior to installing drywall on metal stud walls.

22. Caulking and sealants for this trade's work. Include all required penetrations, and sealing of same, including but not limited to ceiling deck, walls, floors, etc.

23. Coordinate rough-in and final connection with other trades and indicate on a dimensioned layout shop drawing.

24. Complete the installation and testing of all food service equipment, including un-packaging and cleaning the equipment and smoke capture testing of the hoods. Provide documentation and demonstration of the required testing to the Construction Manager prior to the Health Inspection.

25. This WC will be responsible to furnish the hoods indicated. Connection of the hoods to the air handling unit and exhaust fans will be by others.

26. Provide clean-up as required for the performance of this work. The Christman Company will provide dumpsters. Each Trade Contractor will be required to separate and dump debris in the appropriate containers.

27. Furnish access panels where required for the wall and ceilings that are not shown on the drawings but are necessary for the Food Service Systems.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this work category:

1. This work category is responsible for all equipment indicated in the Food Service Equipment written specification and shown on FSE drawings.

2. Responsible for coordination with adjacent trade contractors for final connections of Food Service Equipment to the building's mechanical, plumbing, and electrical systems.

3. Responsible for any permits and Inspections.
4. Provide and install all curbs associated with Food Service Equipment.
5. Provide and install heat tape on coil drain line at the freezer.
6. Provide and install residential appliances per spec section 113013.

Related Work by Others:

1. Slotted Channel Framing for Exhaust Hood by WC 12. This WC needs to coordinate framing requirements with WC 12.
2. Final electrical connections by WC 28.
3. Final plumbing and HVAC connections by WC 27.
4. Connection of hoods by WC 27.
5. Tie in with existing building fire alarm system by WC 28.
6. Custom Millwork by WC 20.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$0**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

Work Category No. 26 - Fire Protection

Work Included:

The subcontractor shall timely perform all Fire Protection work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Contract Forms and General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. All design, fabrication, and installation of all wet and dry fire protection systems. Include all pumps, stand pipe risers, hose cabinets, hoses and associated trim, tamper switches, flow switches, gauges, alarms, test headers, drain inspector's test assembly, and fire department connections as specified and detailed in the documents or as required for a complete installation, including labor, materials, accessories, and equipment for a complete installation.
2. All permits, fees, inspections and approvals required by governing jurisdictions. This will include liaison between state and local agencies and insurance carriers to ensure code compliance and for securing approval for the facility.
3. All demolition, cutting, coring, patching, sleeving and firesafing of walls, floors, ceilings, etc., required for the installation of this work. Patch and repair work is to be done professionally by skilled craftsmen. Include all fire wall penetrations required for this work and sealing of same. All such openings require prior approval from the Construction Manager before work begins.
4. All Utility connections, disconnections, tie-ins crossovers, shut downs and similar work must be performed and scheduled so they will not interfere with other work. It may be necessary to make these changes during "off" hours, or it may be necessary to make "hot tap" connections. The contractor should plan on premium time for this work. Coordinate with the Construction Manager prior to performing this work.
5. Furnish any access panels required for walls and ceiling valves and controls that are not shown on the Architectural/Mechanical/Fire Protection plans but are necessary for the Fire Protection System. Installation will be others.
6. Furnish all hoisting, lifting, scaffolding and handling of all materials required to complete this W.C.
7. This contractor shall produce shop drawings as required by code and show all heads on the Architectural Drawings for approval, prior to installation of the heads. .
8. Provide and install pipe identification and other required identification related to this W.C.
9. The Electrical, Fire Protection, and Mechanical Contractors will be required to coordinate in a formal coordination process to accomplish the rough-in and final layout as required and specified in Section 1049. Your attendance will be required for these meetings. Any relocation required to coordinate work will be done at no additional cost to the Owner. All contractors are required to furnish layout and coordination prints for their work prior to these meetings allowing the team to be better prepared at each coordination meeting. Detailers will be provided by this contractor to accomplish this coordination.
10. Subcontractor shall protect existing structures, equipment and finishes from damage during the

performance of this Work. The items listed below represent a few special requirements to promote a respectful and professional working environment, and are not to be considered all inclusive:

- Gang boxes will not be allowed within spaces that have finish flooring and finish painted walls.
- Pipe thread/cutting machines will have floor protection, preventing oil droppings/spillage onto concrete and finish floors.
- Testing and draining fire protection systems shall be done in a neat and clean fashion, to avoid effluent spraying on finish surfaces.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this work category:

1. Unistrut installation in exposed ceiling locations needs to be closely coordinated and approved by The Christman Company. All contractors will do a mock up for all Unistrut, fasteners, clips, etc. that will be installed in the ceiling space of a typical classroom. This mock up needs to be approved before overhead MEP installation can start.
    a. All unistruct, clips, hangers, etc. that are to be installed in exposed ceilings spaces will be handed over to WC 24 to paint before installation. The tectum deck and glulam beams do not get painted but the exposed MEP items do (expect ductwork).
2. Provide and install fire air compressor and all associated accessories.
3. This WC to provide and install fire suppression riser. WC 02 will run water main to 5' from building, this WC to pick up the water service main from there.
    a. Provide and install fire department connection and splash block at drain.
4. This WC to include a sketch of a typical classroom fire suppression installation **with submission of their proposal**. With exposed tectum deck and glulam beams, how the fire suppression is supported and run is a concern along with how the fire suppression will get to the reading nooks.
5. Provide and install any signage required by JHA at Fire Department Connection.

Related Work by Others:

1. Painting of exposed fire protection by W.C. 24.
2. Electrical, Fire Alarm, and Detection System including wiring of tamper and flow switches by W.C. 28. Connection of fire pump controller to building fire alarm system by WC-28. However, Subcontractor to provide approved installation wiring diagrams/instructions, coordination, factory support etc. to allow for proper installation
3. Installation of access panels by W.C. 11 & 21.
4. Fire extinguishers and fire extinguisher cabinets by W.C. 20.
5. Housekeeping pads if shown by WC 10.
6. Installation of electrical devices furnished with pumps and controllers, but not specified to be factory mounted, by WC-28 (electrical).

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$10,000**. Reference

Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 26

Work Category No. 27 – Mechanical and Plumbing Systems

Work Included:

The subcontractor shall timely perform all Mechanical and Plumbing work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Contract Forms and General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all mechanical and plumbing systems, including domestic water, sanitary and vent, hydronic piping, water heaters, boilers, unit heaters, unit ventilators, air handling units, chillers, cooling towers, VAV boxes, mechanical louvers, radiant heat systems, humidifiers, condensate, heat exchangers, air conditioners, air curtain, ductwork, insulation, plumbing fixtures, trench drains, temperature controls including DDC or BMS systems, system commissioning, air and water balancing, etc., indicated by the contract documents (not just limited to the mechanical and plumbing drawings) or as required for a complete installation, including labor, materials, accessories and equipment for a complete installation.
2. Investigate areas prior to demolition activities, reroute and relocate existing services required for occupied operation. Cut, cap, and make safe, all existing plumbing, temperature controls and HVAC systems in renovated areas prior to demolition. Properly identify and mark system and components to be removed.
3. All cutting, capping, coring, patching and firesafing of walls, floors, ceilings, etc., required for the installation of this work. Patch and repair work is to be done professionally by skilled craftsmen. All such openings require prior written approval from the Construction Manager, before work begins. Furnish and install all sleeves and or misc. steel in walls, floors, roofs and ceilings that may be required by this W.C.
4. Furnish drawings showing size and location of concrete pads required for mechanical equipment to Construction Manager. Installation of these pads is by W.C. 10.
5. All utility connection, disconnections, tie-ins, crossovers, shut downs and similar work must be performed and scheduled so they will not interfere with other work. It may be necessary to make these changes during "off" hours, or it may be necessary to make "hot tap" connections. The contractor should plan on premium time for this work. Coordinate with the Construction Manager prior to performing this work.
6. Furnish access panels where required for the wall and ceiling valves, dampers and controls that are not shown on the Architectural/Mechanical plans but are necessary for the Mechanical Systems.
7. Furnish all hoisting, lifting, scaffolding and handling of all materials required to complete this work category.
8. The Electrical, Fire Protection, and Mechanical Contractors will be required to coordinate in a formal coordination process to accomplish the rough-in and final layout as required and specified in Section 1049. Any relocation required to coordinate work will be done at no additional cost to the Owner. All contractors are required to furnish layout and coordination prints for their work prior to these meetings allowing the team to be better prepared at each coordination meeting. Detailers will be provided by this contractor to accomplish this coordination. These meetings shall be coordinated with

the construction manager and shall be held on-site.

9. Provide and install mechanical equipment tags, pipe identification and other required identification of signage related to his work.

10. Run the various building piping systems out five (5) feet from the building walls and make the final connections to underground systems.

11. The mechanical contractor will provide assistance during concrete pours to guarantee the proper elevation of drains is maintained during the concrete pour. Accommodate floor finishes when calculating elevations.

12. Furnish and install all roof curbs and necessary or required auxiliary steel framing for equipment supplied under this W.C. This includes any auxiliary steel required at roof openings not shown on the structural drawings, or for pipe hangers and plenum stiffeners.

13. A coordination meeting will be set up between the controls contractor, mechanical contractor, electrician, and construction manager prior to control work. This will include all required work for a complete system as indicated in the construction documents.

14. Caulking and sealants for this trade's work. Include all required penetrations, and sealing of same, including but not limited to ceiling deck, walls, floors, etc.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this work category:

1. Unistrut installation in exposed ceiling locations needs to be closely coordinated and approved by The Christman Company. All contractors will do a mock up for all Unistrut, fasteners, clips, etc. that will be installed in the ceiling space of a typical classroom. This mock up needs to be approved before overhead MEP installation can start.

    a. All unistruct, clips, hangers, etc. that are to be installed in exposed ceilings spaces will be handed over to WC 24 to paint before installation. The tectum deck and glulam beams do not get painted but the exposed MEP items do (expect ductwork).

2. Owner is providing a commissioning agent. This WC to work with the commissioning agent as much as needed per contract documents.

3. Furnish and install heat trace. Coordinate with WC 28 for single point power connection locations.

4. Variable Frequency Drives (VFDs) shall be furnished by WC 27 and installed by WC 28.

5. All excavation and backfill related to Work including suitable backfill, compaction, & restoration and removal (from site) of all unsatisfactory fill in accordance with the documents.

6. This WC to carry SC Tech as controls subcontractor for base bid. Please provide voluntary alternates for any other controls subcontractors.

7. Provide and install roof support blocks, mats, etc. for all roof piping. Piping to be run in a professional manner with straight runs and 90 degree turns.

8. Furnish and install bathroom accessories including but not limited to toilet partitions, grab bars, mirrors, soap dispensers, sanitary napkin disposals, shower seats, and waste receptacles. Receive and install owner provided toilet tissue dispensers.

9. Provide and install roof hydrant(s).
10. Provide and install wireguard in the gym for all items installed by this WC as indicated.

Related Work by Others:

1. Concrete equipment pads by W.C. 10.
2. Roof vents flashing and counter flashing by W.C. 14.
3. Fire protection system and risers by W.C. 26.
4. Site and footing drainage systems by W.C. 02.
5. Power supply to mechanical equipment by W.C. 28.
6. Installation of access panels/doors by W.C. 11 & 21.
7. Site utilities beyond 5' from building perimeter by WC 02 or Utility Company.
8. Counter tops to be cut by WC 20.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$20,000**. Reference Section 01020 for specific instructions on allowances.

Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

End of Work Category No. 27

Work Category No. 28 – Electrical Systems

Work Included:

The subcontractor shall timely perform all Electrical work, as detailed below, in accordance with the contract documents (including Bidding Requirements, Contract Forms and General Conditions, Supplemental Conditions, General Requirements, Addenda, etc.), including, but not limited to, the following Specification Sections and Work Scope Items. Unless otherwise noted, this contractor is responsible for all items specified in the following specifications sections:

Reference Work Category Index

Work Category Notes:

1. Furnish and install all electrical systems, including power, lighting, site lighting, site power/data, fire alarm, public address system, lightning protection system, clocks and clock system, telephone/data and CATV systems, system commissioning, low voltage cabling, security, access controls, audiovisual systems, technology, etc., indicated by the contract documents (not just limited to the electrical drawings) or as required for a complete installation, including labor, materials, equipment, adhesives, fasteners, supports, hangers, grounds, blocking, shims and all necessary anchoring devices and accessories.
2. Investigate areas prior to demolition activities, reroute and relocate existing services required for occupied operation. Cut, cap, and make safe, all existing electrical systems in renovated areas prior to demolition. Properly identify and mark system and components to be removed by others.
3. All cutting, capping, coring, patching and firesafing of walls, floors, ceilings, etc., required for the installation of this work. Patch and repair work is to be done professionally by skilled craftsmen. All such openings require prior written approval from the Construction Manager, before work begins. Furnish and install all sleeves and or misc. steel in walls, floors, roofs and ceilings that may be required by this W.C.
4. Furnish drawings showing size and location of concrete pads indicated on the drawings for electrical equipment to the Construction Manager. Installation of these pads is by W.C. 10. All excavation, backfill and compaction related to this W.C. Suitable backfill will be required by this trade and this contractor will be responsible for removal (from site) of all unsatisfactory fill in accordance with the documents.
5. All utility connection, disconnections, tie-ins, crossovers, shut downs and similar work must be performed and scheduled so they will not interfere with other work. It may be necessary to make these changes during "off" hours, or it may be necessary to make "hot tap" connections. The contractor should plan on premium time for this work. Coordinate with the Construction Manager prior to performing this work.
6. Furnish access panels where required for the wall and ceiling valves, dampers and controls that are not shown on the Architectural/Electrical plans but are necessary for the Electrical Systems.
7. Furnish all hoisting, lifting, scaffolding and handling of all materials required to complete this work category.
8. The Electrical, Fire Protection, and Mechanical Contractors will be required to coordinate in a formal coordination process to accomplish the rough-in and final layout as required and specified in Section 1049. Any relocation required to coordinate work will be done at no additional cost to the Owner. All contractors are required to furnish layout and coordination prints for their work prior to these meetings allowing the team to be better prepared at each coordination meeting. Detailers will be

provided by this contractor to accomplish this coordination. These meetings shall be coordinated with the construction manager and shall be held on-site.

9. Provide and install panel labeling, identification and other required identification of signage related to his work.

10. The electrical contractor will provide assistance during concrete pours to guarantee the proper elevation of in-floor items (outlets, activation kits (if applicable), etc) are maintained during the concrete pour. Accommodate floor finishes when calculating elevations.

11. A coordination meeting will be set up between the controls contractor, mechanical contractor, electrical contractor, and construction manager prior to control work. This will include all required work for a complete system as indicated in the construction documents.

12. Electrical connections to equipment and devices provided by others, including by not limited to duct detectors, fire dampers, flow and tamper switches, variable frequency drives, power assist door motors, food service equipment, overhead doors, coiling shutters, projection screens, Owner furnished items, etc. Verify construction documents have been coordinated with power requirements of equipment prior to installation of devices.

13. Furnish and install electrical disconnects for all mechanical equipment provided by W.C. 27.

14. Caulking and sealants for this trade's work. Include all required penetrations, and sealing of same, including but not limited to ceiling deck, walls, floors, etc.

Specific Notes and Details:

The following details and notes are included in this Work Category; this list is to clarify the specific items noted below and does not exclude other details or otherwise limit the scope of work for this work category:

1. Unistrut installation in exposed ceiling locations needs to be closely coordinated and approved by The Christman Company. All contractors will do a mock up for all Unistrut, fasteners, clips, etc. that will be installed in the ceiling space of a typical classroom. This mock up needs to be approved before overhead MEP installation can start.

    a. All unistruct, clips, hangers, etc. that are to be installed in exposed ceilings spaces will be handed over to WC 24 to paint before installation. The tectum deck and glulam beams do not get painted but the exposed MEP items do (expect ductwork).

2. Owner is providing a commissioning agent. This WC to work with the commissioning agent as much as needed per contract documents.

3. Include connection of temporary power to The Christman Company's field office trailer at the beginning of the project. Include disconnection of the temporary power to The Christman Company's field office trailer at the completion of the project.

4. Furnish and install clevertouchs, interactive flat panel displays, and all televisions.

5. Temporary power, wiring, lighting, and distribution in accordance with current MIOSHA requirements. Provide a minimum of enough foot candles in each room to maintain current safe lighting levels. Maintenance of the Temporary Lighting System including replacement of burned out or damaged bulbs by this WC. This WC to work with other trades as walls/ceilings are being built to minimize amount of holes that the temp wiring/lighting creates. During temporary lighting removal, include labor and material to fill holes to meet wall type construction.

    a. Temporary power systems required are: Provide double duplex ground fault 20 AMP-120-

V-I-P outlets throughout the jobsite. There must be a minimum of 4 outlets at each location. Outlet locations need to be spaced so that a 75 extension cord from any location inside the building can reach a outlet.

6. Absolutely no exposed conduits, etc. are allowed in finished spaces without prior approval for the Construction Manager or expressly called out for in the construction documents. This WC needs to work closely with WC 10, 11 and 21 as concrete floors are poured and walls built to make sure all conduits are run in-wall as much as possible. For spaces with exposed ceiling, conduits need to run in-wall as much as possible until they penetrate at the deck/steel or device.
7. The Work Category responsible for all electrical final connections to Food Service Equipment after WC 25 installs the equipment. Refer to Kitchen Equipment Schedule for electrical connection information.
8. Variable Frequency Drives (VFDs) shall be furnished by WC 27 and installed by WC 28.
9. Provide and install natural gas generator.
10. This WC is responsible for providing and installing dual purpose docking station at the generator and everything downstream electrically.
11. Provide and install cable tray throughout the corridors for all low voltage wiring to utilize.
12. Provide and install any concrete for concrete encased conduits if needed.
13. Transport and install Owner's two server cabinets currently stored at their warehouse on the north side of Lansing, MI.
14. All excavation and backfill related to Work including suitable backfill, compaction, & restoration and removal (from site) of all unsatisfactory fill in accordance with the documents.
15. Verify all specified electrical equipment will fit in the layout indicated and can fit through doors/openings provided prior to ordering equipment.
16. Provide and install roof support blocks, mats, etc. for all roof piping. Piping to be run in a professional manner with straight runs and 90 degree turns.
17. Provide and install all security, audiovisual, clock, data, & technology items for a complete operational system per the technology and electrical drawings.
18. Furnish and install all conduits, pull strings, power etc. to exterior elements including but not limited to the outdoor classrooms, marquee sign, generator, utility pole, and pull boxes.
    a. Furnish and install additional conduits/pull strings that are spares for future use.
    b. Provide and install electrical in-ground vaults, pull boxes and inspection boxes.
19. Provide and install back doorbell system outside of the kitchen.
20. Provide and install any curbs/housing needed for electrical roof penetrations. Coordinate with WC 14 for installation.
21. Provide and install wireguard for all light fixtures in the gym.

Related Work by Others:

1. Site Parking lot light poles, power, and controls by LBWL.
2. Concrete equipment pads by W.C. 10.

3. Fire protection system and risers by W.C. 26.
4. Installation of access panels/doors by W.C. 21 or 11.
5. Low voltage wiring not identified on the drawings by the trade providing equipment.
6. Site utilities to transformers/cabinets by Utility Company.
7. Temperature Control wiring and conduit associated with the mechanical systems by W.C. 27.

Allowances:

This Contractor shall include in their Base Bid a Construction Manager's allowance of **$50,000**. Reference Section 01020 for specific instructions on allowances. Intent is to allow newer technology to be bought if requested by Owner later on during the project.

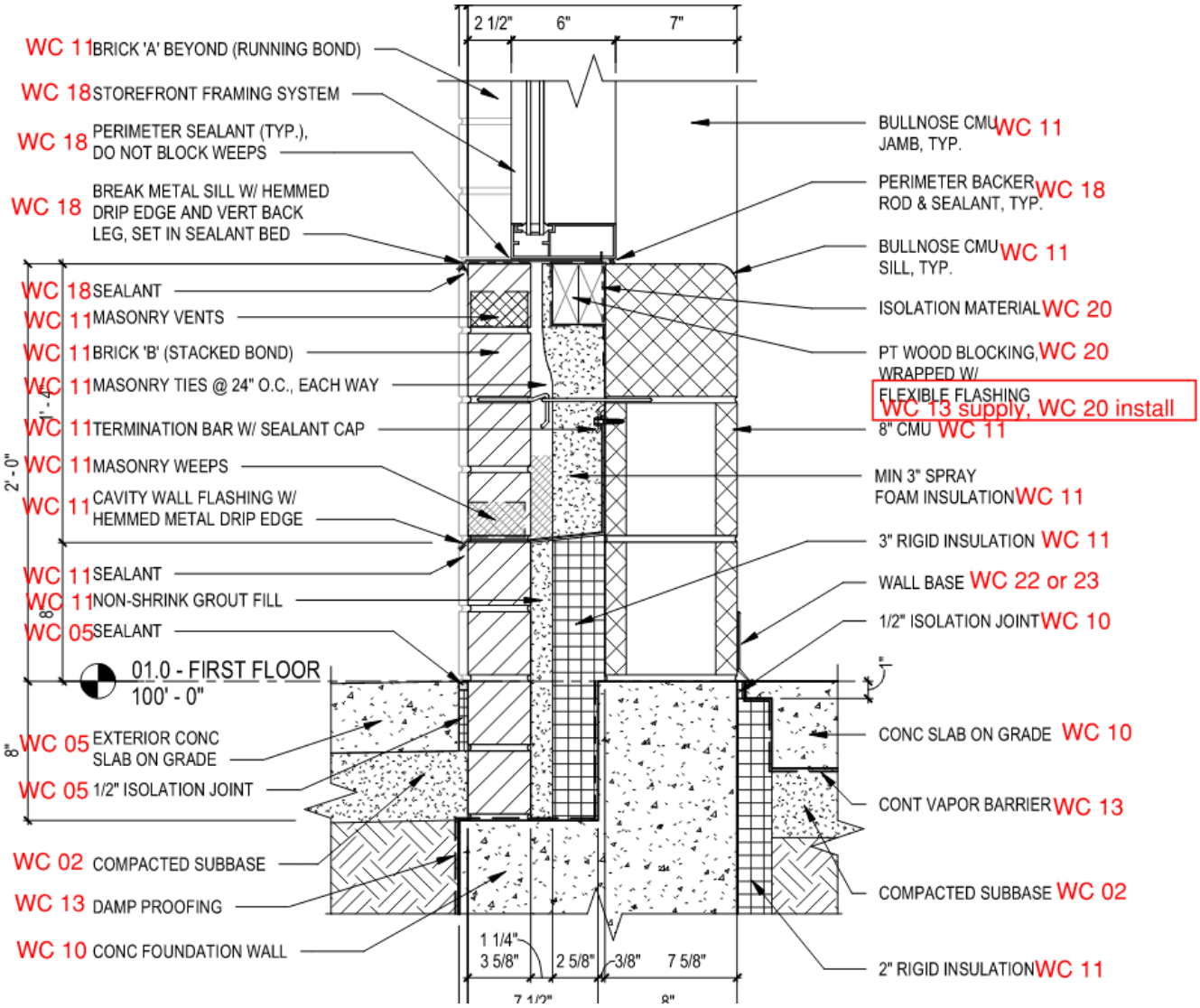
Unit Prices:

Unit Prices are to be complete furnished in-place operations, and include all costs, incidental materials and work, insurance, fringes, bonds, engineering, overhead and profit. Reference the Trade Contract Proposal form for unit pricing required.

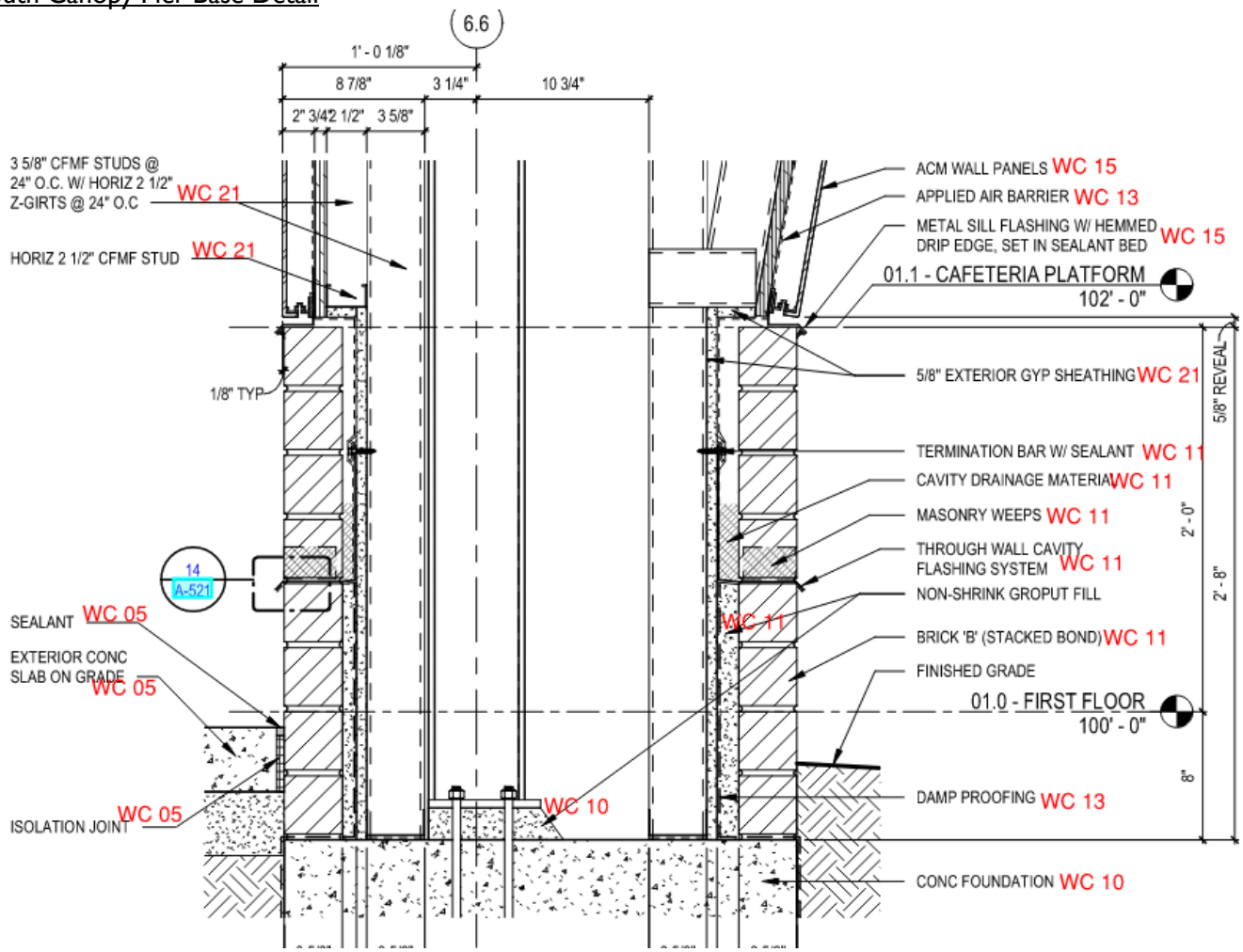
End of Work Category No. 28

Scope Clarification Diagrams

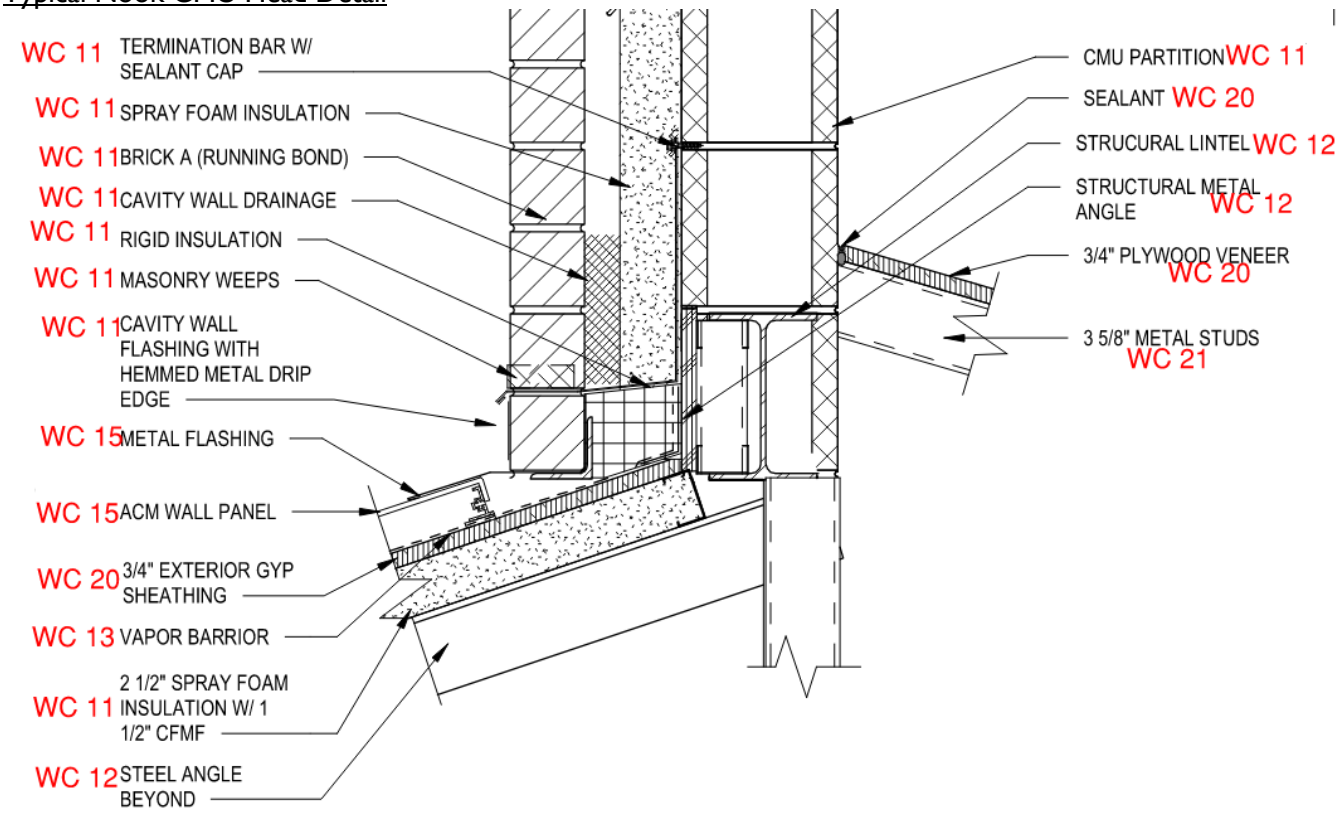
Typ. Exterior Wall Base Detail @ Storefront



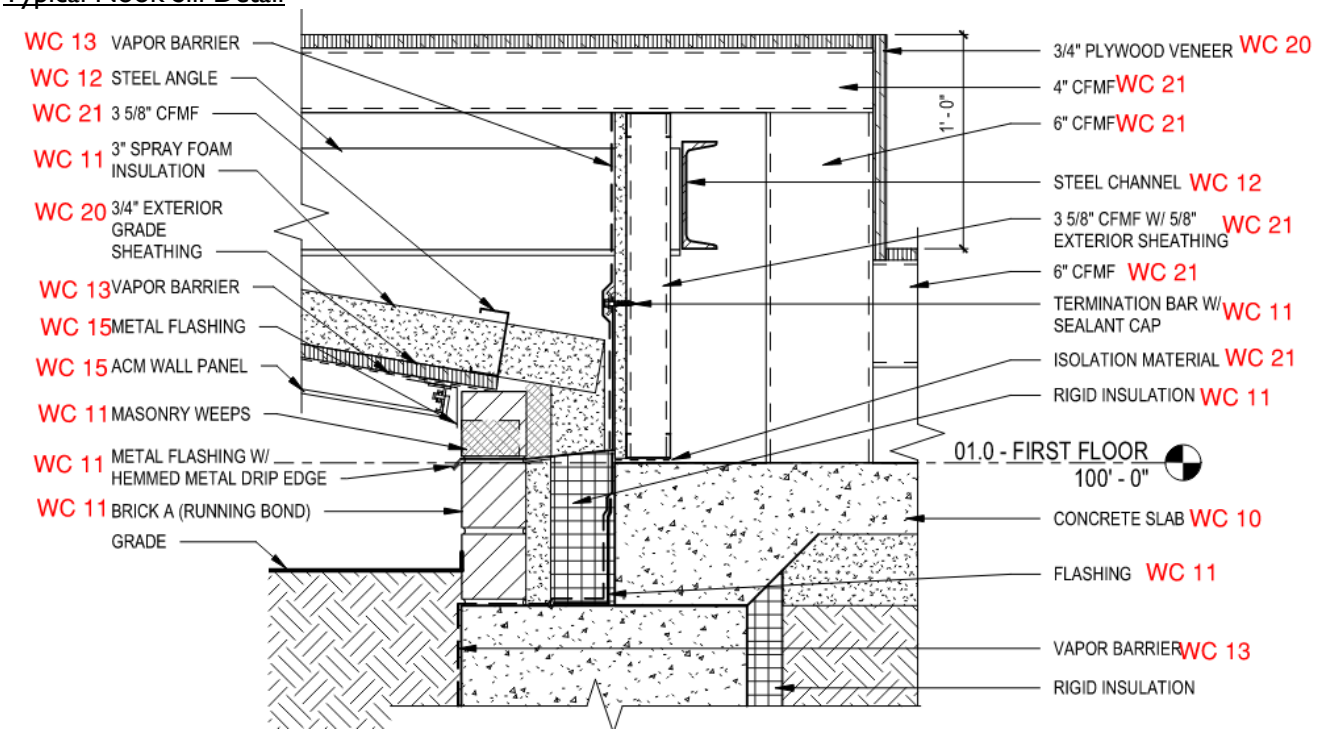
South Canopy Pier Base Detail



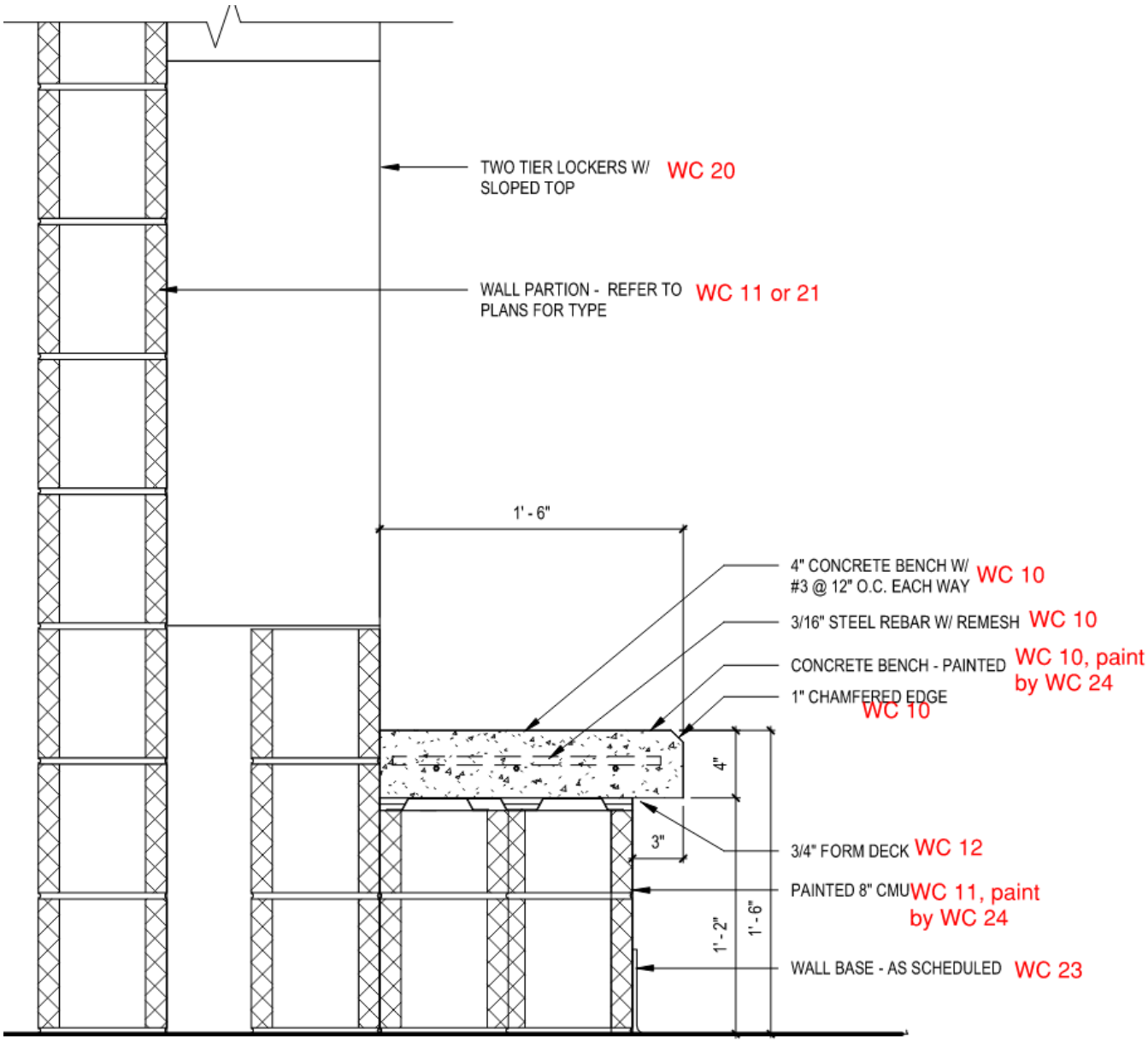
Typical Nook CMU Head Detail



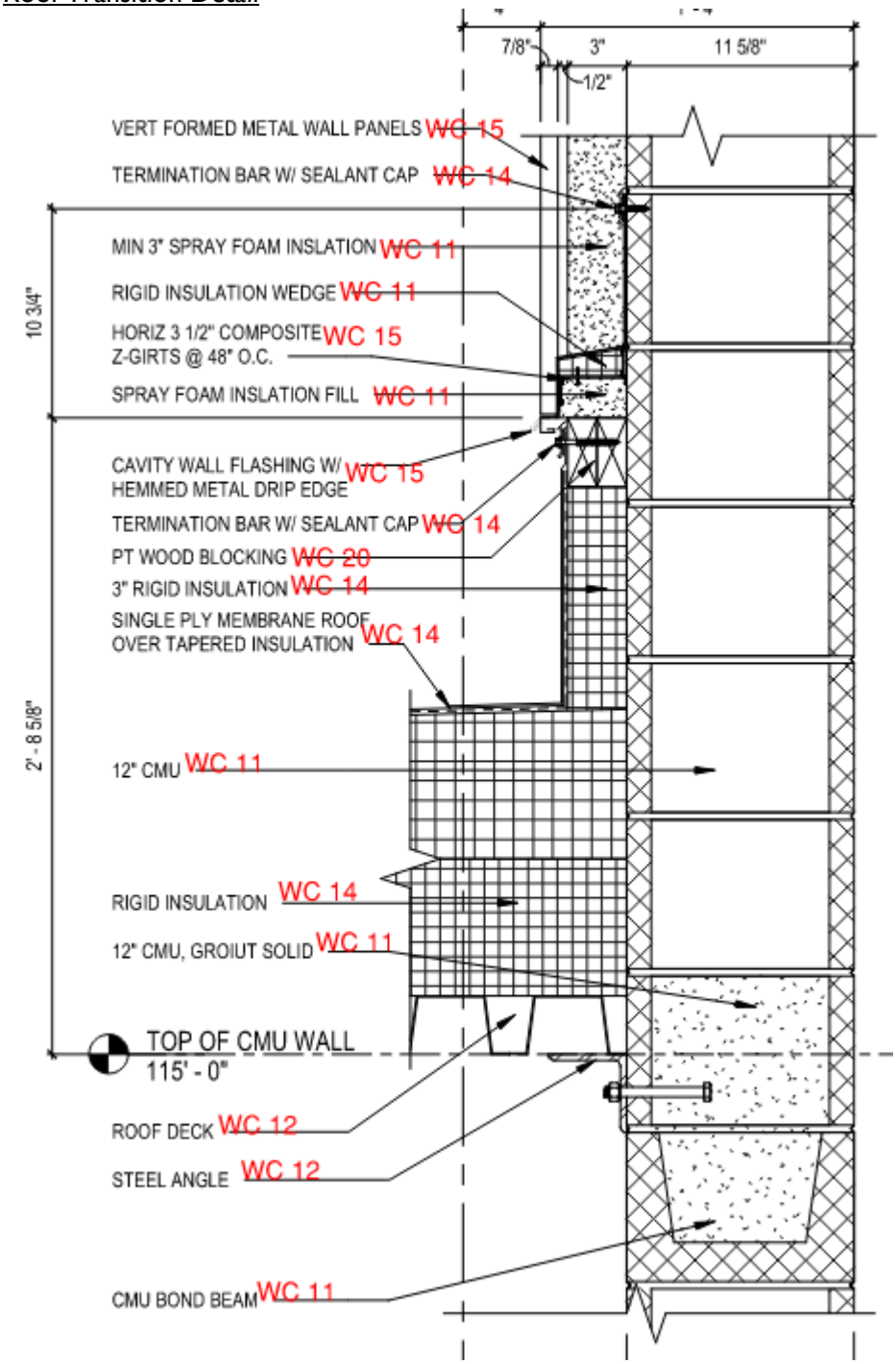
Typical Nook Sill Detail



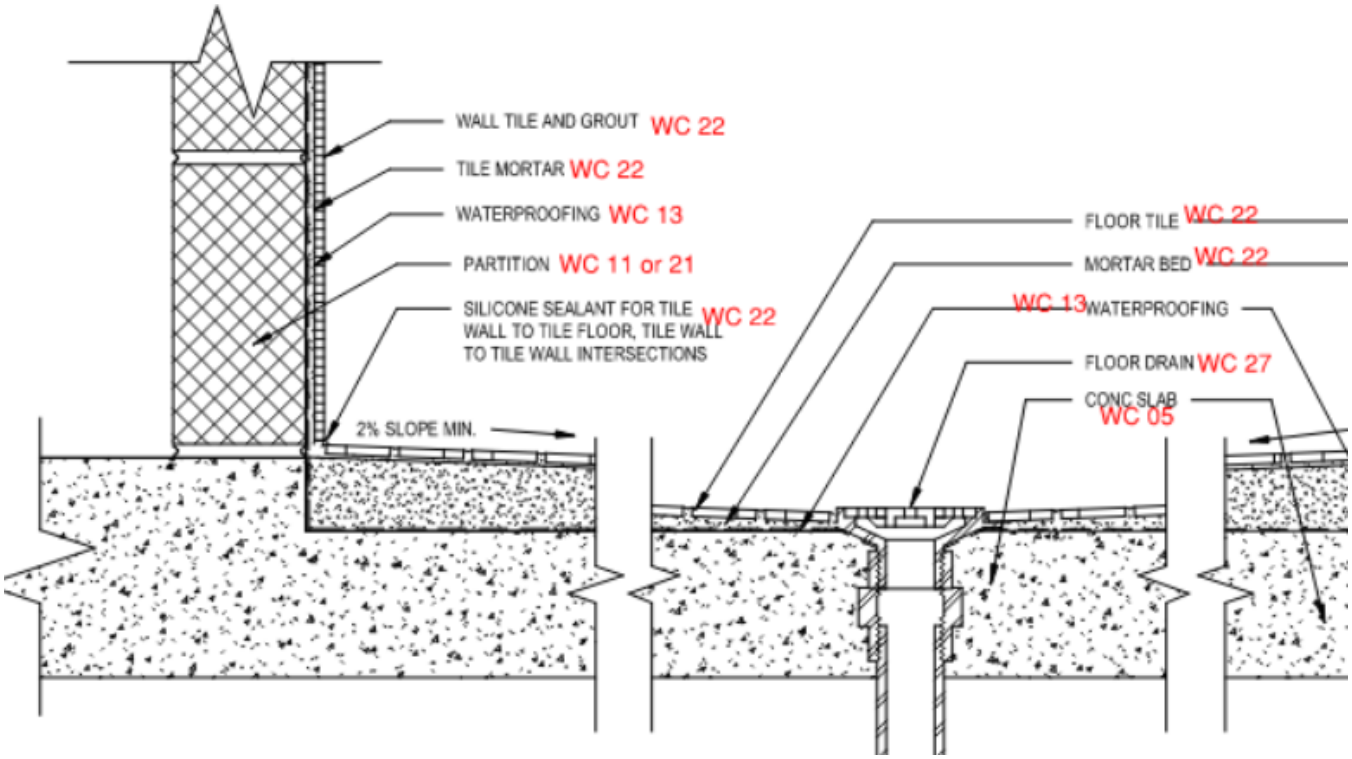
Bench Detail



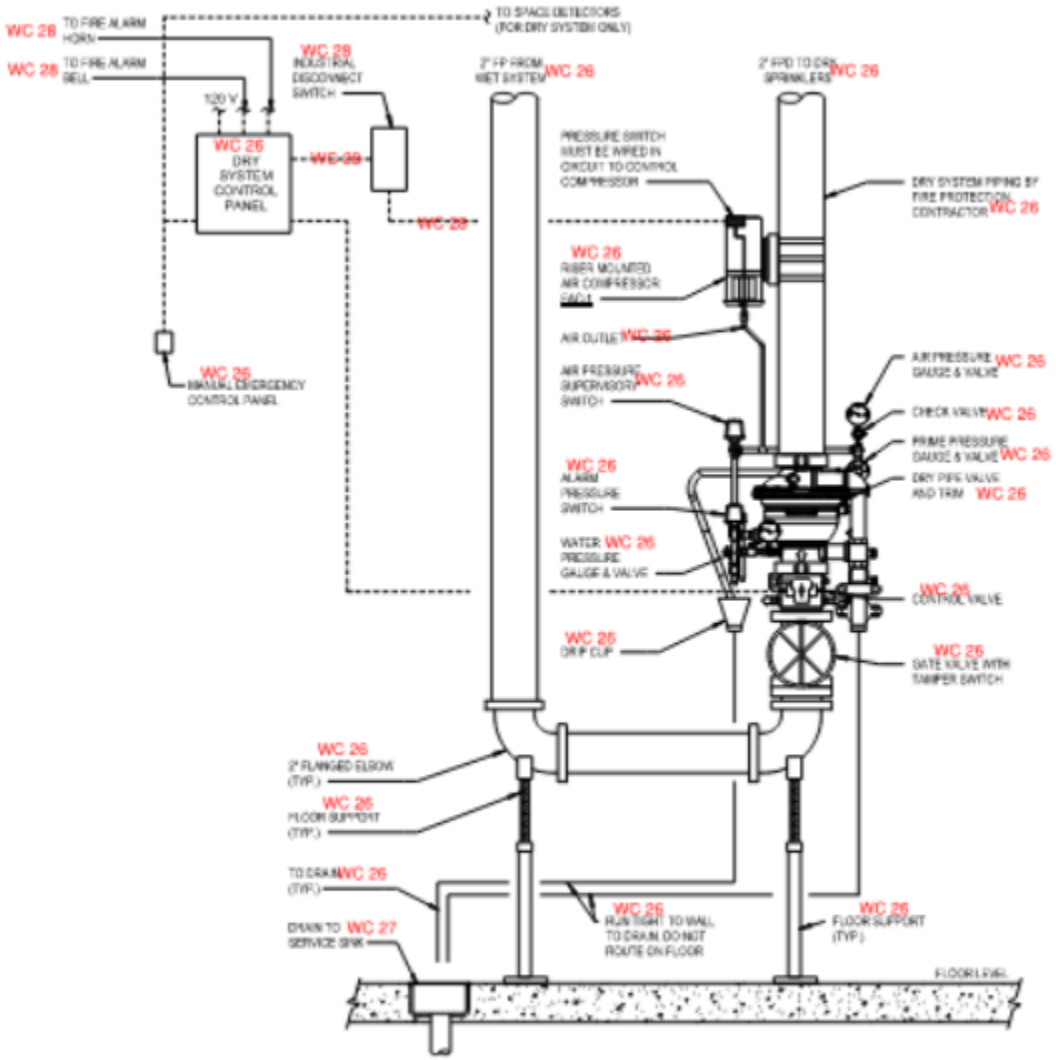
Roof Transition Detail



Shower Pan Detail

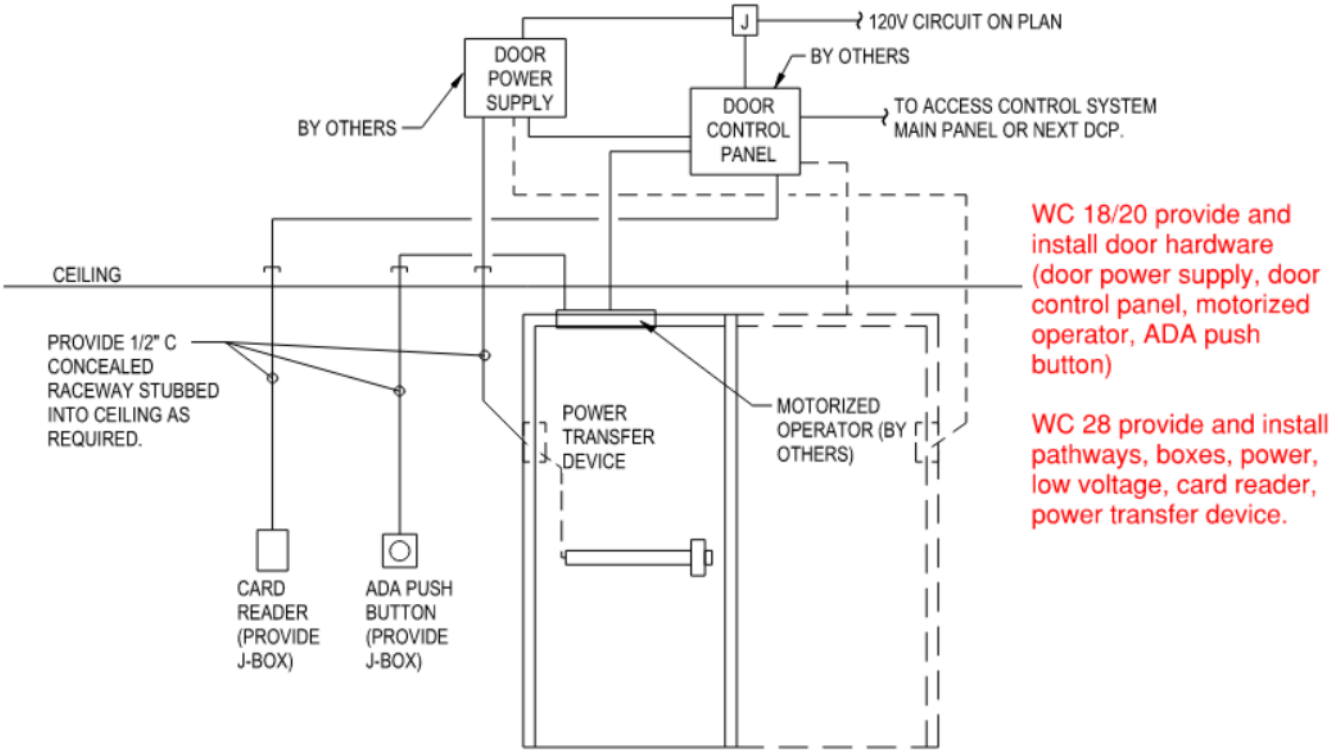


Dry Valve Piping Diagram



DRY VALVE PIPING DIAGRAM
SCALE: NONE

Typical Door Access Control Detail



Trade Contract Proposal
Pre-Submission Checklist

Trade Contract Proposal Form completely filled out?

Form signed by authorized officer of firm?

Costs for Performance and Labor & Material Bond costs excluded in base bid proposal sum but amount included in break out?

All taxes included in base proposal sum?

Bid security (bond or certified check or money order) of at least 5% of base proposal sum included?

Requested alternates & unit prices quoted?

Sworn & Notarized Familial Affidavit for Lansing School District included?

Sworn & Notarized Familial Affidavit for C2AE & Christman included?

Non-Discrimination Certification included in your proposal?

Iran Sanctions Certificate and Act Certificate included?

Affidavit of Bidder – Non-Collusion included with your proposal?

Legal Status of Bidder Certificate included in your proposal?

All information (proposal, bond, etc.) Submitted in duplicate?

Proposal submitted in sealed envelope per specifications?

TRADE CONTRACT PROPOSAL FORM

WORK CATEGORY NO. 00 and _____ Date: _____

TO: The Christman Company
208 N. Capitol Avenue
Lansing, MI 48933-1357

Re: Mt. Hope School

Ladies and Gentlemen:

Having carefully examined General Conditions, Supplementary Conditions, General Requirements, Advertisement for Bids, Instructions to Bidders, Proposal Section, Specifications, Drawings, all Addenda issued, Work Category Descriptions, and understanding the scope of work involved in this Work Category (ies) and those that interface with it (them), the undersigned does hereby propose to furnish all labor, materials, insurances, taxes, tools, equipment and services to complete all work required for the Work Category(ies) indicated in accordance with the Work Category Description and the Contract Documents prepared by _____ .

BASE PROPOSAL SUM:

_____
_____ ($_____)

PERFORMANCE & PAYMENT BOND: The Trade Contractor may be required to furnish a Co-Obligee Labor & Material Payment & Performance Bonds for the full contract amount.
The name of the Bonding Company is: _____.
The sum of ($_____) to cover cost of furnishing these bonds is ***added to*** the base bid.

EXPERIENCE MODIFICATION RATING (EMR):
List the EMR for your firm as determined by your insurance carrier for the past three (3) years.
2022 _____ 2021 _____ 2020 _____

ADDENDA: The following Addenda have been received, are hereby acknowledged, and their execution is included in Bid Sums listed herein.
No _____ Dated _____ No _____ Dated _____ No. _____ Dated _____

TIME AND MATERIAL RATES:

Labor rates listed below include the following:

Cost of labor including Michigan Single Business Tax, Social Security and Medicare, Federal and State Unemployment Tax, and Fringe Benefits Under Collective Bargaining Agreements, and Worker's Compensation Insurance. The rates listed below do not include overhead and/or profit. These rates are only for additions and/or deletions to the contract that could not have been anticipated at the time of the bid.

TRADE CONTRACT PROPOSAL FORM

WORK CATEGORY NO. 00 and _____ Date: _____

	TRADE	STRAIGHT TIME	SHIFT TIME	1 1/2 TIME	DOUBLE TIME
1					
2					
3					
4					
5					
6					

OVERHEAD AND PROFIT(FOR FUTURE CHANGES): Overhead and Profit shall include the following: Supervision, Superintendents, Commercial General Liability and Umbrella Insurances, Wage of Time Keepers, Watchmen and Clerks, Small tools with material value of less than $1,500.00. Incidentals, General Office Expense, and all other expenses not included in Labor Rates as listed above. The percentage fee for Overhead and Profit on the Contractor's own work shall be 15% of net cost. The percentage fee for Overhead and Profit on Subcontractor's work shall be 5% (see log).

MANDATORY ALTERNATES:
Reference Specification Section 01100 for alternate descriptions.

Alternate #1 – Public Address System Add/Deduct $_____
Alternate #2 – Five vs. Three Year Warranty Add/Deduct $_____
Alternate #3 – Surveillance Camera Type Add/Deduct $_____

UNIT PRICES:
WC 02 – Snow Removal (parking lots, drives, laydown area, & walk to main entrance)$_____/Event
WC 02 – Street Sweeping $_____/Event
WC 02 – Excavation & Removal of Unsuitable Soils (Off-Site) $_____/cy (truck)
WC 02 – Engineered Fill (Sand) Compacted in Place $_____/cy (truck)
WC 02 – Engineered Fill (21AA) Compacted in Place $_____/cy (truck)
WC 02 – Amount Included for temporary crane pads and drives $_____
WC 05 – Typical Curb & Gutter $_____/sf
WC 05 – Typical 4" Sidewalk $_____/sf
WC 05 – Heavy Duty Concrete Pavement $_____/sf
WC 06 – Standard Duty Asphalt $_____/sf
WC 10 – Amount to add Barrier One style admixture to slabs $_____/sf
WC 10 – Amount included for concrete survey for specified tolerances $_____
WC 11 – Amount included for winter protection measures $_____
WC 12 – Increase amount if cranes could only use the drives and not crane pads $_____
WC 14 – Increase amount if cranes could only use the drives and not crane pads $_____
WC 20 – Increase amount if cranes could only use the drives and not crane pads $_____

TRADE CONTRACT PROPOSAL FORM

WORK CATEGORY NO. 00 and _____ Date: _____

WC 23 – Amount to add vapor barrier at all flooring not passing moisture tests $_____/sf
WC 27 – Increase amount if cranes could only use the drives and not crane pads $_____
WC 28 – Amount carried for connecting and disconnecting power to TCC Trailer $_____

VOLUNTARY ALTERNATIVES (Variations From Materials Specified):
Undersigned proposes the following voluntary alternates for materials and/or equipment specified, it being understood that, should any voluntary alternate(s) be accepted by the Owner, applicable amount(s) hereinafter listed will be added to or deducted from the Base Bid. (No voluntary alternates are required)

1. _____ $ _____ (Add/Deduct)
2. _____ $ _____ (Add/Deduct)
3. _____ $ _____ (Add/Deduct)

SCHEDULE:
The undersigned if awarded a Contract, agrees to work concurrently with the work of other Trade Contractors and the Construction Manager, according to the "Approved Construction Schedule."

BIDDER'S CERTIFICATE:

I hereby certify that all statements herein are made on behalf of

_____
(Name of Corporation, Partnership or Person Submitting a Bid)

A Corporation organized and existing under the laws of the State of _____

An individual doing business as _____

Signature:
Title:
Address:

Phone:
Fax:
Email:

CHRISTMAN
SINCE 1894

Job No. **Work Category:**

** SUBCONTRACT **

This Subcontract (Agreement) is dated , between , , with its principal place of business at 208 N. Capitol Avenue, Lansing, MI 48933-1357 (Christman), and , with its principal place of business at , (Subcontractor). Christman and Subcontractor are collectively called the Parties. The Parties agree:

ARTICLE 1 - PROJECT

Subcontractor shall perform and pay for all of the Work, for the Contract Sum on the following Project known as , located at , , , , for (Owner) in accordance with the documents prepared by (Architect/Engineer).

ARTICLE 2 - CONTRACT SUM

2.1 Contract Sum Subcontractor shall perform the Work for the Contract Sum, subject to adjustment only with Christman's prior written approval for changes in the Work. For the complete, timely, and satisfactory performance of the Work, Christman will pay Subcontractor the Contract Sum, subject to additions or deletions by Change Order, and subject to the terms of the Contract Documents. The Contract Sum shall not be adjusted unless Subcontractor shall have strictly complied with Articles 13 (Changes). Notwithstanding the foregoing, Christman may adjust the Contract Sum by Change Order, without Subcontractor's consent, for backcharges, set offs, or all costs associated with Subcontractor's Default. Subcontractor shall pay for all costs to perform its obligations, even if those costs exceed the Contract Sum.

Sample

Contract Sum: * DOLLARS*****

. Work Category

Total for Subcontract:

2.2 Resource Planning The Contract Sum shall include any material or labor escalation, incidental costs required for the Project, any additional crews, overtime, shift time, and any other resource necessary to meet the Project Schedule, including any revisions or amendments to the Schedule.

2.3 Employer Contributions & Taxes The Contract Sum shall include: (a) all wages, prevailing wages (if required), premiums, payroll taxes, pension, fringe, welfare, vacation, annuity, travel pay, and union or benefit contributions, apprenticeship or industry advancement funds payable in connection with the Work if applicable or as required by Applicable Laws (collectively, Employer Contributions); and (b) all taxes arising out of Subcontractor's furnishing or installing any labor, material and equipment including but not limited to sales, use, personal property, and excise taxes (collectively, Taxes). Before receiving final payment, Subcontractor shall certify that it has paid all Employer Contributions and Taxes.

2.4 Patents & Copyrights The Contract Sum shall include all license fees and royalties for all items, materials, methods, or systems for the Work provided by subcontractor.

2.5 Lump Sum This is a lump sum contract. Subcontractor represents and warrants that it has independently investigated and ascertained the quantity and cost of the Work. The Contract Sum shall not be adjusted for increases in the quantity or cost of labor or materials. Subcontractor assumes exclusive liability for all matters required to be included in the Contract Sum.

ARTICLE 3 - WORK

3.1 The Work Subcontractor shall provide and install all labor, materials, tools, equipment, hoisting, scaffolding, insurance, Taxes, supervision, services, design, and all other items, in the quantities necessary to properly, efficiently and timely prosecute and

complete the Work identified in the Contract Documents and Supplements, except to the extent specifically indicated in the Contract Documents to be the responsibility of another trade (the Work). The Drawings and Specifications describe the general scope of the Project, and as such, they do not necessarily describe all work required for the full performance of the Work. The Parties execute this Agreement on the basis of such documents with the understanding that Subcontractor shall furnish and install all items reasonably implied or inferable by Christman or the Owner from the Contract Documents as required for the proper completion of the Work without adjustment to the Contract Sum. Subcontractor shall perform the Work in strict accordance with the Contract Documents. All workmanship shall be of the highest grade. All materials and equipment shall be new except as provided in the Contract Documents.

ARTICLE 4 - CONTRACT DOCUMENTS

4.1 Contract Documents Subcontractor, and its subcontractors, consultants, laborers and suppliers (collectively, Lower Tiers), shall be bound by the Contract Documents which consist of this Agreement, Exhibits to this Agreement, the agreement between Christman and Owner/Customer (Prime Contract) except as otherwise provided in this Agreement, all documents incorporated in the Prime Contract, the Drawings, Specifications, Addenda, Conditions, and any documents set forth in Supplements, all of which are incorporated herein and made a part of this Agreement, except payment terms of the Prime Contract and except dispute resolution terms of the Prime Contract as they relate to the specific method of final dispute resolution after claim submission, in which case Article 16 (Dispute Resolution) controls. Subcontractor shall perform all Work subject to all terms and conditions, express or implied, in the Contract Documents relating to its Work, it being the intention that Subcontractor will fully, properly and faithfully discharge the obligations of Christman insofar as the Subcontractor's Work.

4.2 Flow Down Subcontractor assumes toward Christman all of the obligations and responsibilities that Christman, by the Contract Documents, assumes toward Owner insofar as the Subcontractor's Work, regardless of whether Owner enforces these obligations against Christman. Subcontractor shall not have any right or remedy against Christman which Christman does not have to or against the Owner under the Contract Documents. Subcontractor shall incorporate the Contract Documents by reference into any agreements with Lower Tiers. By written contract, Subcontractor shall require its Lower Tiers to assume towards Subcontractor and Christman all of the obligations including but not limited to, insurance, indemnity, and defense that Subcontractor, by the Contract Documents, assumes toward Christman insofar as the Subcontractor's Work. If requested by Subcontractor, Christman shall supply Subcontractor with a copy of the Prime Contract with confidential information redacted.

Sample

4.3 Conflicts & Interpretation The Contract Documents are intended to complement each other and shall be so interpreted where possible. If, however, any provision of this Agreement irreconcilably conflicts with another provision of the Contract Documents, the provision imposing the greater duty, greater quality, or more stringent requirement on Subcontractor shall govern. Further, to the extent the Contract Documents give the Architect/Engineer or Owner the right to determine quantities, quality, and other factors relating to the Work, such determinations shall be binding on Subcontractor to the same extent they are binding on Christman.

4.4 Acceptance Subcontractor's signature on this Agreement or the start of any Work shall constitute Subcontractor's acceptance of this Agreement. However, this Agreement is expressly contingent upon Owner approving Subcontractor. Upon Christman's notice to Subcontractor that Owner rejects Subcontractor, Subcontractor shall have 5 days after notice to overcome its disqualification to the satisfaction of Owner, otherwise this Agreement shall be deemed null and void.

ARTICLE 5 - BONDS

5.1 Surety Qualification If Performance and/or Payment bonds are required, Subcontractor shall pay for and deliver such bonds, within 10 days of Christman's request using the form specified by Christman and attached to this Agreement, each in the full amount of this Agreement, issued by a United States (U.S.) Treasury listed surety with an AM Best rating of A or better, approved and licensed to do business in the state where the Project is located (Controlling State), duly executed by agents with complete Power of Attorney to the full limits therein. Christman shall have the right, in its discretion, to reject Subcontractor's bonds and surety and to require replacement of the bonds and/or surety, at Subcontractor's cost, if the surety proposed by Subcontractor does not meet any requirements of this Agreement upon submission. Subcontractor is not permitted any mark up on bond costs and shall present an invoice from its surety to establish the actual cost of any bonds. Subcontractor shall refund to Christman any rebate or refund in bond premiums resulting from adjustment in bonds.

5.2 Changes & Terms Christman shall have the right, without notice to Subcontractor's surety, to order changes in the performance or time of performance of the Work and to modify this Agreement. No extension of time, change, addition, or omission of terms in this Agreement or the Prime Contract shall affect the surety's obligation on the bonds. Subcontractor and its surety waive notice to the surety of any such extension of time, change, addition, or omission. Subcontractor and surety agree without the necessity for any further authorization, to increase the bonds' penal sums if or when additive changes to the Contract Sum are executed. Christman's response to any surety inquiry as to Subcontractor's performance shall not estop or impair Christman's rights under this Agreement or any bond, and surety shall be required to conduct its own independent investigation of Subcontractor's performance.

5.3 Duration Any Performance Bond shall guaranty Subcontractor's performance through the end of any warranty period and any statute of limitation as to surety's obligations under the Performance Bond shall not begin to accrue until the warranty period ends, subject to the requirements of the Prime Contract and as allowable by Applicable Law.

ARTICLE 6 - INSURANCE

6.1 General Obligation Before starting any Work and as a condition precedent to payment, Subcontractor shall maintain insurance in the types, coverages, and for the limits as set forth below, in the Prime Contract, or in Subcontractor's actual policies of insurance, *whichever is greater or requires more*, and shall furnish Certificates of Insurance (COI) evidencing such insurance.

a. Worker's Compensation — Statutory Limit | $1,000,000 Employer's Liability

b. Commercial General Liability (CGL)*
   1) Bodily Injury — $2,000,000 Each Occurrence | $2,000,000 Per Project Aggregate
   2) Property Damage — $2,000,000 Each Occurrence | $2,000,000 Per Project Aggregate

   Subcontracts greater than $3,000,000
   1) Bodily Injury — $5,000,000 Each Occurrence | $5,000,000 Per Project Aggregate
   2) Property Damage — $5,000,000 Each Occurrence | $5,000,000 Per Project Aggregate

   *Coverage shall be occurrence based and shall include products and completed operations, contractual and independent contractors, and where applicable, underground hazard and/or explosion and collapse

c. Comprehensive Automobile Liability
   1) Bodily Injury — $2,000,000 Each Occurrence | $2,000,000 Per Project Aggregate
   2) Property Damage — $2,000,000 Each Occurrence

d. Professional Liability - when the Work includes any design, engineering, or professional services with a deductible and/or self-insured retention, including those relating to defense costs, not in excess of $25,000
   $2,000,000 Each Occurrence | $2,000,000 Per Project Aggregate

Insurance policy limits shall be in the amounts specified above, as required by the Prime Contract, or as specified in Subcontractor's policies, *whichever is greater*. Policy limits may be achieved through a combination of underlying and excess (umbrella) coverage. Unless the Prime Contract provides for insurance by and at the expense of Owner to protect Subcontractor against loss, Subcontractor shall provide for all of its own insurance of every kind.

6.2 Additional Insured Subcontractor shall name the Owner, Architect/Engineer, Christman, and their directors, officers and agents, and any other persons or entities listed in the Prime Contract and Supplements, as additional insureds (AI) on every policy of insurance, except Workers Compensation, including under the completed operations coverage, using AI ISO form Endorsements CG 20 10 07 04 and CG 20 37 07 04, and with respect to the Architect/Engineer, CG 20 32 07 04. All COIs shall include evidence of these endorsements. Insurance covering the AI parties shall be primary and all other insurance carried by any additional insured shall be excess.

Sample

6.3 Qualifications Subcontractor shall provide insurance from insurers with policy holder ratings not lower than "A" and financial ratings not lower than "XI" in the Best's Insurance Guide, latest edition in effect as of the date of the Agreement.

6.4 Duration Subcontractor warrants and represents that for the duration of its Work, and for such longer periods required herein, Subcontractor has and shall maintain the required insurance coverage. Subcontractor shall maintain Products and Completed Operations insurance for a minimum period of the longer of the following: (a) six years after the Project Substantial Completion Date; or (b) the period of the statute of limitation or the statute of repose of the Controlling State; or (c) the duration set forth in the Prime Contract.

6.5 Cancellation Subcontractor shall provide written notice to Christman of the cancellation or expiration of any required insurance within 3 days of the date of the cancellation or expiration or within 3 days Subcontractor is first aware of any notice of cancellation or expiration, whichever comes first. If Subcontractor becomes uninsured, such event shall be deemed a material breach of contract and an immediate Subcontractor Default without notice.

6.6 Subcontractor Property If any loss or damage to Subcontractor's own property occurs, Subcontractor shall look solely to its own insurance for recovery regardless of whether a Builder's Risk policy is in place on the project, and is solely responsible for its deductibles. Subcontractor shall hold harmless and defend Christman and Owner from such loss or damage.

6.7 Deductibles Subcontractor shall be solely and exclusively responsible for any insurance deductibles to the extent arising out of or relating in any way to its Work, including but not limited to claims which could be covered by Builder's Risk insurance.

6.8 Waiver of Subrogation Subcontractor unconditionally waives all of its rights and shall require its insurers and Lower Tiers to unconditionally waive all rights of subrogation against the Owner, Architect/Engineer, Christman, and their parent companies, affiliates, subsidiaries, partners, officers, directors, employees, and agents, and similarly waives all rights of subrogation against all other subcontractors, vendors and suppliers.

Sample

6.9 Vertical Exhaustion Subcontractor's underlying and excess coverage shall be primary and noncontributory to any policy of insurance maintained by any other entity and shall be vertically exhausted first in the order of coverage before any other policy of insurance. Subcontractor's excess policy shall be tied only to Subcontractor's underlying policy and shall not require the exhaustion of limits of policies of any insurance maintained by any other entity before attaching. Further, Subcontractor's excess policy shall not require the exhaustion of underlying limits only through the actual payment by the underlying insurer.

6.10 Lower Tiers Subcontractor shall require, and Subcontractor represents that its Lower Tiers will maintain, the insurance coverages specified in this Article including naming Owner, Architect/Engineer, and Christman, as additional insureds.

ARTICLE 7 - INDEMNITY

7.1 TO THE MAXIMUM EXTENT PERMITTED BY LAW, SUBCONTRACTOR SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS OWNER, ARCHITECT/ENGINEER, CHRISTMAN, AND THEIR OFFICERS, DIRECTORS, EMPLOYEES, AGENTS AND ASSIGNS, AND OTHER ENTITIES IF ANY, THAT CHRISTMAN IS OBLIGATED TO INDEMNIFY BY THE PRIME CONTRACT, (COLLECTIVELY, INDEMNITEES) FROM AND AGAINST ANY AND ALL CLAIMS, ALLEGATIONS, DEMANDS, DAMAGES, COSTS, EXPENSES, PENALTIES, WORK STOPPAGE, ATTORNEY FEES, AND/OR LIABILITIES OF ANY TYPE OR KIND, REGARDLESS OF THE LEGAL THEORY, ARISING OUT OF OR RELATED TO THE WORK (COLLECTIVELY, CLAIMS) INCLUDING BUT NOT LIMITED TO ANY AND ALL CLAIMS: (a) personal injury or property damage or property impairment; (b) defects or omissions in Subcontractor's workmanship or materials provided; (c) Subcontractor's violation of any Applicable Law, regulatory violations, citations or penalties; (d) Subcontractor's breach or failure to perform this Agreement; (e) Subcontractor's use of Christman's equipment or equipment operator and Christman's use of Subcontractor's equipment in accordance with section 10.4; (f) Subcontractor's infringement of any patent, trademark or other proprietary right; (g) claims and/or liens per Article 12; (h) Subcontractor's breach of any representation or warranty; (i) damage to Subcontractor's own equipment and property; (j) Subcontractor's violation of any applicable confidentiality or nondisclosure agreement; (k) Subcontractor's failure to comply with all matters required to be included in the Contract Sum; (l) Subcontractor

substitutions, regardless of whether Christman or Owner consented to the substitution; and, (m) any claim as described in the Prime Contract. **THIS INDEMNITY OBLIGATION COVERS ALL CLAIMS CAUSED BY OR CONTRIBUTED TO, IN WHOLE OR IN PART, ANY ACTIVITY OR INACTIVITY OF SUBCONTRACTOR, ITS LOWER TIERS, AND THEIR OFFICERS, DIRECTORS, EMPLOYEES, OR AGENTS. THIS INDEMNITY APPLIES REGARDLESS OF ANY ACTIVE AND/OR PASSIVE NEGLIGENT ACT OR OMISSION OF INDEMNITEES. SUBCONTRACTOR, HOWEVER, SHALL NOT BE OBLIGATED TO INDEMNIFY AN INDEMNITEE FOR CLAIMS ARISING FROM THE SOLE NEGLIGENCE OF THAT SPECIFIC INDEMNITEE. THE INDEMNITY OBLIGATIONS SHALL NOT BE LIMITED IN ANY WAY BY ANY LIMITATION ON THE AMOUNT OR TYPE OF DAMAGES, COMPENSATION OR BENEFITS PAYABLE BY OR FOR SUBCONTRACTOR UNDER WORKER'S COMPENSATION ACTS, DISABILITY BENEFIT ACTS OR OTHER EMPLOYEE BENEFIT ACTS..**

7.2 Duty to Defend At its cost and with legal counsel reasonably acceptable to Christman, Subcontractor shall defend Indemnitees from any Claims, including those raised in an administrative hearing, arbitration or similar proceeding. The obligation to defend accrues immediately upon receipt of a notice of Claim. If Subcontractor fails to provide timely, competent defense, Christman shall be entitled to reasonable costs associated with assuming such defense, including but not limited to attorney fees and costs incurred to enforce this indemnity and defense provision.

7.3 Notice to Insurer/Surety Subcontractor shall advise its insurers and sureties of these indemnity, defense, and hold harmless and insurance obligations and shall obtain a contractual coverage endorsement to discharge its obligations as set forth herein.

7.4 Consideration The Parties agree that $1,000 of the Contract Sum is part of the consideration for this indemnity obligation. Only in those states where there must be a contractual limit on indemnity obligations, the contractual limit shall be three times the aggregate value of CGL insurance limits required by this Agreement.

Sample

7.5 Survival Subcontractor's indemnity and defense obligations shall survive the termination or expiration of this Agreement and the completion of the Work.

ARTICLE 8 - SAFETY

8.1 Responsibility Subcontractor represents that it has expertise in the particular means and methods required to safely execute the Work and that it maintains a consistently high level of safety and health compliance. At its expense, Subcontractor shall furnish its workers a place of employment free from recognized hazards that cause or are likely to cause serious physical harm. Subcontractor shall protect from injury, its employees engaged in the Work, employees of other trade contractors working adjacent to Subcontractors Work and all property and persons which may be affected by its operations. The prevention of accidents to workers engaged in the Work and others affected by the Work is the responsibility of Subcontractor. Subcontractor shall strictly comply with the Safety Program of Christman and the Owner, and all Applicable Laws. The Subcontractor shall submit to Christman, a current Safety Program and Experience Modification Rates for Subcontractor and Lower Tiers. Subcontractor shall employ all engineering controls, administrative actions, and personal protective equipment to eliminate, and where elimination is not possible, control and reduce worker exposure to hazardous conditions, including but not limited to respirable crystalline silica and asbestos containing material. Subcontractor shall periodically monitor and evaluate its engineering and work practice controls to ensure they are effective and to discover, prevent and detect hazardous conditions. Subcontractor shall furnish Christman copies of Safety Data Sheets for all materials to be used in executing the Work. Subcontractor's foreman/superintendent (Foreman), at a minimum shall have satisfactorily completed OSHA 10-Hour training. The Foreman shall be assigned for the duration of the Project so as to maintain continuity. The Foreman shall speak English and be able to translate into English for non-English speaking workers to facilitate communications and ensure mutual understanding. Subcontractor shall ensure that all non-English speaking workers fully understand the site safety requirements and their duties for safety, health, and welfare. Subcontractor shall immediately correct any unsafe or hazardous condition related to its Work. If Subcontractor fails to immediately correct an unsafe condition, Christman may have the unsafe condition corrected by others at Subcontractor's expense or direct that the Work be stopped in the area of the unsafe condition.

8.2 Hazardous Materials Christman makes no representation or warranty as to conditions described in any hazardous materials

survey. If Subcontractor encounters any hazardous conditions or materials, Subcontractor shall immediately stop Work in the affected area and notify Christman in writing. Subcontractor acknowledges that it is fully apprised of all Applicable Law regarding hazardous conditions or material and that it will be fully responsible for disturbing any hazardous material, including for any and all fines, penalties, or damages assessed against Subcontractor or Christman. If Subcontractor uses hazardous materials on site of any type for which an employer is required by Applicable Laws to notify its employees of such use Subcontractor shall, before using the materials on site, give timely written notice of the materials to Christman. Subcontractor shall immediately correct any unsafe or hazardous condition related to its Work. If Subcontractor fails to immediately correct an unsafe condition, Christman may have the unsafe condition corrected by others at Subcontractor's expense or direct that the Work be stopped in the area of the unsafe condition.

8.3 Notice Subcontractor shall immediately notify Christman and provide Christman with copies of all OSHA citations and accident reports.

8.4 Responsibility Per Article 7, Subcontractor shall bear sole responsibility for any Claims arising out of any breach of, in whole or in part, or failure to comply with this Article, by the Subcontractor or its Lower Tiers, their invitees, or vendors, including any claims arising from regulatory violations, citations or penalties.

ARTCLE 9 - DESIGN SERVICES (If Applicable)

9.1 Design Services If the Work includes any design, engineering or professional services, Subcontractor accepts the design standards, criteria and performance specifications in the Contract Documents and agrees that such data is sufficient for Subcontractor's proper design and functioning of the Work. Christman does not warrant the accuracy or completeness of information in the Contract Documents, however, Subcontractor may rely on these items to the same extent Christman is entitled to rely upon such items in the Prime Contract. Subcontractor agrees that its design services relate to a part of the overall design of the Project and that its design must integrate into the Project's overall design concept expressed, inferred or reasonably implied by the Contract Documents. Subcontractor shall coordinate its Work with the services performed by others. Subcontractor shall submit to Christman detailed drawings and specifications (Work Product) describing the requirements for the Work and showing the relationship of the Work to the overall Project. Subcontractor shall provide Work Product in the form and quantity required by the Contract Documents. Christman shall be entitled to rely upon the adequacy, accuracy and completeness of the services and certifications or approvals performed by Subcontractor and its Lower Tiers. Subcontractor shall perform agreed upon revisions and submit revised Work Product for Christman's review. Subcontractor shall provide written notice to Christman and other affected trades of all design development changes in sufficient time to preclude additional costs and conflicts with the work of others.

Sample

9.2 Design Consultant Subcontractor's engagement of any design consultant shall be subject to Christman's written approval. The consultant's seal shall appear on all drawings, calculations, specifications, certifications, shop drawings and other Work Product prepared by the consultant. All consultants shall be licensed in accordance with Applicable Laws and fully bound to Christman in the same manner as Subcontractor is bound to Christman for all Contract Document requirements applicable to the Work, including all insurance requirements, including professional liability insurance. Subcontractor shall be responsible for the services performed by its consultants.

9.3 Standard of Care Subcontractor's standard of care for all design services shall be the highest care and skill used by members of the design profession practicing under similar conditions at the same time and locality of the Project, or as stated in the Prime Contract, whichever imposes the higher standard of care.

ARTICLE 10 - EXECUTION OF THE WORK

10.1 Project Investigation Subcontractor assumes responsibility for all Project investigation as related to its Work. Subcontractor represents that it has carefully inspected the Project site. Subcontractor represents that it is familiar with, has satisfied itself as to, and assumes all risk of: (a) the nature, location, and amount of the Work; (b) site conditions and access; (c) ability to perform the Work in accordance with the Project Schedule and Contract Documents; (d) any Applicable Laws and inspection requirements; (e) all safety and barricade requirements; (f) the terms and conditions of applicable collective bargaining agreements, to the extent applicable; (g) the quality, quantity, and availability of labor, materials, equipment, and utilities; and, (h) the limiting physical, climatic, and other conditions. Subcontractor is not relying on any opinion or representation of Christman as to Project conditions.

Subcontractor shall be solely responsible for all cost, expense and damage that may result from Subcontractor's failure to perform or properly perform such investigations including its failure to properly notify Christman and obtain written approval before proceeding with related Work.

10.2 Document Investigation Subcontractor warrants that it has thoroughly reviewed and fully acquainted itself with the Contract Documents and that the Contract Documents are suitable and sufficient for their intended purposes, without any express or implied representation or warranty having been made as to their accuracy, consistency, adequacy, completeness or constructability. Subcontractor shall give written notice to Christman of any error, inconsistency, ambiguity or omission in the Contract Documents within the earlier of 3 days after Subcontractor first becomes aware of the error, or 3 days before the time Christman is required to make such claims to the Owner under the Prime Contract. Subcontractor shall not be excused from any provision of the Contract Documents due to a lack of knowledge or understanding of their content. Christman disclaims any and all warranties, express or implied, as to the accuracy or adequacy of the plans, specifications, design, or other Contract Documents. Subcontractor shall make no claim based upon such disclaimed warranties.

10.3 Qualifications Subcontractor represents and warrants at all times it shall obtain and maintain all necessary credentials, certifications, licenses and other qualifications to do business and safely perform the Work. Subcontractor's obligation to perform the Work is non-delegable and nontransferable. Subcontractor shall be solely responsible for determining, supervising and implementing the means, methods, techniques, sequences, procedures and inspections of its Work. Christman shall not be responsible for the direction, supervision, inspection, quantity or quality of Subcontractor's Work.

10.4 Progress & Cooperation Subcontractor shall furnish sufficient equipment, tools and materials and a sufficient number of properly skilled workers to carry on the Work and conduct its activities in a manner and at a rate of performance in all respects satisfactory to Christman and the Owner and in a manner that will not interfere with, disrupt or delay the activities of Christman, the Owner, or others involved in the Project. Subcontractor shall erect, maintain, inspect and operate all of its equipment including but not limited to scaffolding, hoists, and material handling equipment in accordance with Applicable Laws. Subcontractor shall not unreasonably refuse Christman's use of Subcontractor equipment. If Christman utilizes Subcontractor's equipment, Christman shall not be liable to Subcontractor for the erection, maintenance or inspection of any such equipment, except to the extent Christman has assumed such obligations under written agreement with Subcontractor, and any such use by Christman shall be done in strict accordance with equipment manufacturer's instructions. Any Christman employee engaged in such use has all the necessary and requisite training to operate such equipment. Subcontractor shall cooperate with Christman and others involved in the Project, including those that Subcontractor's schedule may affect, to avoid any conflict and to ensure a first class workmanlike job in every respect. Subcontractor shall maintain good order among its employees and others and not permit upon the Project any disorderly, intemperate, or unfit person or anyone unskilled in performing the Work. At all times Subcontractor shall have a competent person with authority available to act on its behalf. Subcontractor shall provide all technical personnel required to startup, test, commission, and operate any equipment, and to test and use any material, supplies, or other items provided by Subcontractor in connection with the Work and to instruct Christman and Owner's personnel in the operation and maintenance of any equipment, materials, supplies, or other items. Subcontractor shall not perform any work directly for Owner or any Owner tenant or deal directly with the Owner's representatives in connection with the Project.

Sample

10.5 Shop Inspection The Owner, Architect/Engineer, Christman, and their representatives, shall have full access at reasonable hours to Subcontractor's Work and its Lower Tier's shops, factories, or other places of business to inspect the general condition and progress of the Work.

10.6 Submittals Within the time directed by Christman and without delay, Subcontractor shall furnish all mock ups, submittals, shop drawings, product data, specifications, samples, interim design submissions if applicable, electronic data or similar items (Work Product). By submitting such Work Product, Subcontractor represents that it has verified materials, field measurements, and field construction criteria related thereto, or will do so, and has checked and coordinated the information in its Work Product with the requirements of the Contract Documents. If Subcontractor's Work Product is rejected after a reasonable number of reviews, Christman may backcharge Subcontractor for the actual costs to continue review and process the rejected Work Product. Subcontractor waives any claim arising out of Subcontractor's failure to comply with this requirement. Christman's review of Work Product shall be limited to conformance with general design and general detailing and Christman need not verify dimensions or field

conditions. Subcontractor shall not make any substitutions in the Work, unless it first requests in writing permission for a substitution by expressly identifying the item or method substituted, as a "Substitution" and then only upon receipt of Christman's written consent to such substitution. Christman or Owner's review or consent of any Work or Work Product, shall not relieve Subcontractor from its responsibility for any deficiency that may exist or from its obligation to perform the Work in strict accordance with the Contract Documents.

10.7 Layout Subcontractor shall be solely responsible for the layout, accuracy, and workmanship of its Work. Before starting its Work, Subcontractor shall examine the work of others affecting its Work and verify all dimensions set forth in the Contract Documents as they pertain to or may affect Subcontractor's Work. If any defect, conflict, or inconsistency exists, Subcontractor shall immediately notify Christman in writing. Subcontractor shall not proceed until the defect is corrected or Christman provides written authorization to proceed. If Subcontractor fails to inspect or give written notice, Subcontractor shall be deemed to have accepted the work of others as fit and proper to receive Subcontractor's Work and waives any claim as to the defects. Subcontractor is responsible for all corrective work.

10.8 Compliance Subcontractor shall obtain and pay for all necessary permits, licenses, assessments and inspections, and comply with all statutes, ordinances, rules, regulations and orders of any governmental or quasi-governmental authority applicable to the Work (Applicable Laws) including: any LEED building, sustainable construction means, methods or requirements, or energy performance requirements, including those in the Contract Documents; local, state or federal safety and health laws and regulations, including those related to hazardous materials, such as crystalline silica; local, state or federal fair employment practices laws, affirmative action programs, minority contracting programs, business ethics and compliance; rules and regulations of any Contract Compliance Division of the state and federal Civil Rights Commission or any similar commission having jurisdiction; all immigration laws, rules and regulations, including I-9 verification and E-verify; Buy American provisions; and, Davis Bacon and/or state prevailing wage requirements. At Christman's request, Subcontractor shall certify to Christman's satisfaction that its employees have presented the correct documents to legally work in the U.S. Subcontractor shall immediately correct any violations of Applicable Laws.

Sample

10.9 Protecting the Work Subcontractor shall protect all Work, tools, material and equipment against any loss, damage or theft (Loss). At its sole risk, Subcontractor shall bear any Loss to its Work arising from any cause until Substantial Completion as defined in the Prime Contract, or such duration required by the Prime Contract, whichever is greater. Subcontractor is responsible for any Loss to existing property, structures, materials or equipment, the Work, the work of others, and property of Owner and adjacent land owners, utilities, roads, bridges, and waterways, arising out of Subcontractor's operations. Subcontractor shall repair or replace such items to the satisfaction of and at no cost to Christman. If Subcontractor refuses or fails to repair, replace, or correct the Loss, at Christman's sole election, Subcontractor shall accept a deduction in Contract Sum to the extent of the cost incurred by Christman or demanded by Owner. If a dispute arises between Subcontractor and another trade as to which is responsible for any Loss, Christman may determine the responsibility for such Loss and its determination shall be final and binding upon Subcontractor. Christman may backcharge Subcontractor the reasonable actual costs to investigate and respond to such claims.

10.10 Christman Tools & Equipment Subcontractor is responsible for all unloading, moving, lifting, protection, securing, and handling of its materials and equipment at the job site. In consideration of Christman's permission to use any tools or equipment of any nature whatsoever, including but not limited to elevators, hoists, derricks, cranes, side tracks, and yards, Subcontractor contractually assumes complete risk, responsibility, and liability for the use or operation of such equipment, and for any Claim arising in any manner because of Subcontractor's use or operation of tools and equipment or use of same for Subcontractor's benefit, irrespective of who actually operated the tools and equipment.

10.11 Clean Up Subcontractor shall at all times keep the Project and Owner's premises, adjoining premises, and streets clear of rubbish, debris, overspray and similar items resulting from its Work and shall remove all such rubbish at its own expense, as directed by Christman. Subcontractor shall maintain broom clean conditions at the end of each day. Christman shall designate the location of all dumpsters. Subcontractor shall not dispose of any hazardous waste or waste requiring special manifests in these dumpsters. If Subcontractor fails to clean the site to the satisfaction of Christman and/or the Owner upon 24 hours' notice (except where such condition creates a safety concern, and in that case, without notice) then Christman may do so and backcharge Subcontractor the actual cost of cleanup.

10.12 Labor Relations Subcontractor shall only use labor which will not cause disharmony or labor disputes in the performance at the Project. Subcontractor shall implement policies and practices to avoid work stoppages, slowdowns, disputes, and strikes. Subcontractor shall notify Christman promptly of any actual or potential dispute that may affect the Work. Subcontractor guarantees that there shall be no strike, lock-out or other work slowdown affecting its Work or the work of others. Subcontractor represents that it has the legally binding agreement of all bargaining representatives of any part of its workforce (or before beginning Work will obtain such agreement), that the represented workers will not strike, picket, engage in any slow-down or other concerted activity where Work is performed, and will cross and work behind any picket line at the job site, regardless of by whom. If Subcontractor's workers are involved in a dispute with other trades on the Project, or any union, or such workers refuse work due to any labor disputes, Subcontractor shall immediately resolve the disputes. Failure to do so shall be a material breach of this Agreement. If a labor condition threatens the timely completion of any portion of the Work, Christman may, at its option, terminate Subcontractor's right to proceed with Work for Default or employ others to perform the affected Work and backcharge Subcontractor the cost thereof. Notwithstanding the foregoing, Subcontractor shall not be liable for strikes, work stoppages, jurisdictional disputes, lockouts, union and non-union disputes and other similar claims or conflicts ("Labor Issues") except to the extent such Labor Issues are caused, in whole or in part, by the actions or inactions of Subcontractor or anyone else for whom Subcontractor is responsible.

10.13 Meetings Subcontractor shall attend any project meetings as directed by Christman. Subcontractor shall be represented by its Project Manager or Senior Representative responsible for the Project and its Site Supervision. Subcontractor shall attend an on-site pre-installation meeting before beginning any Work. Christman will maintain and distribute to attendees minutes of the meetings for review. Subcontractor shall review the minutes and provide written notice of any objections within 3 days after issuance of the minutes; failure to do so shall be deemed Subcontractor's acceptance without reservation of the content of the minutes.

Sample

10.14 Material Delivery & Installation Space for storage on the Project site may be limited. Subcontractor shall schedule material deliveries accounting for the limited storage or lay down area and to coincide with construction phasing. Subcontractor shall coordinate its access, deliveries, staging, trailers, storage areas and parking in advance, and as approved by Christman's superintendent before Subcontractor's mobilization on site. If Subcontractor's Work includes installation of materials or equipment furnished by others, Subcontractor shall examine the items with due care and install the items with such skill and care as to ensure a satisfactory and proper installation and to preserve all warranties. All material and equipment delivered to the job site or off site and in the process of fabrication shall become the property of the Owner and shall not be removed from the site or damaged in any way.

10.15 Cutting & Patching Unless otherwise directed in writing by Christman, Subcontractor shall do all cutting, fitting, and patching of its Work that may be required to make its several parts come together properly and to fit it to receive or be received by work of others.

10.16 Employment Practices Subcontractor shall not discriminate against any person with respect to his/her hire, tenure, terms, conditions or privileges of employment because of race, color, age, sex, religion, sexual orientation, the presence of a physical, sensory or mental disability, or national origin. Subcontractor shall comply with any and all Applicable Laws as to fair employment practices and other employment programs required by the Contract Documents.

10.17 Conduct Subcontractor and its Lower Tiers shall not engage in any harassment or offensive behavior. Christman strictly prohibits any request to engage in illegal or unethical conduct and negative comments or actions based on race, color, age, sex, religion, sexual orientation, physical, sensory or mental disability, or national origin. Subcontractor shall immediately address any claim of harassment or offensive behavior involving it or its Lower Tiers, properly discipline any person who engaged in such conduct, including removal from the Project where appropriate, and use its best efforts to ensure that such conduct does not reoccur. In its sole judgment, Christman shall have the right to cause removal from the Project any worker who engages in unsafe work practices or violates this Article.

10.18 Recordkeeping Subcontractor shall keep full and detailed accounts and exercise such controls as may be necessary for proper financial management, using accounting and control systems in accordance with generally accepted accounting principles.

During the Work and for a period of 3 years after final payment, Christman and/or Owner and their accountants shall be afforded access to and the right to periodically audit, upon reasonable notice, Subcontractor's records, books, receipts, subcontracts, purchase orders, man hours and equipment hours, and other data relating to the Work, all of which Subcontractor shall preserve for 3 years, or such longer period as specified in the Prime Contract.

10.19 Operation Manuals Upon approval of shop drawings and Submittals, Subcontractor shall provide an electronic copy (unless some other form is specified in the Prime Contract) of Operation and Maintenance Manuals for each item approved, as applicable.

ARTICLE 11 - WARRANTY

11.1 Warranty Subcontractor warrants that the Work shall strictly conform to the requirements of the Contract Documents and shall be free from defects in design, workmanship, and materials. Subcontractor shall promptly correct any defective or nonconforming Work, by (at Christman's exclusive option) adjustment, repair, or replacement to the satisfaction of Christman and Owner. Subcontractor shall pay all costs associated with accessing the Work to make warranty repairs and returning the Work and all affected surrounding work to the condition required by the Contract Documents. If Christman determines that Subcontractor is not timely completing its warranty obligation, Christman may replace or repair, at its sole election, and backcharge Subcontractor all associated costs. If no sums remain due Subcontractor, Subcontractor shall pay Christman all those costs immediately upon demand.

11.2 Duration The Subcontractor shall provide a one (1) year warranty from the actual Project "Substantial Completion Date" on all material, equipment and workmanship, or the warranty duration specified in the Contract Documents, whichever is longer. For any portion of the Work repaired or replaced, Subcontractor shall provide an additional one (1) year, or longer if the Contract Documents require, warranty on the Work after the date of repair or replacement.

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11.3 Statutory Warranty Nothing in this Article shall limit the rights afforded to Christman and Owner under Applicable Law as to Subcontractor's warranty against defects in design, workmanship and materials or defective or non-conforming Work, nor shall this Article limit any statutory period of liability for warranty, design, and latent defects.

ARTICLE 12 - PAYMENT

12.1 Schedule of Values Subcontractor shall submit all payment, insurance and other compliance documents through Christman's Trade Contractor Portal. Within the time required by Christman, Subcontractor shall submit for review, through the Trade Contractor Portal, a detailed schedule of values (SOV) on AIA Form G703 or equivalent. The SOV shall be itemized into discrete items and areas of Work and include labor and material breakdowns for each work item, general conditions, mobilization, demobilization, punch list, and administrative close out, with no less than 5% designated for close out. For any allocation for mobilization, there must be an equal allocation for demobilization. To the extent practicable and subject to Christman's approval, the SOV shall not contain a single line item greater than 5% of the Contract Sum. Christman shall have the right to require modification at any time of the SOV to align with proper allocation of scopes of work and distribution of resources. Christman will not process a payment application until Subcontractor revises or corrects the SOV to account for imbalance, errors or irregularities.

12.2 Conditions To the extent permitted by Applicable Laws, for Subcontractor's complete, timely, and satisfactory performance of the Work, Christman will pay Subcontractor out of such equivalent payment Christman receives from Owner for Subcontractor's Work. Christman will pay Subcontractor within 7 days after Christman receives Owner's payment, less retainage held by Owner or Christman. To the extent permitted by Applicable Laws, Christman's receipt of Owner's payment is an absolute condition precedent to Christman's obligation to pay Subcontractor. If Christman has furnished a payment or performance bond, the obligations of Christman and its surety to make progress payments or final payment is subject to the absolute condition precedent of Owner prior payment. Christman's surety is a third party beneficiary of this condition precedent. Christman's payment to Subcontractor shall not be construed as an admission by Christman of the classification, quantity, quality, or sufficiency of Work done, or as an acceptance or release of Subcontractor's responsibility under this Agreement. Also to the extent permitted by Applicable Law, as an absolute condition precedent to Christman's obligation to pay Subcontractor and using Christman's Trade Contractor Portal, Subcontractor shall timely furnish with each payment request: (a) a satisfactory sworn statement sworn by an officer of Subcontractor; (b) conditional waivers of lien from Subcontractor and its Lower Tiers for the current payment application; (c)

unconditional waivers of lien or bond claims by Subcontractor and its Lower Tiers reflecting Christman's previous payments; (d) payrolls and, if required by the Prime Contract, weekly certified payrolls in compliance with Applicable Laws; and (e) any other information or documents reasonably requested by Christman. The form and content of all submissions shall be satisfactory to Christman. Sworn statements must include a complete and accurate list of all Lower Tiers including equipment lessors and any entity entitled to assert a lien or bond claim.

12.3 Process On the date of the month specified by Christman, Subcontractor shall submit a payment application in the form and manner specified by Christman, detailing costs accrued and percent of Work complete, through the time period of the month specified by Christman. Subcontractor's determination of percentage of work complete is subject to the approval of Christman, Owner, and/or Architect. Any application not timely submitted may not be included in Christman's payment application to Owner. Subcontractor shall not request payment for any Work for which it does not intend to promptly pay its Lower Tiers. Payment for all materials stored offsite is solely at Christman's discretion.

12.4 Cost Reimbursable Items If Subcontractor is entitled to reimbursement of any costs incurred for the Work (Reimbursable Costs), such as approved Change Order work, payment of Reimbursable Costs shall be made in accordance with cost reimbursement terms of the Prime Contract, or in the absence of such terms, in accordance with this Agreement. Subcontractor shall maintain, in a manner and quality satisfactory to Christman, accounting records for Reimbursable Costs, including, without limitation, Lower Tier invoices, material receiving reports, segregated cost data, payrolls, labor hours, equipment hours, and other documentation necessary to fully substantiate each Reimbursable Cost. These records shall be subject to audit by Christman, the Owner or their designated representatives.

12.5 Joint Payment Subcontractor authorizes Christman to communicate with Subcontractor's Lower Tiers on payment issues and to make payment via joint check to any Lower Tier if, in Christman's sole discretion, Christman determines that joint checks are necessary or appropriate. Subcontractor gives this authorization without the need for any further joint-check arrangement. Christman's payment by joint check shall be deemed to be made directly to Subcontractor. Christman may issue a joint check for the amount shown on Subcontractor's Sworn Statement as due to Lower Tiers, less any setoffs, backcharges, warranty work, or other deductions to which Christman may be entitled. Subcontractor waives any claim against Christman for any errors that may arise out of a joint check payment and accepts responsibility for the validity any endorsements of any joint check. Christman's right to pay by joint check does not create any obligation to do so, and no joint check payee or third party shall have third party beneficiary or other rights to demand joint payment.

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12.6 Removal of Claims Provided Christman has paid Subcontractor in accordance with this Agreement, within 3 days of Christman's written request, Subcontractor shall cause to be discharged any Lower Tier lien or bond claim related to the Work. If Subcontractor fails to do so, Christman, at its sole discretion, may use whatever means necessary to remove such suit, claim or lien and backcharge Subcontractor the cost of so doing. Subcontractor shall be responsible for any costs, including attorney fees, litigation costs, and consultant fees that Christman incurs in removing or attempting to remove such suit, claim or lien, plus a markup of 20% for administrative and overhead expenses (Contractor Markup). If Owner or Christman receive any lien, bond claim or notice of intent to file, Christman may withhold the full amount of such claim, plus Contractor Markup pending adjustment. If Subcontractor defaults in payment of its debts on the Project, Christman shall have the right to pay such debts and charge them to Subcontractor. If Christman determines, in its sole discretion, that the balance of the Contract Sum then remaining unpaid will not be sufficient to complete the Work in accordance with the Contract Documents, no additional payments will be due Subcontractor unless Subcontractor, at no cost to Christman, performs, and pays in full for, a sufficient portion of the Work such that the balance of the Contract Sum then remaining, as determined by Christman, is sufficient to complete the Work.

12.7 Trust Fund Subcontractor shall hold each payment from Christman in trust to satisfy all indebtedness to Lower Tiers first, before paying any other indebtedness of the Subcontractor.

12.8 Withholding Christman may withhold payment to Subcontractor or set off any payment for any of the following reasons: (a) failure to remedy defective Work or perform clean-up; (b) off-site fabrication not meeting production quotas or quality standards; (c) Subcontractor has damaged any portion of its Work or the work of others; (d) claims, levies, liens, attachments, stop notices or court orders or reasonable evidence indicating probable filing of such claims, including unpaid insurance claims arising out of the

Work; (e) allegations that Subcontractor has not timely paid employees or Lower Tiers or Subcontractor fails to produce proof requested by Christman of such payments; (f) there exists reasonable doubt in Christman's sole discretion that the Work can be completed for the unpaid balance of the Contract Sum or within the Project Schedule; (g) unsatisfactory prosecution of the Work; (h) failure to deliver current insurance certificates, bonds, submittals, shop drawings, SOVs, "as built" drawings, written guarantees or warranties, or the approvals required of the Work by any authority having jurisdiction; (i) Christman is exposed to an Owner claim for liquidated damages arising in whole or in part from the Work; (j) a petition for bankruptcy or reorganization is filed by or against Subcontractor or Subcontractor has made an assignment without Christman's prior written consent; (k) Subcontractor is unlicensed or its license is invalid or lapsed; (l) any violation of Applicable Laws; (m) Subcontractor expresses an intent to repudiate the Agreement or reduce its work force, equipment, or materials; and (n) any circumstance that would constitute a Subcontractor Default, even if Christman has not declared a Subcontractor Default.

12.9 Contract Balance Subject to the absolute conditions precedent in this Article and Applicable Laws, the balance of the Contract Sum (Contract Balance) is defined as that amount payable to Subcontractor after Christman exercises any right to withhold or offset the Contract Sum. The Contract Balance does not include pending or disputed change order work. No Subcontractor surety bond shall alter this definition or prevent Christman's exercise of the right to withhold or setoff before making any Contract Balance available to surety under any bond.

12.10 Final Payment As an absolute condition precedent to Christman's obligation to make final payment of the Contract Balance to Subcontractor, Subcontractor shall submit to Christman: (a) an affidavit to Christman's satisfaction that Subcontractor has paid all indebtedness connected with the Work; (b) consent of surety, if required by Christman; (c) satisfaction of required closeout procedures and documentation; (d) receipts, releases, and waivers of lien and/or bonds in the form designated by Christman or Owner and other satisfactory evidence that there are no liens, bond claims, or other indebtedness related to the Work; and (e) Subcontractor's written Warranty. Upon Subcontractor's satisfaction of this condition precedent, after Subcontractor's application for final payment, and after Owner's acceptance of and payment for all Work, Christman shall pay the Contract Balance to Subcontractor. If Owner asserts a claim for, or assesses and retains against Christman any liquidated damages, Christman's payments to Subcontractor shall be reduced to the extent such assessment is attributable to Subcontractor. Subcontractor shall not assert a claim for retention until Owner's assessment of liquidated damages is finally resolved. Subcontractor's acceptance of final payment shall be deemed a final waiver of all claims of any nature against the Owner and Christman, but shall not relieve Subcontractor of liability for indemnity and warranty obligations, or for faulty or defective work appearing before or after final payment. To the extent permissible by Applicable Laws, all payments, including final payment, shall be out of such equivalent payments Christman receives from the Owner. Christman's receipt of such payments is an absolute condition precedent to payment to Subcontractor.

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ARTICLE 13 - CHANGES AND EXTRA WORK

13.1 Changes Without invalidating this Agreement, Christman may make any changes by altering, adding to, or reducing the extent and/or scope of the Work, including the deletion of any major items of work to be completed. Except as provided below, no change in the extent or scope of such Work shall be made except by a Change Order signed by Christman. The charge or credit for any such changes shall be determined, at Christman's option, by any of the following methods: (a) agreed upon lump sum price; (b) unit prices named in this Agreement or subsequently agreed upon in writing; or (c) time and material. Subcontractor shall submit for approval a quotation covering any change in the Work which affects the Contract Sum. The quotation shall contain a detailed itemization of costs and shall identify any impact on the Project Schedule, Subcontractor's progress of the Work, milestone dates, and/or the Substantial Completion date. Subcontractor shall submit its quotation within 7 days' of receipt of notification of the change, or such shorter time as Christman directs. If the Parties cannot agree about whether there exists a change in the Work or cannot agree on the amount of the addition or deletion, to maintain the Project Schedule, pending final resolution of the Change Order, Subcontractor shall nonetheless timely perform the Work as changed by Christman's written direction and proceed in accordance with Article 13.4.

13.2 Written Authorization Subcontractor shall not perform any changes or additional work except upon Christman's prior written direction. If Subcontractor proceeds without such written authority, Subcontractor expressly waives any and all claims for additional payment. No oral or other claimed waiver of the requirement of prior written authority shall be binding. An increase in the Contract Sum by virtue of such change shall not occur until a Change Order has been issued and signed by Christman and

Subcontractor, and, for Owner or Architect initiated changes, Owner has signed a Change Order. Any adjustment in the Contract Sum, Project Schedule or other provisions as set forth in each Change Order shall operate as an Accord and Satisfaction and shall constitute the full, final and complete compensation to Subcontractor for the entire cost and schedule effect related to the stated changes and the cumulative impact and effect resulting from the stated changes on all prior Work and prior changes in the Work. Subcontractor waives any claims for any other additional compensation, damages or time extensions in connection with the stated changes. The Contract Sum may be equitably adjusted by Christman by written Change Order or directive issued by Christman, with or without Subcontractor's consent, for reasonable backcharges and adjustments to the Contract Sum permitted under this Agreement.

13.3 Signature With the exception of backcharges, all Change Orders must be approved and signed either by Christman's representative who executed this Agreement or another representative on the same or higher level of authority. No changes to the Agreement may be made or agreed to by any field personnel. Email, texts, or other electronic means of communications shall not be sufficient to establish a Change Order. Field representatives may not authorize or sign for changes in the Work or additional work and do not have any authority to agree to or approve changes. Superintendents may sign time tickets for the sole purpose of documenting time on the Project; under no circumstances shall such signature be deemed to accept or authorize additional work or otherwise obligate Christman to pay for such work, notwithstanding any language on Subcontractor's time ticket or other documentation to the contrary.

13.4 Claims If Subcontractor intends to assert any claim for additional compensation or schedule extension, as an absolute condition precedent to such claim, Subcontractor's notice and claim shall strictly conform to Articles 14 and 15.

ARTICLE 14 - TIME

14.1 Schedule Time is of the essence. Within the time specified by Christman, Subcontractor shall provide Christman with scheduling information and a proposed schedule for performing the Work which shall include a projection of labor hours and crew sizes, all in forms acceptable to Christman. Subcontractor's proposed schedule shall conform to the Project Schedule and all revisions or changes made to the Project Schedule from time-to-time. Subcontractor shall maintain the specified rate of progress for its Work and shall complete the Work on or before the dates set by Christman for Subcontractor's Work. Subcontractor shall perform the Work in a prompt and diligent manner without delaying or hindering the work of others. The Project Schedule is not a representation by Christman that Subcontractor will be able to perform its activities on certain dates. Subcontractor acknowledges that as construction progresses it may be necessary for Christman to change the sequential order and duration of activities to account for unanticipated delays, occurrences, and other factors that alter Christman's schedule. Christman may require Subcontractor, at no additional cost to Christman, to prosecute the Work in such sequence as the progress of other trades and the Project Schedule reasonably dictate. Scheduling may require temporary omission of the Work at locations determined by Christman. All patches, fill-in and "come back" work for the proper completion of the Work shall be included in the Contract Sum. Subcontractor expressly agrees that the reasonable scheduling and sequencing of the Work is Christman's exclusive right and that Christman reserves the right to reasonably reschedule and re-sequence the Work from time to time as the demands of the Project require without additional cost or expense to be paid to Subcontractor. Christman's exercise of any rights or remedies under this Agreement, including ordering changes in the Work, directing suspension, rescheduling or correction of the Work, regardless of the extent or frequency of Christman's exercise of such rights or remedies shall not be construed as active or unreasonable interference with Subcontractor's performance of the Work.

14.2 Failure to Progress If Subcontractor delays or disrupts the progress of any work, Subcontractor shall, at its own cost and expense, take such action as Christman deems necessary or appropriate to improve Subcontractor's rate of progress, including, but not limited to, increasing the number of superintendents, foemen, skilled and unskilled labor, increasing the number of crews and or shifts, employing more or better equipment, working overtime, expediting delivery of materials, changing sequence of performance, prosecuting parts of the Work in preference to other parts, and any other increase or acceleration effort to avoid or mitigate delays. Subcontractor shall be subject to liquidated or other damages on the basis stated in the Prime Contract if Subcontractor causes or contributes, in whole or in part, to any delay, even if concurrent, which would allow the Owner to assess liquidated or other damages against Christman. Regardless of whether liquidated damages are specified, Subcontractor shall be liable to Christman for any loss, damage or liability of Christman, caused in whole or in part by delays, disruptions or other reasons attributable to Subcontractor.

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14.3 Cure If Subcontractor fails to correct, replace and/or re-execute faulty or defective Work or materials, fails to maintain the progress of its Work in a timely and proper manner and with such effort, speed and diligence to maintain the Project Schedule, current revisions of milestone dates, interim completion dates, activity durations, or otherwise fails to facilitate the orderly progress of the Project, or is unable to proceed with the Work because of any labor dispute, then Christman, upon 48 hours' notice to Subcontractor, shall have the right to correct, replace and/or re-execute such faulty, defective, damaged or delayed work, or to supplement Subcontractor's crews, or to take over this Agreement with all materials of the Subcontractor on the site and complete the remaining Work, charging such cost to Subcontractor. Under such circumstances, Christman shall also have the right to withhold payments to Subcontractor until Subcontractor pays Christman in full for such costs.

14.4 Time Extension If, without fault or cause by Subcontractor, Subcontractor's performance is delayed, and provided that such delay is not concurrent with a delay caused by Subcontractor, Subcontractor may request an extension of time for performance, but shall not be entitled to any increase in the Contract Sum, any additional compensation, damages for schedule compression, acceleration, stacking, or loss of labor/equipment productivity, or consequential damages, as a result of such delays, such extension of time for performance being Subcontractor's sole and exclusive remedy for any schedule or delay related claim. Notwithstanding the foregoing, Christman will cooperate with Subcontractor in submitting to Owner any just claim arising from delay which is permitted by the Contract Documents and by applicable law.

14.5 Claims Any claim for a time extension shall strictly comply with the Claim provisions in Article 15.

ARTICLE 15 - CLAIMS

15.1 Owner Claims For any claim by Subcontractor seeking payment of money or a schedule extension because of any act, failure to act, default or interference by the Owner and/or the Architect, and/or their respective subcontractor or suppliers, the Subcontractor shall carefully observe all terms and conditions of the Prime Contract relating to claims and shall give Christman timely written notice of such claim in the form required by the Prime Contract. Subcontractor shall specifically label the notice a "Notice of Claim." Unless expressly prohibited by Applicable Laws, Subcontractor shall provide such notice, no later than 5 days before the time Christman is required to make such claim to the Owner under the Prime Contract, or within 5 days of the beginning of the event giving rise to the claim, whichever is earlier. Subcontractor shall not claim any time extension, cost reimbursement, compensation, or damages for any delay, disruption, or interference except to the extent that Christman is entitled to a corresponding time extension, cost reimbursement, compensation, or damages from Owner under the Contract Documents and Applicable Laws. Subcontractor shall be solely responsible for all attorneys' fees, costs, and expenses (Pursuit Costs) Christman incurs in submitting such claim and shall reimburse Christman on a monthly basis for Pursuit Costs. Subcontractor's recovery shall be limited to the amount, if any, that Christman actually receives from Owner for Subcontractor's claim. To the extent permitted by Applicable Laws, Owner's payment to Christman for such claim shall be an express condition precedent to Christman's duty of payment to Subcontractor.

15.2 Contractor Claims For any claim by Subcontractor against Christman seeking payment of money or a schedule extension or other relief with respect to the terms of this Agreement because of any claimed act, failure to act, default or interference by Christman or Christman's other subcontractors, Subcontractor shall give Christman written notice no later than 5 days from the beginning of the event giving rise to the claim. Such notice shall be specifically labeled a "Notice of Claim" and served in accordance with 15.5.

15.3 Claim Substantiation For all claims, within 14 days of providing a timely Notice of Claim, Subcontractor shall provide Christman with: (a) detailed actual cost records supporting the claim and identifying the actual discrete costs attributable to the claim; (b) an affidavit under oath by an officer of Subcontractor certifying and stating (a) the specific relief sought; if money is sought, the specific dollar amount sought; (b) that the actual discrete costs claimed are true and correct. The affidavit must contain or attach sufficient supporting documentation to reasonably allow its consideration, including without limitation, any documentation required by the Contract Documents.

15.4 Claim Calculation Subcontractor agrees that the total cost approach of calculating damages, or variations thereof (collectively, TCA) or any other method of calculating claims through estimating based upon the measured mile analysis (MMA),

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earned value analysis (EVA), or the use of industry standards, is inherently unreliable and uncertain. Therefore, Subcontractor waives any damages based on the TCA, MMA, or EVA, and/or any claim based on estimated costs or industry guidelines such as the Mechanical Contractors Association of America, the National Electrical Contractors Association, or any other organization. As an absolute condition precedent to any claim, claims must be based upon a discrete actual costs analysis supported by contemporaneously (daily) documented actual costs properly allocated to the claim. Subcontractor waives any claim not contemporaneously documented and properly allocated. If Christman receives Subcontractor daily time reports, such receipt shall be deemed solely for documentation purposes and not as an admission of quantity, validity or liability of a claim.

15.5 Delivery of Notice For all claims, Subcontractor shall provide written notice via certified or registered mail to the address on page 1 of this Agreement. **EMAIL OR FACSIMILE OF A NOTICE OF CLAIM IS PROHIBITTED AND IS INSUFFICIENT TO ESTABLISH NOTICE.**

15.6 Strict Compliance Subcontractor's strict compliance with all claim requirements (timely notice, form, substantiation, calculation and delivery) is a strict and absolute condition precedent to any claim and the failure to adhere to any one of these requirements is an absolute defense to the claim. Subcontractor waives any claim that does not strictly comply with Article 15 and Christman shall not be liable to Subcontractor on any claim not timely or properly presented. Christman's actual or constructive notice of a claim shall not satisfy or excuse Subcontractor from strict compliance nor prevent Subcontractor's waiver of the claim. If Subcontractor does not strictly comply with this Article or if Christman cannot in good faith certify or submit Subcontractor's Owner Related Dispute to Owner, Christman is not obligated to do so.

ARTICLE 16 - DISPUTE RESOLUTION

16.1 Owner Related Disputes In case of any dispute between Christman and Subcontractor, which in Christman's sole opinion is in any way related to or arising from any act or omission of the Owner or Architect/Engineer, (Owner Related Dispute), Subcontractor shall be bound to Christman to the same extent that Christman is bound to Owner by the Contract Documents and by any and all preliminary and final decisions, determinations or agreements made by Christman and Owner or so authorized in the Contract Documents or by the court or arbitrator designated in the Contract Documents whether or not Subcontractor is a party to such agreement or proceeding. Subcontractor shall stay any and all legal actions against Christman or its surety until a final non-appealable decision has been obtained from or against the Owner as to the Owner Related Dispute. Christman and its surety shall not be liable to Subcontractor in excess of any sum actually received from Owner for Subcontractor's Owner Related Dispute. Unless expressly prohibited by Applicable Laws, Christman's receipt of payment from the Owner for Subcontractor's Owner Related Dispute is a strict condition precedent to Christman's and its surety's obligation to pay Subcontractor.

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16.2 All Other Disputes All disputes arising out of or relating to this Agreement or any performance or payment bonds furnished by either party shall first be resolved in the following order: (1) by a meeting of the project management on site, within 7 days of the date a party requests such meeting; (2) if that fails, by a meeting of the principals in charge for each Party within 10 days following the project management site meeting; (3) if that fails, within 30 days after the principals in charge meeting, by mediation where the Parties select a mediator, the costs of which shall be shared equally. All disputes and claims that are not disposed of as provided herein shall be resolved by submission to the state or federal court whose district includes the county where the Project is located (Controlling Venue). The Controlling Venue is the exclusive venue for any claim and litigation may only be filed in that county. Subcontractor consents to personal jurisdiction in any court whose jurisdiction includes the Controlling County. **The Parties waive their right to a trial by jury and acknowledges that they have had the opportunity to seek the advice of legal counsel before waiving this right**.

16.3 No Stop Work Pending the resolution of any dispute, Subcontractor, without waiver of its other rights and remedies, shall not stop work or reduce its labor force, equipment, or progress, and shall diligently proceed with the Work.

ARTICLE 17 - DEFAULT AND TERMINATION

17.1 Adequate Assurance If at any time Christman deems in its sole discretion, that there are reasonable grounds of insecurity as to Subcontractor's ability to properly and timely perform, Christman may give Subcontractor written demand for adequate assurance of performance. Subcontractor shall provide such assurance, reasonably acceptable to Christman, within 10 days after Subcontractor's receipt of written demand.

17.2 Subcontractor Default Any of the following shall be considered a Subcontractor Default: (a) default in the performance of any requirement of this Agreement or the Prime Contract insofar as the Work; (b) failure to provide a sufficient crew of skilled workers and proper quantity and quality of equipment and materials as and when required; (c) failure to maintain the progress of its Work in a timely and proper manner and with such effort, speed and diligence to maintain the Project Schedule, current revisions of milestone dates, interim completion dates, activity durations, or otherwise failing to facilitate the orderly progress of the Project as a whole; (d) reduction in work force, equipment or materials, or abandonment of portions of the Work; (e) interference with the performance of others on the Project; (f) failure to timely pay any Employer Contributions, labor employed by Subcontractor, or any Lower Tiers; (g) failure to pay or to maintain satisfactory credit relationships for the purchase of labor, supplies, materials, equipment, and services; (h) repudiation or anticipatory repudiation of all or part of the Agreement; (i) failure to provide adequate assurance of timely performance; (j) failure to timely remedy any defects in Work; or (k) failure to perform in strict accordance with Christman's safety requirements.

17.3 Notice to Cure / Remedies If Subcontractor commits a Default and fails to commence and continue satisfactory correction of the Default within 48 hours after receipt of a written Notice of Default, then Christman, at its option, and in its sole discretion, and without prejudice to any other right or remedy, shall have the immediate right to any or all of the following remedies: (a) supplement Subcontractor's Work; (b) enter on the site of the Work and take possession of, for the purpose of completing the Work, Subcontractor's material; (c) employ any other person or persons to finish the Work; (d) provide materials or equipment to complete the Work; (e) terminate Subcontractor and/or Subcontractor's right to proceed; or (f) take whatever other or additional steps Christman deems, in its sole discretion, are in the best interests of Christman or the Project. Notwithstanding the terms of any surety bond to the contrary, Christman shall have the absolute right to exercise any remedy at the cost of Subcontractor or its sureties and shall have the right to enforce any bond right if Subcontractor is declared in Default, during Subcontractor's attempted cure of Default, and/or during surety's investigation of Default. Christman's exercise of any remedy shall not be deemed to impair, prejudice, extinguish, or otherwise diminish any obligation of Subcontractor's surety, nor shall it impair, prejudice, extinguish or diminish the rights of Christman under any such bond.

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17.4 Assignment If Christman elects in writing, in its sole discretion, and effective only upon Christman's termination of Subcontractor's right to proceed, Subcontractor shall assign to Christman any Lower Tier contract for the Work. Subcontractor shall include provisions in its Lower Tier contracts for such assignment without further consent of such Lower Tiers.

17.5 Set Off Christman shall be entitled to recover from Subcontractor and its sureties (as applicable), all expenses, damages, and liabilities Christman incurs as a result of a Default including the cost of labor and materials to complete the Work, acceleration costs incurred in performing the work or engaging others to perform the Work, costs paid to other subcontractors, additional supervision, consultant fees, attorney's fees, and liquidated damages, plus Contractor Markup (collectively, Default Damages). Christman shall have the immediate right to offset or deduct the Default Damages from any money due or to become due to Subcontractor and thereby reduce any unpaid balance of the Contract Sum, notwithstanding any term in a surety bond to the contrary. Subcontractor and its sureties shall remain liable to Christman for Default Damages as they continue to accrue, without waiver of or prejudice to any other right, remedy or claim Christman may have. If a Default occurs, Subcontractor shall not be entitled to any further payment until Owner finally accepts the Work, and until after Christman offsets or deducts Default Damages. If the Default Damages exceed the unpaid balance of the Contract Sum, then Subcontractor and/or its surety shall pay the difference to Christman. If it is determined, by litigation, arbitration or otherwise, that any remedy exercised by Christman, including a termination for Default, was unjustified, such remedy or termination shall be deemed for convenience and Subcontractor's remedies shall be limited to those provided for as a termination for convenience.

17.6 Termination for Convenience Christman may terminate this Agreement for convenience by written notice to Subcontractor for any reason provided in the Prime Contract or within Christman's sole discretion. If a Termination for Convenience occurs, Christman shall only be obligated to pay Subcontractor, as otherwise provided for and in accordance with the terms of this Agreement, and as Subcontractor's sole and exclusive remedy: (a) that portion of the cost of the Work allocable to the portion of the Project satisfactorily performed by Subcontractor before the effective date of termination, plus reasonable overhead and profit on such work; and (b) demobilization costs as properly substantiated by proof acceptable to Christman. Under no circumstances shall Subcontractor be entitled to recover for profit and overhead on work not performed before the notice of termination for

convenience.

ARTICLE 18 - MISCELLANEOUS

18.1 Calendar Day All references in this Agreement to days shall mean calendar days.

18.2 Assignment Subcontractor shall not assign or subcontract this Agreement or any portion thereof, nor assign any payment, claims or rights under this Agreement to any third party without Christman's prior written consent. Consent will not be given to any proposed agreement that would relieve the Subcontractor or its surety of their responsibilities under this Agreement. Christman may assign this Agreement to its surety, joint venture partner, an affiliate, or other third party. Christman may also assign this Agreement to Owner, its designated assignee, or lender, in accordance with the terms of the Prime Contract or Owner's loan documents associated with the Project.

18.3 Ownership of Work Product Subcontractor grants to Christman and the Owner if required by the Prime Contract, all ownership and property interests in all Subcontractor Work Product. To the extent Subcontractor Work Product includes or otherwise utilizes trade secrets, copyrighted materials or other similarly protected intellectual property, Subcontractor grants to Christman a license for the use of such Work Product solely and exclusively for the Project.

18.4 Data Ownership & Confidentiality Engineering, architectural, or other information provided pursuant to this Agreement is the property of Christman (or the Owner if so provided in the Prime Contract) and is not to be reproduced or disclosed to others or used for other purposes without Christman's written permission. All information about the Project. Christman's systems, processes, procedures, and other operations, and the Owner's systems, processes, procedures, and business operations shall be kept strictly confidential by Subcontractor and its Lower Tiers unless otherwise prohibited by Applicable Laws or to the extent exceptions are permitted by written approval from Christman. If confidential information is disclosed by Subcontractor or its Lower Tiers, Subcontractor shall immediately notify Christman of the unauthorized disclosure and details pertaining to what was disclosed, to whom and when the disclosure occurred. Subcontractor shall be responsible to Christman and to the extent applicable in the Prime Contract, to the Owner for any unauthorized disclosure.

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18.5 E-Data Except as to a Notice of Claim, the parties may exchange and execute records in electronic form. Christman disclaims any representation or warranty as to the functionality of the software or computer program associated with electronic transmission of records. Christman disclaims any warranty, express or implied, including the warranty of fitness for a particular purpose, as to the information transmitted in electronic form.

18.6 Integration This Agreement including incorporated documents is the entire agreement between the Parties, supersedes and cancels any prior written or verbal agreements, and constitutes the only agreement between the Parties for the Work and the Project. Except for Christman backcharges to Subcontractor, no terms of this Agreement or the nature and extent of the Work shall be waived, modified, reduced, or enlarged, except in writing signed by both Parties. No additional or contrary term in any Subcontractor document related to this Agreement is binding on Christman.

18.7 Controlling Law This Agreement is governed by the law of the Controlling State and to the extent applicable, all federal laws, rules and regulations. The term "State" includes all 50 states, the District of Columbia, Puerto Rico, and any other unincorporated territory of the U.S.

18.8 Independent Contractor Subcontractor shall be deemed to be an independent contractor fully responsible for the means, methods and safety measures and procedures utilized fulfilling the scope of services or terms of this Agreement. Under no circumstances shall the Subcontractor be deemed to be an employee or joint venturer with Christman.

18.9 Authority Subcontractor affirms that its signatory to this Agreement is an authorized agent of Subcontractor, with full authority to enter into this Agreement on behalf of Subcontractor. This Agreement may be executed electronically and a copy of a signed Agreement may be exchanged via email in which case signatures shall be deemed binding for all purposes and an original signature is not required.

18.10 Severability If any portion of this Agreement is deemed invalid or unenforceable, such term may be severed from this Agreement and the remainder of the Agreement shall be valid and enforceable to the fullest extent permitted by law.

18.11 Work Before Signing Subcontractor's liabilities and obligations to Christman hereunder shall apply to all the Work, even Work that may have been performed before the date of this Agreement pursuant to prior negotiations, representations, agreements, understandings or otherwise. Notwithstanding a later signing of this Agreement by Christman or Subcontractor, this Agreement is deemed effective on the date Subcontractor first commences any Work.

18.12 Enforcement Christman's failure to insist in any one or more instances on Subcontractor's performance of any term or condition of this Agreement, or failure to exercise any of its rights, shall not constitute waiver or relinquishment of such term, condition, or right as to further performance or Christman's right to enforce any term or condition. Christman's waiver of any term, condition, or rights shall be made in writing and such written waiver shall not be deemed a waiver of any other term or condition.

ARTICLE 19 - EXHIBITS

The following Exhibits, whether attached hereto or not, are incorporated by reference.

Exhibit I	Supplement A
Exhibit II	Christman's Safety Program
Exhibit III	Payment & Performance Bonds
Exhibit IV	Supplement B, if applicable

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[SIGNATURE PAGE TO FOLLOW]

ACCEPTANCE

The said parties, for themselves, their heirs, successors, executors, and administrators and assignees, do hereby agree to the full performance and covenants contained herein.

By signing below these parties affirm that they are each authorized agents of their respective organizations, with full rights and privileges to enter into this Agreement on behalf of those respective organizations. This Agreement may be executed by facsimile signature, or a copy of a signed Agreement may be delivered via email by either party and such signature will be deemed binding for all purposes hereof without delivery of an original signature being thereafter required.

Signature	Signature
Print Name	Print Name
Title	Title
Date	Date

Sample

SUBCONTRACTOR PAYMENT BOND

BOND NUMBER: _____

SUBCONTRACTOR: _____
Address: _____

SURETY: (or Sureties) _____
Address: _____
Phone Number: _____
Email: _____

CONTRACTOR: **THE CHRISTMAN COMPANY**
Address: 208 N. Capitol Avenue, Lansing, MI 48933

PROJECT: _____

SUBCONTRACT DATE: _____

CONTRACT AMOUNT: $ _____

BOND AMOUNT: _____ Dollars
($)

Contractor has entered into a Subcontract or Purchase Order (Agreement) with Subcontractor in the amount stated above (Contract Amount) for the Project for the performance of work, including warranty obligations (Work), as detailed in the Agreement. That Agreement is incorporated by reference in its entirety into this Bond.

By virtue of this Bond, Subcontractor and Surety are held and firmly bound to Contractor to pay for labor, materials, and equipment (collectively, "Improvements") furnished for use in performing the Work and agree to bind themselves and their respective heirs, administrators, executors, successors and permitted assigns, jointly and severally, firmly as follows:

1. **Payment Made** If Subcontractor promptly pays all sums due Claimants and defends, indemnifies and holds harmless Contractor from claims, demands, liens or suits by any person or entity seeking payment for Improvements furnished for use in performing the Work, then Subcontractor and Surety shall have no obligation under the Bond.

2. **Surety Obligation to Contractor** Surety's obligations to Contractor shall arise after Contractor notifies Surety and Subcontractor in writing of claims, demands, liens or suits against Contractor or the real property upon which the Project is located, by any person or entity seeking payment for Improvements. Upon such notice, Surety shall promptly, and at Surety's expense, defend, indemnify and hold Contractor harmless from such claim, demand, lien or suit.

3. **Surety Obligation to Claimant** Every Claimant who has not been paid in full before the expiration of ninety (90) days after Claimant provided or performed the last of the Work, or furnished the last of the Improvements for which the claim is made, may have a right of action on this Bond. The Surety's obligation shall not exceed the Bond Sum, as modified.

4. **Limitation of Action** Claimant shall not commence any suit or action on this Bond:

   a. Unless Claimant, except a Claimant having a direct contract with Subcontractor, shall have given written notice of non-payment to Subcontractor, Contractor and Surety within ninety (90) days after Claimant last performed or furnished the Improvements for which the claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom Claimant provided the Improvements. Claimant shall serve such notice to the addresses set forth in this Bond. And, after the expiration of one (1) year from the date when Claimant last performed or provided Improvements to the Project. If this provision is prohibited by law, the minimum period of limitation available to surety in the jurisdiction shall apply; and,
   b. Other than in any court of competent jurisdiction in the location where the Project is located.

5. **Contractor Notice** Contractor's written notice to Subcontractor and Surety of Claimant's claim, served by Contractor to the addresses set forth in this Bond, shall be sufficient to satisfy Claimant's obligation in paragraph 4(a) to furnish notice. Contractor's notice in the form of email with delivery or read-receipt verification shall be sufficient written notice. Notwithstanding the foregoing, Contractor shall have no affirmative obligation to Claimant, Subcontractor or Surety to provide notice on behalf of Claimant.

SUBCONTRACTOR PAYMENT BOND

BOND NUMBER: _____

6. **Surety Response** When the conditions of paragraph 4(a) are satisfied, Surety shall promptly, and at Surety's expense, take the following actions:

   a. Provide a written response to Claimant, with a copy to Subcontractor, within forty-five (45) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and,
   b. Pay any undisputed amounts.

7. **Claimant** Claimant means an individual or entity having a direct contract with Subcontractor, or with a subcontractor or vendor of the Subcontractor, to provide Improvements. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located.

8. **Improvements** The intent of this Bond shall be to include, without limitation, in the terms "Improvements" and "labor, materials, or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in performing the Work, architectural, engineering, and consulting services required for the work of the Subcontractor and the Subcontractor's subcontractors, and all other items for which a mechanic's lien may be asserted.

9. **Principal Surety** Surety is the principal surety and its obligations under this Bond shall be deemed primary to any bond procured by Contractor, with Contractor's surety being deemed a sub-surety.

10. **Changes** Surety agrees that no change, extension of time, alteration, addition, deletion, amendment, or other modification of the Agreement or the Prime Contract between Contractor and the Project owner, or both, or in the Work, specifications, drawings, whether material or otherwise, or in the manner, time or amount of payment as provided therein, and whether or not made in the manner as provided therein, shall in any way affect Surety's obligations on this Bond, except that the Bond Sum shall increase directly with any additive amendments to the Agreement. Surety hereby waives notice of any changes, extensions of time, alterations, additions, deletions, amendments, and other modifications to the Agreement.

Subcontractor and Surety cause this Bond to be duly executed and acknowledged as set forth below, on this day of _____.

SUBCONTRACTOR
Company:

_____
By:
Its:

SURETY
Company:

_____
By:
Its: Attorney in Fact

(Impress Corporate Seal)

SUBCONTRACTOR PERFORMANCE BOND

BOND NUMBER: _____

SUBCONTRACTOR: _____
Address: _____
As Principal (the Principal), and

SURETY: (or Sureties) _____
Address: _____
Phone Number: _____
Email: _____
As Surety or Co-Sureties (collectively, Surety), and

CONTRACTOR: **THE CHRISTMAN COMPANY**
Address: 208 N. Capitol Avenue, Lansing, MI 48933
As Obligee (Obligee)

PROJECT: _____

SUBCONTRACT DATE: _____

CONTRACT AMOUNT: $ _____

BOND AMOUNT (Penal Sum): Dollars _____
($)

WHEREAS, Principal has by written agreement entered into a Subcontract Agreement or Purchase Order (Agreement) with Obligee in the amount stated above (Contract Amount) for the performance of work, including warranty obligations (Work), as detailed in the Agreement, which Agreement in its entirety is by reference expressly incorporated into this Bond.

WHEREAS, the amount of this Bond (Penal Sum) is in the amount stated above.

NOW THEREFORE, Principal and Surety are held and firmly bound to Obligee for the payment of the Penal Sum and agree to bind themselves and their respective heirs, administrators, executors, successors and permitted assigns, jointly and severally, firmly as follows:

1. If Principal shall promptly and faithfully perform the Agreement within the time provided therein, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

2. Surety agrees that no change, extension of time, alteration, addition, deletion, amendment, or other modification of the Agreement or the Prime Contract between Obligee and the Project owner, or both, or in the Work, specifications, drawings, whether material or otherwise, or in the manner, time or amount of payment as provided therein, and whether or not made in the manner as provided therein, shall in any way affect Surety's obligations on this Bond, except that the Penal Sum of this Bond shall increase directly with any additive amendments to the Agreement provided the additive change(s) do not, either singly or in the aggregate, exceed 20% of the original Contract Amount. If any change singly or in the aggregate exceeds 20% of the original Contract Amount, Obligee shall obtain Surety's written consent to increase the Penal Sum. Surety hereby waives notice of any changes, extensions of time, alterations, additions, deletions, amendments, and other modifications to the Agreement.

3. Whenever Obligee has declared Principal to be in default of the Agreement, Surety shall, within twenty (20) calendar days of receipt of Obligee's declaration of default (Investigation Period), respond as follows, failure of

which shall be a material breach of this Bond:

a. Determine the amount for which Surety may be liable and tender the amount to Obligee; or,

b. Notify Obligee that Surety has elected to complete the Work itself or through its agents or contractors in accordance with the terms and conditions of the Agreement, in a manner acceptable to Obligee, and thereafter promptly begin the Work; or,

c. Obtain bids or offers from replacement subcontractors (Completing Subcontractor), reasonably acceptable to Obligee, to complete the Agreement in accordance with its terms and conditions, and upon determination by Surety and Obligee jointly of the lowest responsible bidder or offeror, arrange for new performance and payment bonds from the Completing Subcontractor in a form and from a surety as required by the Agreement, all of which must be completed before expiration of the Investigation Period. Upon execution of the agreement between Completing Contractor and Obligee, Surety shall pay to Obligee, within five (5) days of execution, the difference between the cost to complete the Work and the Contract Balance; or,

d. Arrange to provide financial and/or other assistance to the Principal (Financing) to assist the Principal with timely completion of the Agreement. This option is subject to Obligee's concurrence, which concurrence may be withheld in Obligee's sole discretion.

e. Having made an independent assessment of the facts and circumstances of Obligee's declaration of default, deny Surety's liability in whole or in part and provide a detailed explanation of the reasons for its denial, specifying amounts that are disputed and undisputed. Surety shall tender payment of any undisputed amount.

4. Surety may request an extension of up to twenty (20) calendar days (Extension Period) to respond as required by the Bond. Surety shall finance performance of the Work during the Extension Period on a schedule and in a manner acceptable to Obligee. Upon expiration of the Extension Period, Surety shall respond as outlined in paragraph 3.

5. Upon declaration that Principal is in default, Obligee shall have the right, but not the obligation, to immediately proceed to perform or correct the Work and take such other action pursuant to its rights under the Agreement to mitigate the damages caused by Principal's default (Mitigation Work). Obligee's overhead (both field and home office) and profit shall be included in the cost of the Mitigation Work at a markup of 20% to the actual labor, material, equipment, and subcontractor costs Obligee incurs. Obligee shall keep Surety reasonably informed of costs incurred for the Mitigation Work. Obligee shall be entitled to deduct the cost of the Mitigation Work from the Contract Balance. To the extent Obligee's cost of the Mitigation Work exceeds the Contract Balance, Surety shall, as the Work progresses, promptly and without deduction, reimburse Obligee for such shortage. Reimbursement by Surety shall reduce the Penal Sum by the amount of Surety's reimbursement to Obligee.

6. The term Contract Balance means the Contract Amount, as adjusted by any amendments to the Agreement issued before declaration of default, less the amount paid by Obligee to Principal or others in accordance with the Agreement, less amounts to which Obligee is entitled to a setoff under the Agreement, and less any other amounts for which the Principal or Surety is liable under the Bond or Agreement.

7. Surety shall be liable for:

a. Principal's responsibilities for correcting defective work, warranty work, latent defects, indemnity, and completion of the Work.

b. Legal, design professional and delay costs resulting or arising from Principal's default, or resulting or arising from the actions or failure to act of the Surety under paragraph 3 herein,

SUBCONTRACTOR PERFORMANCE BOND

BOND NUMBER: _____

and liquidated damages, or if no liquidated damages are specified in the Agreement, and actual damages caused by delayed performance or non-performance of the Principal.

c. Principal's responsibilities for damages and set-offs in accordance with the Agreement.

8. If Surety elects to act under paragraph 3, Surety's liability is limited to Penal Sum, as adjusted pursuant to paragraph 2 above. Notwithstanding the foregoing, Surety shall reimburse Obligee for Obligee's reasonable attorney fees and costs, which shall not be credited against the Penal Sum, from disputes arising from this Bond.

9. Neither Surety's payments for Work performed before Obligee's declaration of default, nor Surety's payments to Claimants as defined in any payment bond issued by Surety as a companion payment bond to this Bond, shall be credited against the Penal Sum of this Bond.

10. All Information Obligee provides to Surety, whether before or after Surety issues the Bond, is provided by Obligee voluntarily as a matter of courtesy and is merely an expression of opinion. Furnishing such information is not a guaranty or warranty of the accuracy or correctness and no responsibility or liability is assumed by Obligee as a result of providing such information to Surety. Surety shall not rely on such information in any manner and waives and releases Obligee and Obligee's surety from any such claims.

11. Surety shall not be liable to Obligee for obligations of the Principal that are unrelated to the Agreement.

12. If this Bond has been furnished to comply with a statutory requirement in the location of the Project, any provision in this Bond conflicting with the statutory requirement shall be deemed deleted and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

13. No right or action shall accrue on this Bond to or for the use of any person or corporation other than Obligee or its heirs, executors, administrators, assigns or successors.

Principal and Surety cause this Bond to be duly executed and acknowledged as set forth below, on this day of _____.

SUBCONTRACTOR AS PRINCIPAL	**SURETY**
Company:	Company:
_____	_____
By:	By:
Its:	Its: Attorney in Fact

(Impress Corporate Seal)

AFFIDAVIT OF BIDDER

The undersigned, the owner or authorized officer of _____(the "Bidder), pursuant to the familial disclosure requirement provided in the _____(the "School District") advertisement for construction bids, hereby represent and warrant, except as provided below, that no familial relationships exist between the owner(s) or any employee of _____and any member of the Board of Education of the School District or the Superintendent of the School District.

List any Familial Relationships:

BIDDER:

_____

By: _____

Its: _____

STATE OF MICHIGAN)
)ss.
COUNTY OF _____)

This instrument was acknowledged before me on the _____ day of _____, 20___, by

_____.

_____

, Notary Public

_____ County, Michigan

My Commission Expires: _____

Acting in the County of: _____

AFFIDAVIT OF BIDDER

The undersigned, the owner or authorized officer of _____(the "Bidder), pursuant to the familial disclosure requirement provided in the _____(the "School District") advertisement for construction bids, hereby represent and warrant, except as provided below, that no familial relationships exist between the owner(s) or any employee of C2AE Architects and or The Christman Company.

List any Familial Relationships:

BIDDER:

_____

By: _____

Its: _____

STATE OF MICHIGAN)
)ss.
COUNTY OF _____)

This instrument was acknowledged before me on the _____ day of _____, 20___, by

_____.

_____

, Notary Public

_____ County, Michigan

My Commission Expires: _____

Acting in the County of: _____

NON-DISCRIMINATION IN EMPLOYMENT CERTIFICATION

Lansing School District
Certificate of Intent to Comply with
"NON-DISCRIMINATION IN EMPLOYMENT" POLICY

I have read Lansing School District's Policy #3310, including paragraph #13 and hereby state my intent to comply with the terms and conditions contained therein. Further I agree to furnish the Michigan Civil Rights Commission with such data and records concerning employment as may be requested by that agency in determining compliance with the policy.

Print or type name of Contact Person:

Signed: _____

_____

Title: _____

Company: _____

Date: _____

AFFIDAVIT OF BIDDER - NON-COLLUSION

Lansing School District
AFFIDAVIT OF BIDDER
SWORN STATEMENT
"Non-Collusion"

DATE: _____

The Bidder, by its officers and agents or representatives, present at the time of filing this bid, being duly sworn, on their oaths, say that neither they nor any of them, have in any way, directly or indirectly, entered into any arrangement or agreement with any other Bidder, whereby such affiant or affiants or either of them has paid or is to pay to such other Bidder any sum of money, or has given, or is to give, to such other Bidder anything of value whatever, or such affiant or affiants or either of them has not, directly or indirectly, entered into any arrangement or agreement with any other Bidder or Bidders, which tends to or does lessen or destroy free competition in the letting of the Contract sought for by the attached bids; that no inducement of any form or character other than that which appears upon the face of the bid, will be suggested, offered, paid or delivered to any person whomsoever to influence the acceptance of the said bid or awarding of the Contract, nor has this Bidder any agreement or understanding of any kind whatsoever, with any person whomsoever to pay, deliver to, or share with any other person in any way or manner, any of the proceeds of the Contract sought by this bid.

IN TESTIMONY WHEREOF, the Bidder (an authorized individual) has agrees to the above:

_____
(Company Name)

By: _____
(Authorized Signer)

_____
Print or type Name and Title of Signer

Address:_____

Notary Public:_____

Subscribed and sworn to before me on this _____ day of _____, 2016

County of:_____ My Commission expires: _____

Telephone number: _____

IRAN ECONOMIC SANCTIONS ACT CERTIFICATE

In accordance with the Iran Economic Sanctions Act, Michigan 2012 PA 517, effective April 1, 2013, (MCL 129.311, *et seq.*), (the "Act"), the undersigned certifies in support of its bid or proposal that it is not an Iran linked business as such is defined in the Act.

Contractor:_____

By:_____

Dated: _____

Name:_____

Title:_____

Act No. 517
Public Acts of 2012
Approved by the Governor
December 28, 2012
Filed with the Secretary of State
December 28, 2012
EFFECTIVE DATE: April 1, 2013

STATE OF MICHIGAN
96TH LEGISLATURE
REGULAR SESSION OF 2012

Introduced by Senators Kahn, Marleau, Brandenburg, Anderson, Green and Booher

ENROLLED SENATE BILL No. 1024

AN ACT to prohibit persons who have certain economic relationships with Iran from submitting bids on requests for proposals with this state, political subdivisions of this state, and other public entities; to require bidders for certain public contracts to submit certification of eligibility with the bid; to require reports; and to provide for sanctions for false certification.

The People of the State of Michigan enact:

Sec. 1. This act shall be known and may be cited as the "Iran economic sanctions act".

Sec. 2. As used in this act:

(a) "Energy sector of Iran" means activities to develop petroleum or natural gas resources or nuclear power in Iran.

(b) "Investment" means 1 or more of the following:

(*i*) A commitment or contribution of funds or property.

(*ii*) A loan or other extension of credit.

(*iii*) The entry into or renewal of a contract for goods or services.

(c) "Investment activity" means 1 or more of the following:

(*i*) A person who has an investment of $20,000,000.00 or more in the energy sector of Iran.

(*ii*) A financial institution that extends $20,000,000.00 or more in credit to another person, for 45 days or more, if that person will use the credit for investment in the energy sector of Iran.

(d) "Iran" means any agency or instrumentality of Iran.

(e) "Iran linked business" means either of the following:

(*i*) A person engaging in investment activities in the energy sector of Iran, including a person that provides oil or liquefied natural gas tankers or products used to construct or maintain pipelines used to transport oil or liquefied natural gas for the energy sector of Iran.

(*ii*) A financial institution that extends credit to another person, if that person will use the credit to engage in investment activities in the energy sector of Iran.

(f) "Person" means any of the following:

(*i*) An individual, corporation, company, limited liability company, business association, partnership, society, trust, or any other nongovernmental entity, organization, or group.

(*ii*) Any governmental entity or instrumentality of a government, including a multilateral development institution, as defined in section 1701(c)(3) of the international financial institutional act, 22 USC 262r(c)(3).

(*iii*) Any successor, subunit, parent company, or subsidiary of, or company under common ownership or control with, any entity described in subparagraph (*i*) or (*ii*).

(g) "Public entity" means this state or an agency or authority of this state, school district, community college district, intermediate school district, city, village, township, county, public authority, or public airport authority.

Sec. 3. (1) Beginning April 1, 2013, an Iran linked business is not eligible to submit a bid on a request for proposal with a public entity.

(2) Beginning April 1, 2013, a public entity shall require a person that submits a bid on a request for proposal with the public entity to certify that it is not an Iran linked business.

Sec. 4. If a public entity determines, using credible information available to the public, that a person has submitted a false certification under section 3(2), the public entity shall provide the person with written notice of its determination and of the intent not to enter into or renew a contract with the person. The notice shall include information on how to contest the determination and specify that the person may become eligible for a future contract with the public entity if the person ceases the activities that cause it to be an Iran linked business. The person shall have 90 days following receipt of the notice to respond in writing and to demonstrate that the determination of false certification was made in error. If a person does not make that demonstration within 90 days after receipt of the notice, the public entity may terminate any existing contract and shall report the name of the person to the attorney general together with information supporting the determination.

Sec. 5. The attorney general may bring a civil action against any person reported under section 4. If a civil action results in a finding that the person submitted a false certification, the person is responsible for a civil penalty of not more than $250,000.00 or 2 times the amount of the contract or proposed contract for which the false certification was made, whichever is greater, the cost of the public entity's investigation, and reasonable attorney fees, in addition to the fine. A person who submitted a false certification shall be ineligible to bid on a request for proposal for 3 years from the date the public entity determines that the person has submitted the false certification.

Sec. 6. The provisions of this act are effective only if Iran is a state sponsor of terror as defined under section 2 of the divestment from terror act, 2008 PA 234, MCL 129.292.

Enacting section 1. This act takes effect April 1, 2013.

This act is ordered to take immediate effect.

Carol Morey Viventi

Secretary of the Senate

Gary E Randall

Clerk of the House of Representatives

LEGAL STATUS OF BIDDER

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS. The Vendor and/or Bidder certifies to the best of its knowledge and belief that it and its principals: Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency; Have not within a three-year period preceding this agreement been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of federal or state antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property; Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offences enumerated above in this certification; and Have not within a three-year period preceding this agreement had one or more public transactions (Federal, State, or local) terminated for cause or default; is not now or has been, within a three-year period preceding this date, been listed on the Excluded Parties List System website (EPLS).

Vendor/contractor will notify the Lansing School District Purchasing Office immediately upon becoming suspended or debarred if there is any current or ongoing contract or agreement in place between the district and the vendor/contractor.

Firm Name: _____

Address: _____

Phone & E-mail: _____

Name, title and signature of individual duly authorized to execute contracts:

The Owner, Principal, or Corporate Office of the responding firm is also attesting that all the information provided within this response is true.

Name: _____

Title: _____

Signature: _____

A Corporation organized and existing under the laws of the

State of ____

CHRISTMAN
SINCE 1894

Trade Contractor Guarantee

Project: Mt. Hope
Job No.:
Owner: Lansing School District
A/E: C2AE
Date:

Trade Contractor: (company)
(address)
(city, state)

Work Category No.: (wc) (wcdescription)

We, the undersigned, hereby guarantee that all work accomplished and materials provided under the above-named contract or subcontract is in accordance with the terms of the contract documents as prepared by The Christman Company and the Architect/Engineer, including all addenda, change orders, and clarifications issued.

All work under the above-named contract or subcontract shall be guaranteed against defective material and workmanship for a period of **two (2)** year after **(appropriate date)**; correction of any deficiencies or defective work developing during this period shall be undertaken within three (3) working days following the receipt of notice by The Christman Company or Owner; and such work shall be made good by this trade contractor or sub-trade contractor at his own expense.

The following extended guarantees are a part of this contract or subcontract and shall be guaranteed as specifically described in the contract documents and as follows, but not limited to:

Trade Contractor: _____
By: _____
Signature: _____
Address: _____
_____
Telephone: _____
Fax: _____

DATE: Monday, November 28, 2022

PROJECT: Mt. Hope School

OWNER: Lansing School District

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

Attached project specific version of AIA A201-2017 as modified. All references to the “Standard form of General Conditions” are hereinafter used in these specifications shall refer to the above documents.

END OF SECTION

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

2022 Bond Issue Construction as identified in the preliminary qualification of bonds application # SBL/33-020-4-K12-28-01, in accordance with the Owner-approved plans and specifications, all applicable laws, the Owner's fixed budget, and as otherwise approved by the Owner.

THE OWNER:
(Name, legal status and address)

Lansing School District
519 West Kalamazoo Street
Lansing, Michigan 48933
Telephone Number: (517) 755-1000

THE ARCHITECT:
(Name, legal status and address)

C2AE
106 West Allegan Street, Suite 500
Lansing, MI 48933

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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User Notes: (1798464555)

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the ~~Agreement,~~ Agreement in writing, the Contract Documents ~~do not~~ also include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, accepted portions of the Contractor's bid or proposal, ~~or~~ and portions of Addenda relating to bidding or proposal requirements. The Contractor's execution of the Owner/Contractor Agreement and the Architect's execution of the Owner/Architect Agreement shall constitute their respective acceptance of all provisions of the Drawings, Addenda, and all Contract Documents as of the revision applicable to the date of such signature.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate the Contractor's performance of ~~the Architect's~~ its duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions or interpretations, as applicable, on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.1.9 The term "Product(s)" as used in the Contract Documents refers to the materials, systems and equipment provided by the Contractor for use in the work of the Project.

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§ 1.1.10 The terms "Warranty" and "Guarantee" as uscd in the Contract Documents shall have the same meaning and shall be defined as "legally enforceable assurance of satisfactory performance or quality of a product or Work," but in all events subject to the terms and qualifications of the Contract Documents.

§ 1.1.11 Where materials, systems and equipment items are referred to in the singular, such reference shall not serve to limit the quantity required. The Contractor shall furnish quantities as required by the Contract Documents to complete the Work.

§ 1.1.12 Unless specifically limited in the Contract, the words "furnish," "install," and "provide," or any combination thereof, mean to furnish and incorporate into the Work, including all necessary labor, materials, and equipment and other items required to perform the Work indicated.

§ 1.1.13 The Project Manual is a volume assembled for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. If the Drawings and Specifications conflict with each other regarding the quality or quantity of Work required, the better quality and/or the greater quantity shall govern, and shall be provided, unless instructions are otherwise furnished to the Contractor by the Architect in writing with the Owner's consent.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Where responsibility for particular Work is required of the Contractor, the Contractor shall not be released from that responsibility by reason of the location of the Specification, Drawing, or other information that establishes the responsibility. Thus, for example, the Contractor shall be responsible for all Work required of it, even though that responsibility may be shown only in that portion of the Contract Documents typically pertaining to another contractor or trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 If there should be a conflict between two or more of the Contract Documents, the following order of interpretation shall apply.

.1 Where requirements specifically set forth in the Agreement are in conflict with other Contract Documents, including, but not limited to, these General Conditions, the Agreement shall govern.

.2 In all other instances, the conflict shall be resolved by complying with the provision that is most favorable to the Owner, as determined in the Owner's sole discretion.

.3 When a duplicate of material or equipment occurs in the Drawings, the Specifications or other Contract Documents, each Contractor shall be deemed to have bid on the basis of each furnishing such material or equipment. The Owner will decide which Contractor shall furnish the same.

§ 1.2.4.1 Without limiting the applicability of Section 1.2.4, if there should be conflict or ambiguity within any single Contract Document (for example, these General Conditions, as modified), the conflict or ambiguity shall be resolved by complying with the provision that is most favorable to the Owner, as determined in the Owner's sole discretion.

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§ 1.2.5 It is the intent of the Contract Documents to accomplish a complete and workmanlike installation in which there shall be installed new products as specified, and workmanship shall be thoroughly first class, executed by competent and experienced workmen.

.1 Details of preparation, construction, installation, and finishing encompassed by the Contract Documents shall conform to the industry standards of the respective trades, and that workmanship and construction methods shall be of workmanlike quality so as to accomplish a neat and finished job, consistent with industry standards.

.2 Where specific recognized standards are mentioned in the Specifications, it shall be interpreted that such requirements shall be complied with.

§ 1.2.6 The Contractor acknowledges that there may be items of the Work that the Contractor is responsible to provide under the Contract Documents that are not drawn or specified in the design but are necessary for the proper execution and completion of the Work, and are consistent with, and reasonably inferable from, the Drawings and Specifications. Provided the necessary work or materials does not materially increase the cost of the Work, all such items shall be provided as part of the Work without delay in its progress and without any increase in the Contract Sum.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and unless otherwise indicated in the Contract Documents or the Owner/Architect Agreement, the Architect and the respective consultants will retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of ~~Service provided to them,~~ Service, subject to any protocols established pursuant to ~~Sections 1.7 and 1.8,~~ Section 1.7, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.5.3 The Drawings, Specifications, and other documents and all data used in compiling any tests, surveys, or inspections at the Project Site and the results therefrom, as well as all photographs, drawings, specifications, schedules, data processing output, computer-aided design/drafting (CADD) system disks/tapes, computations, studies, audits, reports, models and other items of like kind, and all intellectual property, prepared or created for or in connection with the Project and required by the Owner, the Contractor, or a third party, belong to the Owner. The Contractor may retain one record set. All copies of them, except Contractor's record set, shall be returned or suitably accounted for upon completion of the Work. They are for use solely with respect to the Project. The Contractor shall not, without the prior written consent of the Owner, use or permit anyone to use any Drawings, Specifications, or other documents prepared for or in connection with the Project, or any concepts or ideas developed in connection with the Project, for any purpose other than the Project. The Owner shall at all times have access to and control over the disposition of any Drawings, Specifications, and other documents pertaining to the Project.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to ~~the designated~~ an appropriate representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by

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registered or certified mail, by courier, or by electronic transmission if ~~a method for electronic transmission is set forth in the Agreement.~~an acknowledgment of receipt is received from the recipient or proof of receipt is otherwise established. The parties acknowledge that an appropriate representative of the Owner shall have authority only to the extent provided by the Owner's Board of Education.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to ~~the designated~~ an appropriate representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery. The parties acknowledge that an appropriate representative of the Owner shall have authority only to the extent provided by the Owner's Board of Education.

§ 1.7 Digital Data Use and Transmission

The parties ~~shall~~ may agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form.~~The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.~~

~~**§ 1.8 Building Information Models Use and Reliance**~~

~~Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.~~

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to ~~all~~ matters requiring the Owner's approval or ~~authorization.~~ authorization subject to parameters of authority established by the Owner's Board of Education as provided in writing to Contractor. Benjamin Shuldiner or his designee shall serve as initial Owner representatives and shall be reasonably available to Contractor. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 ~~The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.~~**NOT USED.**

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall ~~furnish~~ furnish, as applicable, to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended ~~appropriately.~~appropriately by a mutual agreement in writing by the Owner and Contractor.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall immediately notify the Owner that the Work has ~~stopped.~~ stopped and state with specificity why any evidence provided (or not provided) by the Owner is insufficient. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this

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Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents. The parties' disagreement as to the appropriateness of payment for services performed shall not constitute the Owner's failure to make financial arrangements to fulfill the Owner's obligations under the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where information is protected by law and/or the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose such "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. ~~The~~ To the extent permitted by law, the Contractor may also disclose such "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, ~~including~~ including, but not limited to, those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the ~~jurisdiction where the Project is located.~~ State of Michigan. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor ~~to whom the Contractor has no reasonable objection and~~ whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. ~~The~~ Taking into account the Contractor's experience and expertise, and exercise of professional caution, the Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work. The Contractor shall not be entitled to additional compensation resulting from its failure to confirm the location of site utilities or existing structures.

§ 2.3.5 ~~The~~ Upon specific written request by the Contractor, the Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services. Contracts with other Contractors alone shall not constitute sufficient Owner control for purposes of this Section.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or ~~repeatedly~~ fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3. This right shall be in addition to and not in limitation of the Owner's rights under any provision of the Contract Documents.

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§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ~~ten-day~~ three business day period after receipt of notice from the Owner or the Owner's designee (including, for this purpose, the Architect) to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, ~~correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may,~~ including any claim against the Contractor's Performance Bond, correct such default or neglect. In the event the Contractor's default or neglect results in a threat to the safety of persons or property, the Contractor shall immediately commence and continue correction; otherwise, the Owner may undertake the same actions as permitted in the prior sentence. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses, including any and all legal expenses incurred to effectuate and enforce this provision, and compensation for the Architect's and/or other Contractor's additional services made necessary by such default, neglect, or failure. If the Contractor does not agree to a Change Order as described in the preceding sentence, the Owner may nevertheless withhold the reasonable cost of correcting such deficiencies and the expenses identified in the preceding sentence (including, but not limited to, all legal expenses incurred to effectuate and enforce this provision). Exercise of such rights shall in no way limit or jeopardize the Owner's right to any claim against the Performance Bond or Contractor. The Architect may also, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including the aforementioned Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15. In the event the Owner directs another entity to perform Work pursuant to this Section that otherwise is the obligation of the Contractor, including correction of safety violations, either at the Contractor's request or as a result of the Contractor's failure to perform such Work, the Owner may withhold any payments due Contractor to cover all costs for labor, material, and equipment plus that other entity's administrative, profit, and overhead costs. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.1.4 These General Conditions refer to the relationship between the Owner and Contractor. As to the contract between the Contractor and its Subcontractors, the General Conditions shall be read as the Contractor having the position of the Owner and the Subcontractors having the position of the Contractor. The Subcontractors are bound to the Contractor just as the Contractor is bound to the Owner. The Subcontractor shall have all the rights, duties and obligations to the Contractor as the Contractor has rights, duties and obligations to the Owner. The Subcontractors shall agree to and accept the same responsibility to the Owner as the Contractor. In the event any failure of a Subcontractor or the Subcontractor's Subcontractor or supplier, at any tier, causes any type of defective Work, injury, loss or damage to the Owner, direct or indirect, the Contractor shall be jointly and severally liable to the Owner for such injury in addition to any responsibility or liability of the Subcontractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal

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observations with requirements of the Contract Documents. The Contractor shall independently verify all information related to utilities prior to beginning the Work. The Contractor shall make careful investigation to establish the exact location of any such items indicated on the Drawings (e.g., locate via hand digging before excavating). The Contractor shall be responsible for all costs arising out of damage to such items or additional construction costs incurred because Contractor failed to verify said information.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may ~~require.~~require, with a copy of same to be forwarded to the Owner.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the ~~Owner, subject to Section 15.1.7,~~ Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.2.5 Prior to submitting its bid, the Contractor shall have studied and compared the Contract Documents and shall have reported to the Architect any discovered error, inconsistency or omission in the Contract Documents. It will be presumed that the Contract Sum includes the cost of correcting any such error, inconsistency or omission, which could have been discovered by the exercise of reasonable diligence. Unless the Contractor establishes that such error, inconsistency or omission could not have been discovered by the exercise of reasonable diligence, the Contractor and the bidding Subcontractor(s) will make such corrections without additional compensation so that the Work is fully functional.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures. The Contractor shall immediately notify the Architect and Owner of delays of any other Contractors that could impact timely coordination and completion of the Work.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

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§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work. The Contractor shall be deemed to have accepted prior work when it commences provision of subsequent Work and shall be responsible for the cost of repair, replacement, or reconstruction if the prior work is found to be improper.

§ 3.4 Labor and Materials and Utilities

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. Such provision of labor and materials shall occur in sufficient time to satisfy the existing Project schedule. The Contractor bears the risk of any failure to timely provide such labor and materials for any reason. The Contractor agrees to execute the appropriate UCC forms to effectuate the Owner's ownership of the material and equipment furnished pursuant to this Agreement.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.4.4 The Contractor agrees that neither it nor its Subcontractors will discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to hire, tenure conditions or privilege of employment, or any matter directly or indirectly related to employment, because of race, age, sex, color, religion, national origin, ancestry or physical disability. Breach of this covenant may be regarded as a material breach of this Contract.

§ 3.4.5 Immediately after "award of the Contract," the Contractor shall provide the Architect a list showing the name of the manufacturer proposed to be used for each of the product(s) identified in the Specifications and, where applicable, the name of the installing Subcontractor.

§ 3.4.6 The Architect will reply in writing to the Contractor stating whether the Owner or the Architect, after due investigation, has reasonable objection to any such proposal. If adequate data on any proposed manufacturer or installer is not available, the Architect may state that action will be deferred until the Contractor provides further data.

§ 3.4.7 In all cases involving utilities, unless the Contract Documents specifically provide otherwise, it shall be the Contractor's responsibility to coordinate the Work with the owners of such utilities for the protection of such utilities and for the safety associated with working with or in the vicinity of such utilities. The Contractor shall coordinate any work required by private and/or public utility companies to provide utilities to the Work and/or shall coordinate relocation of utilities as required by the Work. Any reference to the Owner being responsible for the coordination of, the paying for, or the relocation of any utility or associated equipment, which it does not own or control, requires only reasonable efforts by the Owner to coordinate such activity.

§ 3.4.8 Asbestos-Free Product Installation

§ 3.4.8.1 It is hereby understood and agreed that no product and/or material containing asbestos, including chrysolite, amosite, crocidolite, tremolite asbestos, anthorphyllite asbestos, actinolite asbestos and any combination of these materials that have been chemically treated and/or altered shall be installed or introduced into the Work by the Contractor or its employees, agents, Subcontractors, or other individuals or entities over whom the Contractor has control. The Contractor shall be required to provide a signed certification statement ensuring that all products or materials installed or introduced into the Work will be asbestos-free.

§ 3.4.8.2 The Contractor also shall be required to furnish certified statements from the manufacturers of supplied materials used during construction verifying their products to be asbestos-free in accordance with the requirements of Section 3.4.8.1.

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§ 3.4.8.3 The Contractor shall complete and submit to the Owner a certification evidencing asbestos-free product installation prior to issuance of the final Certificate for Payment in a form acceptable to the Owner.

§ 3.4.9 Asbestos may be present within the construction areas. Contractors are to become aware of Owner's hazardous material report prior to construction. Work is not to disturb any in-place hazardous materials. The Contractor must immediately stop all Work and notify the Owner if it reasonably suspects the presence of unknown hazardous materials and/or has disturbed any materials reasonably suspected to be hazardous materials.

§ 3.5 Warranty

§ 3.5.1 ~~The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective.~~ In addition to any other warranties, guarantees, or obligations set forth in the Contract Documents or applicable as a matter of law, and not in limitation of the terms of the Contract Documents, the Contractor warrants and guarantees that:

- .1 The Owner will have good title to the Work and all materials and equipment incorporated into the Work and, unless otherwise expressly provided in the Contract Documents, will be new.
- .2 The Work and all materials and equipment incorporated into the Work will be free from all defects, including any defects in workmanship or materials.
- .3 The Work and all materials and equipment incorporated into the Work will be merchantable at the time of installation.
- .4 The Work and all materials and equipment incorporated into the Work will conform in all respects to the Contract Documents in the reasonable judgment of Architect.

The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. ~~If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.~~

Upon notice of the breach of any of the foregoing warranties or guarantees or any other warranties or guarantees under the Contract Documents, the Contractor, in addition to any other requirements in the Contract Documents, will commence to correct such breach within 72 hours after written notice thereof and thereafter will use its commercially reasonable best efforts to correct such breach to the satisfaction of the Owner; provided that if such notice is given after final payment hereunder, such 72 hour period shall be extended to seven (7) days. The foregoing warranties and obligations of the Contractor shall survive the final payment and/or termination of the Contract.

The Contractor shall, at the time of final completion of the Work and as a condition precedent to final payment to the Contractor, assign to the Owner all manufacturers' warranties related to the materials and labor used in the Work. The Contractor further agrees to perform the Work in such manner as to preserve any and all such manufacturers' warranties and deliver to the Architect the warranties, project manuals, operating procedures, and other materials related to each of the building systems and materials included in the Contractor's Work and as required by the Specifications.

Notwithstanding anything contrary in the foregoing or in any other Contract Document(s), labor shall be warranted for one year, commencing as of the date specified in the Architect's Certificate of Substantial Completion, and the manufacturer warranties applicable to the materials integrated into the Work shall commence and end as provided in the such warranty documents, provided to Owner in accordance with this Section 3.5.1.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect. The Contractor shall pay all local, state and federal taxes levied on its business, income or property and

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shall make all contributions for social security and other wage or payroll taxes. The Contractor shall be solely responsible for such payments and shall indemnify the Owner and hold it harmless from same.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 ~~Unless otherwise provided in the Contract Documents, the~~ The Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work ~~knowing it to be~~ contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide written and dated notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Owner and Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, they will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the ~~Architect determines~~ Owner and Architect determine that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the ~~Owner and Contractor,~~ Contractor in writing, stating the reasons. If ~~either party~~ Contractor disputes the ~~Architect's~~ determination or recommendation, ~~that party may~~ the Contractor shall submit a Claim as provided in Article 15. The requirements of Section 2 of 1998 PA 57, as amended, are hereby incorporated into this document. The Contractor shall be alert to any indication or evidence of existing underground or concealed utilities or structures not shown on the Contract Documents and shall immediately notify the Owner of discovery of such evidence. If the Contractor encounters such utilities or structures, it shall cease operations immediately to minimize damage and shall notify the Owner and Architect. The Contractor shall bear the cost of damage resulting from its failure to exercise reasonable care in its construction activity or from continuing operations without notifying the Owner.

§ 3.7.4.1 The Contractor bidding on the Work is responsible for visiting the site and determining all local conditions, except those that are hidden or unknown, that may in any way affect its Work.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall ~~notify~~ provide written and dated notification to the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features ~~may be made~~ shall be made, as needed, as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

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.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs ~~are more than or less than~~ differ from allowances, the Contract Sum ~~shall~~ may be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. The superintendent shall be satisfactory to the Owner in all respects, and the Owner shall have the right to require the Contractor to remove any superintendent from the Project whose performance is not satisfactory to the Owner and to replace such superintendent with a superintendent who is satisfactory to the Owner.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Owner and/or the Architect may notify the Contractor, stating whether the Owner ~~or~~ and/or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. ~~Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.~~

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's ~~consent, which shall not unreasonably be withheld or delayed.~~ consent .

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits ~~current under the Contract Documents.~~ required under the Contract Documents or any scheduling updates issued by the Architect or Owner. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project. In no event shall the Contractor's Construction Schedule be extended due to action or inaction of the Contractor, except with prior written approval of the Owner within the Owner's sole discretion.

The Contractor shall cooperate with the Architect and Owner in scheduling and performing the Contractor's Work to avoid conflict with, and as to cause no delay in, the work or activities of other contractors or the construction or operations of the Owner's own forces. The Contractor acknowledges and understands that the work schedule will be modified from time-to-time with the Owner's approval to coordinate with the work of others and that such schedule changes do not give rise to a claim for damages or additional compensation by the Contractor for delay or otherwise. The Contractor shall be required to conform to the most recent Owner-approved schedule and acknowledges that fact was taken into account when it agreed to the Contract Sum and entered into this Contract.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the ~~Architect's approval. The Architect's approval~~ Owner's and Architect's approval. The Owner's and the Architect's approvals shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, ~~and (2) allow the Architect reasonable time to review submittals.~~ (2) allow for a reasonable amount of time to review submittals, and (3) shall provide for expeditious and practical execution of the Work. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent ~~schedules submitted to the Owner and Architect.~~approved Project schedules and the most recent Work schedule submitted to the Owner and Architect consistent therewith.

§ 3.10.4 Progress Meetings: Meetings of representatives of the various Contractors may be held for the purpose of coordination and furthering the progress of the Work. Contractor and Subcontractor attendance is mandatory. Meetings shall be held at regular intervals as provided in the General Requirements; special meetings may be held if deemed necessary by the Owner and/or Architect.

§ 3.10.5 The Contractor shall proceed strictly (not substantially) in accordance with the critical path set forth in the Construction Schedule. The Contractor shall monitor the progress of the Work for conformance with the requirements of the Construction Schedule and shall promptly advise the Owner of any delays or potential delays. If any progress report indicates any delays, the Architect shall propose an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary. In no event shall any progress report constitute an adjustment of the Contract Time or any Milestone Date or the Contract Sum unless any such adjustment is agreed to by the Owner and authorized pursuant to a Change Order.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor for submittal to and review by the Architect to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor for submittal to and review by the Architect to illustrate materials or equipment for some portion of the Work. All Work shall be furnished and installed in accordance with the Drawings, Specifications, and as additionally required by the manufacturer's printed instructions. The Contractor shall review the manufacturer's instructions, and where conflict occurs between the Drawings or Specifications and the manufacturer's instructions, the Contractor shall request clarification from the Architect prior to commencing the Work.

§ 3.12.3 Samples are physical examples for submittal to and review by the Architect that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

The Contractor agrees to ensure that its first submissions shall comply with all the requirements of the Contract Documents. It is further agreed that if any Shop Drawing, Project Data, Sample, or similar submittals require excessive submissions to secure the approval of the Architect due to the Contractor's failure to comply with specified

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products, resulting in delays or excessive reviews by the Architect, the Contractor will be held responsible for delays, added review costs, and damages to the Owner caused by such delays. Without limiting the foregoing, the Contractor's obligation to hold the Owner harmless from and bear the costs for any delay, good faith rejection of or resulting from any Shop Drawing, Project Data, Sample or similar submittal by Architect provided such delay or rejeetion is eonditioned on such delay or rejection being attributable to a negligent act or omission of Contractor.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's review and approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect in detailed writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. ~~The~~ Subject to its professional skill and expertise, the Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

~~The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.~~**§ 3.13.1** The Contractor shall confine operations at the site to areas

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permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.2 Anything contained in the Contract Documents to the contrary notwithstanding, no one except the Owner shall be permitted to disrupt the operation of any building system or any other services without the Owner's prior written consent. Any request to perform such work shall be in writing, received by the Owner no less than five (5) days prior to the commencement of the requested disruption, and shall detail (1) the exact nature and duration of such interruption, (ii) the area affected, and (iii) any impact upon the Construction Schedule caused by such proposed temporary disruption. Unless otherwise approved by the Owner, all work shall be performed during the hours and on the days set forth in the Specifications, in accordance with the most-recent project schedule, and/or as directed by the Owner or Architect. The Contractor's failure to comply with the notice provisions of this section shall constitute a waiver by the Contractor of any right it may have to an adjustment of the Contract Time, on account of any postponement, rescheduling, or other delays ordered by the Owner in connection with any Work for which appropriate notice was not furnished.

§ 3.13.3 The Contractor will consult with the Owner and the Architect concerning any necessary operations at the Project site, including staging area limits, office or storage trailer locations, dumpster operations, equipment and material deliveries, hoisting areas and any other construction impacts on the Owner's grounds.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor and its Subcontractors, under the Contractor's direction, shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.15.3 Any areas and/or concurrently occupied space both occupied by the Owner and used in the progress of the Work, both within the limits of the construction site and the adjacent areas leading to it, shall be maintained, opened to travel and kept in a clean condition. Failure by the Contractor to maintain said areas will result in the Owner's cleaning of same, at the expense of the Contractor.

§ 3.15.4 In addition to removal of rubbish, the Contractor and its Subcontractors, under the Contractor's direction, shall replace any broken glass, remove stains, spots, marks, and dirt from decorated work, clean hardware, and/or remove spots and smears from all surfaces which were affected by the Work.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall indemnify and hold harmless the Owner and Architect ~~harmless from~~ from any and all cost, damages, or loss on account thereof, including, but not limited to, actual attorneys' fees, but shall not be

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responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect. The review by the Owner or Architect of any method of construction, invention, appliance, process, article, device or materials of any kind shall be for its adequacy in the Work and shall not be an approval for the use thereof by the Contractor in violation of any patent or other rights of any third person.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Owner's Board of Education, its board members, administration, its successors, assigns, Architect, Architect's consultants, and agents and employees of any of them (the "Indemnitees") from and against any and all claims, costs, damages, losses, liabilities, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the ~~Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the~~ Work ~~itself), but only~~ to the extent caused in whole or in part by (i) the negligent acts or omissions of the Contractor, ~~a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder.~~ its officers, directors and employees, agents or subcontractors; (ii) any breach of the terms of the Contract Documents by the Contractor; or (iii) any breach of any representation or warranty by the Contractor under the Contract Documents. The Contractor shall notify the Owner by certified mail, return receipt requested, immediately upon knowledge of any claim, suit, action, or proceeding for which the Owner or one or more of the Indemnitees may be entitled to indemnification under the Contract Documents. Further, the Owner shall be entitled to recover attorneys' fees and legal fees from the Contractor under the following eireumstances: (1) the Owner has to defend a third-party claim or action for which the Contractor must indemnify the Owner as described above; and (2) the Owner successfully asserts a claim or action against the Contractor for professional negligence, breach of contract, and/or defective Work. For purposes of the previous sentence "successfully" means the Owner recovers damages from the Contractor, regardless of amount. The Contractor shall not be responsible for indemnifying an Indemnitee for the Indemnitee's negligence, but shall remain responsible to the fullest degree of Contractor's fault, on a comparative basis. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In ~~claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.~~addition to and not in limitation of the Contractor's other indemnity obligations, the Contractor hereby accepts and assumes exclusive liability for and shall indemnify, protect, and hold harmless the Owner and Architect from and against the payment of the following:

- **.1** all contributions, taxes, or premiums (including interest and penalties thereof) which may be payable under the unemployment insurance law of any state, the federal Social Security Act, federal, state, county, and/or municipal tax withholding laws, or any other law, measured upon the payroll of or required to be withheld from employees by whomsoever employed, engaged in the Work to be performed and furnished under this Contract;
- **.2** all sales, use, personal property and other taxes (including interest and penalties thereof) required by any federal, state, county, municipal, or other law to be paid or collected by the Contractor or any of its Subcontractors or vendors or any other person or persons acting for, through or under it or any of them, by reason of the performance of the Work or the acquisition, ownership, furnishing, or use of any materials, equipment, supplies, labor, services, or other items for or in connection with the Work; and
- **.3** all pension, welfare, vacation, annuity, and other benefit contributions payable under or in connection with respect to all persons by whomsoever employed, engaged in the Work to be performed and furnished under this Contract.

Provided Owner or Architect has, in good faith and to the best of their knowledge, provided Contractor with complete, accurate, reports identifying the presence of any and all hazardous materials on Site as of the date of commencement of the Work, Contractor shall indemnify, defend, and hold the Owner harmless from any claim, damage, loss or

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expense, including, but not limited to, actual attorney fees, incurred by the Owner related to any hazardous material, condition or waste, toxic substance, pollution, or contamination brought into the Project site or caused or exacerbated by the Contractor or used, handled, transported, stored, removed, remediated, disturbed, or dispersed of by Contractor.

§ 3.18.3 In the event that any claim is made or asserted, or lawsuit filed for damages or injury arising out of or resulting from the performance of the Work, whether or not the Owner or Architect is named as a party, the Contractor shall immediately advise the Owner and Architect, in writing, of such claim or lawsuit and shall provide a full and complete copy of any documents or pleadings thereto, as well as a full and accurate report of the facts involved.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement. The Term "Architect," "Architect/Engineer," "Engineer," or "Design Professional" as used herein means the Architect or the Architect's authorized representative.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the ~~Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.~~Owner and Architect.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for ~~Payment.~~ Payment and with the Owner's written concurrence during the correction period. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or ~~as otherwise agreed with the Owner, to become generally~~ more frequently as agreed with the Owner or required by law, to become familiar with the progress and quality of the portion of the Work completed, and to determine ~~in general~~ if the ~~Work observed is being performed in a manner indicating that the~~ Work, when fully completed, will be in accordance with the Contract Documents. ~~However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The~~ Except as otherwise set forth herein or in the Owner/Architect Agreement, the Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents. The Architect shall provide all services and duties that may be performed by an "Architect" or "Engineer" in 1937 PA 306 and 1980 PA 299, including but not limited to supervision of construction.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner ~~reasonably~~ informed about the progress and quality of the portion of the Work completed, will guard the Owner against defects and deficiencies in the Work, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. ~~The~~ Except as required by the Owner/Architect Agreement or other Contract Documents, the Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and, except as provided in the agreement between Owner and Architect or this document, will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work. The Architect shall provide all services and duties that may be performed by an "Architect" or "Engineer" in 1937 PA 306 and 1980 PA 299, including but not limited to supervision of construction.

§ 4.2.4 Communications

The Owner and Contractor shall endeavor to include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise ~~relating to~~ materially affecting the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

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§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Owner and Architect or, in the absence of an approved submittal schedule, with reasonable promptness as to cause no delay in the Work while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component. However, should the Architect discover during the course of such review any inaccuracies, incompleteness, or other irregularities, the Architect shall immediately notify the Owner of the same to determine an appropriate corrective course of action or notify the Contractor of the same to correct the irregularities.

§ 4.2.8 The Architect will ~~prepare~~ review and recommend for approval Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to ~~determine~~ determine, with the Owner's concurrence, the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site.~~The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.~~

§ 4.2.11 The Architect will interpret ~~and decide~~ matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable ~~promptness.~~promptness given the particular circumstances.

§ 4.2.12 Interpretations ~~and decisions~~ of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such ~~interpretations and decisions,~~ interpretations, the Architect will endeavor to secure faithful performance by ~~both Owner and~~ Contractor, ~~will not show partiality to either,~~ and will not be liable for results of interpretations or decisions rendered in good ~~faith.~~faith and without negligence.

§ 4.2.13 The Architect's ~~decisions~~ interpretations on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with

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reasonable ~~promptness.~~ promptness given the particular circumstances. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor. The term "Subcontractor" shall also include Sub-subcontractors at any tier and material and equipment suppliers. Each and every subcontract shall be understood to have the Owner as a third-party beneficiary, and the Owner shall enjoy all third-party beneficiary rights permitted by law.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract ~~Documents,~~ Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect in writing of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. ~~Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.~~ All contractual agreements with additional persons or entities serving as a Subcontractor or supplier shall expressly identify the Owner as a third-party beneficiary, and the Owner shall enjoy all third-party beneficiary rights not prohibited by law.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, despite the Architect's or Owner's reasonable objection, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution. The Contractor shall notify the Owner and Architect of any proposed substitution a minimum of ten (10) days prior to such proposed change.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the

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proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work that is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and ~~Contractor;~~ Contractor in writing; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation ~~shall be equitably adjusted for increases in cost resulting from the suspension.~~may be adjusted as negotiated by the parties.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity.~~If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.~~

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation. The Contractor shall be responsible for coordinating the Work with the work of other Contractors, including the Owner's own forces or Separate Contractors, so as to complete the Work in accordance with the Project time schedule.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 ~~Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.~~**NOT USED.**

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly

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notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not ~~apparent.~~ reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's ~~delays, improperly timed activities,~~ damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor ~~wrongfully~~ causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and ~~the Architect will~~ allocate the cost among those responsible. The Owner's right to clean up shall in no event be deemed a duty, and should the Owner choose not to pursue this remedy, the Contractor necessitating such action shall remain fully responsible for the same.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, only by Change Order, Construction Change ~~Directive~~ Directive, written contract amendment, or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive ~~requires agreement~~ may be issued by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Unless expressly stated otherwise in the Change Order, an agreement on any Change Order shall constitute the Contractor's final position on all matters relating to the change in the work that is subject to the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum and the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in

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the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one or more of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- **.4** As provided in Section 7.3.4.

However, the Contract Time shall be adjusted only if the Contractor demonstrates to the Owner that the changes in the Work required by the Construction Change Directive adversely affect the critical path of the Work.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall ~~determine~~ determine, with the Owner's approval, the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to ~~the following:~~a reasonable amount of the following that are actually incurred by the Contractor:

- **.1** Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- **.2** Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- **.3** Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- **.4** Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- **.5** Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time. Contractor agreements to a Construction Change Directive shall require a follow-up writing or signature as contemplated in Section 7.3.7.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for undisputed Work completed under the Construction Change Directive in Applications for Payment. ~~The~~ For those undisputed portions, the Architect will make an interim determination for purposes of

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monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of ~~cost~~ cost, if agreed to by the Owner in writing, shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of ~~either party~~ the Contractor to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree in writing with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the ~~adjustments,~~ adjustments in writing, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.3.11 In no event shall the Contractor be entitled to receive, and the contractor hereby waives the right to receive, any payment or any extension of time for additional or changed work, whether partially or fully completed or simply proposed, unless such additional work is authorized by a written Change Order or Construction Change Directive signed by the Owner, nor shall the Contractor be obligated to proceed with any such work. Only the Owner shall have the right to issue a written Change Order or Constructive Change Directive to the Contractor authorizing an addition, deletion or other revision in the scope of the Work and/or an adjustment in the Contract Sum or the Construction Schedule.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall either (i) file a Claim in accordance with Article 15 and continue to implement the change in the Work, or (ii) notify the Owner and Architect in writing and shall not proceed to implement the change in the Work. ~~If~~ Without limiting other restrictions on payment, if the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for obtaining all supplies, materials, tools and equipment necessary to perform the Work and for properly performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time. All work shall be completed in sufficient time to allow for clean-up and preparation for Owner move-in prior to the Date of Substantial Completion.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 ~~If~~ Provided the Contractor submits a written request for an extension not more than fourteen (14) days after the occurrence that gives rise to the delay, if the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by ~~labor disputes, fire, unusual delay in deliveries,~~ fire, government-declared

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emergencies, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending ~~mediation and binding dispute resolution;~~ litigation, mediation, arbitration or binding dispute resolution, as applicable; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may ~~determine.~~
determine and with which the Owner agrees. Failure of the Contractor to submit a timely request for an extension shall irrevocably waive the Contractor's right to such an extension of time. If the Contract Time is subject to extension pursuant to this subparagraph, the Contractor shall receive such an extension, and subject to Owner review and written approval, may receive extension costs related to Construction Management staff and GC costs.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents. Only upon Owner review and written approval, the Contractor may receive extension costs related to Construction Management staff and GC costs..

§ 8.4 Delay Damage Claims

§ 8.4.1 In the absence of a delay caused by something outside the Contractor's reasonable control, if the Contractor fails to complete its Work on time resulting in loss or damage to the Owner, whether or not liquidated damages are called for in the Contract Documents, the Owner shall be entitled to make a Claim for direct damages caused by the Contractor's delay.

§ 8.4.2 In the event the Contractor is hindered in the commencement or progress of the Work for any reason by someone other than the Owner, and in the event the Contractor claims damages as a direct and proximate consequence thereof (including, but not limited to, extended general conditions, overhead, profit, overtime, interest, supervision or other costs or profits whatsoever), then the Contractor shall only assert claims against the Owner related to extended general conditions and costs of paying staff.

For any delay claims raised against the Owner for any reason, the Contractor's sole and exclusive remedy is an extension of time to perform the Work not to exceed the time frame of any proven delay. Under no circumstances is the Contractor entitled to monetary delay damages from the Owner.

§ 8.4.3 Notwithstanding the foregoing, in the event of any delay in the completion of the Contractor's Work or scheduling of the Contractor's Work, including the sequence of that Work which is attributable to the Owner, and if it is determined by a court of competent jurisdiction that the Owner is liable for such delay despite the other terms of this Contract barring any Owner liability for damages for delay, then the Owner shall be liable to the Contractor for liquidated damages in the amount of not to exceed One Hundred Dollars ($100) per day, maximum, which shall include all of the Contractor's claims, including by way of example, delays, compressions of schedule, lost productivity, lost profits, lost opportunities, out of sequence work, overhead, crowding, tools, equipment, rentals, etc.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

~~Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the~~ The Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Owner or Architect may require, and unless objected to by the Owner or Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

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§ 9.2.1 The schedule of values shall be prepared in such manner that the value associated for each major item of work and each subcontracted item of work is shown with materials and labor indicated separately on AIA Document G702 - Application and Certificate of Payment, and AIA Document G703 - Continuation Sheet, or otherwise.

§ 9.3 Applications for Payment

§ 9.3.1 At least ~~ten~~ fifteen (15) days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of ~~values, if required under Section 9.2,~~ values for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents. The form of Application and Certificate for Payment shall be AIA Document G702, Application and Certification for Payment, supported by AIA Document G703, Continuation Sheet, unless otherwise agreed by the Owner. Applications for Payment are due to the office of the Architect by the designated day of the month. Applications for Payment that are received after the specified date will not be processed until the following month.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders. A request for payment of sums related to work regarding Construction Change Directives shall, unless qualified in writing at the time of request, constitute full and complete consent to the Construction Change Directive(s) and to the issuance of a Change Order.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.1.3 The Contractor shall submit with each monthly Application for Payment (1) an Affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the previous application was submitted and for which the Owner might in any way be responsible have been paid or otherwise satisfied, and (2) a release or waiver of liens arising out of the Contract from each Contractor and/or Subcontractor, materialman, supplier and laborer for the Contractor addressing all previous Applications for Payment submitted for the Project.

§ 9.3.1.4 The Contractor must provide copies of the insurance certificates, bonds, and the same for all of the Subcontractors prior to submitting the first Application for Payment.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site. Payment to Contractor for materials stored off site is discouraged. When circumstances indicate that the Owner's best interest is served by off-site storage, the Contractor shall make written request to the Owner for approval to include such material costs in the next progress payment. The Contractor's request shall include the following information:

.1 A list of the fabricated materials consigned to the Project (which shall be clearly identified, giving the place of storage, together with copies of invoices and reasons why materials cannot be delivered to the site.

.2 Certification that items have been tagged for delivery to the Project and that they will not be used for another purpose.

.3 A letter from the Contractor's Surety indicating agreement to the arrangements and that payment to the Contractor shall not relieve either party of their responsibility to complete the Work.

.4 Evidence of adequate insurance covering the material in storage, which shall name the Owner as additionally insured.

.5 Costs incurred by the Architect to inspect material in off-site storage shall be paid by the Contractor.

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.6 Subsequent pay requests shall itemize the materials and their cost which were approved on previous pay requests and remain in off-site storage.

.7 When a partial payment is allowed on account of material delivered on the site of the Work or in the vicinity thereof or under possession and control of the Contractor, but not yet incorporated therein, such material shall become the property of the Owner, but if such material is stolen, destroyed or damaged by casualty before being used, the Contractor will be required to replace it at its own expense.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in aeeordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for eonformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the ~~Architect. However,~~ Architect, in writing, together with the certification to which it pertains. However, unless otherwise required by the Owner/Architect Agreement, any other Contract Document, or applicable law, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum. Nothing in this Section 9.4.2 shall be interpreted to reduce or eliminate the Architect's duties as set forth in Section 3.1.9 of the Owner/Architect Agreement, including supervision of construction.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not ~~remedied;~~remedied, or the Contractor is in default on the Agreement;

.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;

.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

.5 damage to the Owner or a Separate Contractor;

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.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;~~or~~

.7 ~~repeated~~ failure to carry out the Work in accordance with the Contract ~~Documents.~~ Documents;

.8 the Work not having progressed to the extent set forth in the Application for Payment;

.9 representations of the Contractor are untrue;

.10 failing to conform to Project Schedule;

.11 default in the performance of any obligation to the Owner under another contract; or

.12 failure to provide sufficiently skilled workers.

§ 9.5.2 When ~~either party~~ the Contractor disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, ~~that party~~ the Contractor may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.5.5 If the Contractor disputes any determination by the Owner or Architect with regard to any Certificate for Payment, the Contractor shall nevertheless continue to expeditiously perform the Work and such dispute shall provide no basis for any manner of suspension of the Contractor's performance of the Work.

§ 9.5.6 Notwithstanding anything herein to the contrary, the Owner has no obligation to pay the Contractor absent receipt of a Certificate for Payment for the requested amount, and neither the Architect's failure to issue a Certificate for Payment nor the Architect's failure to notify the Contractor and/or Owner of a withheld Certificate for Payment creates an obligation on the Owner to pay the Contractor. The foregoing sentence shall not operate to limit the right of the Owner to dispute amounts requested by the Contractor or to withhold payments from the Contractor as provided in the Contract Documents.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The ~~Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.~~Owner may, in its sole discretion, after providing Contractor with ten (10) days prior written notice, make direct payments to the Contractor's Subcontractors, suppliers, laborers or claimants relating to labor or material provided to the Contractor for which the Contractor has not provided a waiver of lien, in the event the Subcontractors, suppliers, laborers or claimants threaten to or actually cease providing labor and/or materials for the Project such that, in the Owner's determination, progress of the Project and the Project's Schedule are jeopardized. All payments made

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pursuant to this section shall be considered the same as if paid directly to the Contractor and shall constitute partial payment of the Contract Sum. In the event the Contractor disagrees with the amount proposed to be paid to one or more Subcontractors, suppliers, laborers or claimants, the Contractor shall provide a bond in the amount the Contractor believes the Owner will overpay, within ten (10) days of receipt of notice, or be barred from making any claim that the amount of the direct payment was incorrect. Payment under this provision shall not jeopardize any other remedy available to the Owner.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.6.9 Subject to applicable law, if a petition in bankruptcy or any other arrangement or proceeding regarding insolvency, assignment for the benefit of creditors, trust, chattel mortgage, or similar state or federal proceeding, whether voluntary or involuntary, shall be filed with respect to the Contractor, the Owner may withhold the final balance, or any other payments, whether or not an application for progress payment has been properly filed, until expiration of the period of any guarantees or warranties required for the Contractor, and the Owner may pay out such funds the amount necessary to satisfy any claims or costs that otherwise would have been covered by such guarantees or warranties.

§ 9.7 Failure of Payment

If ~~the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if~~ without justifiable basis under the Contract Documents, including these General Conditions, the Owner does not pay the Contractor within seven days after the date established in the Contract ~~Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days'~~ Documents the undisputed amount asserted by the Contractor in its Application for Payment or awarded by a court, then the Contractor may, upon twenty-one (21) additional days' written notice to the Owner and Architect, stop the Work until payment of the undisputed amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents. The Contractor acknowledges the Owner's right to dispute in good faith any amount requested by the Contractor, and, irrespective of the Architect's issuance of a Certificate for Payment, the Owner's right to withhold payments from the Contractor, including, without limitation, to correct Work that fails to conform with the Contract Documents or as an offset or recoupment to recover the cost of damages incurred by the Owner due to the Contractor's breach of the Contract or a wrongful or negligent act or omission of the Contractor.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents and when all required occupancy permits, if any, have been issued, so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of

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items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item ~~upon notification by the Architect.~~ immediately. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.8.6 Notwithstanding Sections 9.8.1 and 9.8.2, as a condition precedent to establishing the date of Substantial Completion, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected (a "punch list"). The Contractor shall respond immediately to correct Work deficiencies and/or punch list items. Should the Contractor fail to make corrections in a timely fashion, but not later than fifteen (15) calendar days from the date of Substantial Completion or notification of the required corrections, whichever is earlier, such Work may be corrected by the Owner at the Contractor's sole expense, and any remaining payments due the Contractor shall be withheld by the Owner.

§ 9.8.7 The Contractor shall promptly notify the Architect, in writing, when the Work deficiencies and/or punch list items are completed. Upon the review of the Work by the Architect after such notification by the Contractor, if Work deficiencies and/or punch list items shall continue to exist, the Contractor shall reimburse the Owner its cost plus ten percent (10%) overhead and profit on any cost incurred by the Owner, including the Architect's fees for re- inspection of the Work. Failure to pay such costs within ten (10) days of receipt of a demand regarding the same shall permit the Owner to pay such costs out of retainage held by the Owner on the Contractor's contract.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

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§ 9.9.4 Any agreement as to the acceptance of non-conforming Work not complying with the requirements of the Contract Documents shall be in writing in the form of a Change Order, acceptable to the Owner's authorized representative and signed by all parties.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, ~~and (6)~~ (6) an affidavit that states the Work is fully completed and performed in accordance with the Contract Documents, (7) in the event of Contractor bankruptcy, at the Owner's option, an order entered by the court having jurisdiction of the Contractor's insolvency proceeding authorizing such payment, (8) a general release executed by the Contractor on a form provided by the Architect, (9) all close-out documents, (10) all warranties collected and provided in an acceptable manner, and (11) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and ~~reasonable~~ actual attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising ~~from~~from:

.1 ~~liens, Claims, security interests, or encumbrances arising out of the Contract~~ Claims already asserted as of the date of final payment and unsettled;

.2 failure of the Work to comply with the requirements of the Contract Documents and resulting demands and Claims asserted in accordance with the Contract Documents;

.3 terms of ~~special~~ all warranties required by the Contract ~~Documents;~~ Documents or provided at law or in equity; or

.4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of ~~claims by that payee except those previously made in writing and identified by that payee~~ all claims of the Contractor except those previously made by the Contractor in writing, including Claims pending as of the final payment date, or

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identified by the Contractor as unsettled at the time of final Application for ~~Payment.~~Payment and specifically referenced as being an exception to the waiver contained in this section.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall continuously maintain adequate protection of all Work from damage and shall protect the Owner's property from injury or loss. The Contractor shall make good any such damage, injury or loss at no cost to the Owner, except to the extent directly caused by agents or employees of the Owner. The Contractor shall adequately protect the Work and adjacent property as required by law, the Contract Documents, or as otherwise required, to cause no damage to the Work and adjacent property during the execution of the Work. This requirement shall also apply to structures above and below ground as conditions of the site require. The Contractor shall also provide recommendations and information to the Owner regarding (a) the assignment of responsibilities for safety precautions and programs by the Subcontractors and responsibilities for safety precautions and programs by the Subcontractors and the Owner for the safety of the Owner, and the general public; (b) temporary facilities; and (c) equipment, materials and services for common use of Subcontractors. The Contractor shall verify that the requirements and assignment of responsibilities are included in the proposed Contract Documents.

§ 10.1.2 The Contractor is solely responsible to the Owner for safety at the Project site and, accordingly, shall be solely responsible for initiating, monitoring, maintaining and supervising all safety precautions and programs in connection with the performance of the Work. The foregoing does not relieve the Subcontractors of their responsibility to the Contractor for the safe performance of their Work in accordance with all applicable laws.

§ 10.1.3 The Contractor shall develop and implement a safety plan that complies with all applicable laws covering all activities on the Project Site except those activities performed solely by the Owner. The Contractor shall provide the Owner a copy of such health and safety plan prior to commencement of Work. The Owner shall have no duty to review the plan and shall assume no duty by doing so.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take ~~reasonable precautions~~ every reasonable precaution for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall ~~comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.~~take all reasonable safety precautions with respect to its Work and work of others, shall comply with all standard industry safety measures and shall comply with all applicable laws, ordinances, rules, regulations and orders of any public authority and all other requirements of the Contract Documents, including those applicable to the safety of persons or property. The Contractor shall be responsible for the safety of all of the Contractor's employees and the safety of all of the Contractor's Subcontractors, suppliers, and their employees. The Contractor shall report in writing to the Architect any injury to any of Contractor's or its Subcontractor's employees at the site within one (1) day after the occurrence of such injury.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, ~~reasonable~~ reasonable, necessary and appropriate safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

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§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. The Contractor shall be solely and fully responsible for any and all damage claims and for defense of all actions against the Owner relating to such explosives, hazardous materials and/or unusual methods.

§ 10.2.5 The Contractor shall promptly remedy damage and loss ~~(other than damage or loss insured under property insurance required by the Contract Documents)~~ to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If ~~either party~~ the Contractor suffers injury or damage to person or property because of an act or omission of the ~~other party,~~ Owner, or of others for whose acts ~~such party~~ the Owner is legally responsible, written notice of the injury or damage, whether or not insured, shall be given to the ~~other party~~ Owner within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the ~~other party to investigate the matter.~~ Owner to investigate the matter. This provision shall be for investigative purposes only and shall not eliminate or reduce a party's obligation to pursue Claims. The Contractor's failure to do so shall be an irrevocable waiver of any Claim arising out of such injury or damage. Injury or damage to persons or property suffered by the Owner because of an act or omission of the Contractor, or others for whose acts the Contractor is legally responsible, shall be subject to the limitation periods established by Michigan law.

§ 10.2.8.1 The Contractor causing damage to the Work of another shall be responsible for the repair and replacement of such damaged Work. Back charges shall be made against the Contract Sum of the damaging Contractor when corrections are not made promptly.

§ 10.2.8.2 If the Contractor or any Subcontractor chooses to use any systems, equipment, facilities, or services which have been incorporated in the Project as a permanent part thereof by any other, the Contractor shall assume full responsibility for damages caused to said systems, equipment, facilities or services, and have damages repaired as required, so that in no case will the performance of the used systems, equipment, facilities or services be diminished from the specified criteria as a result of such use.

§ 10.2.9 The Contractor acknowledges that the safety of the Owner's students, employees and guests is of the utmost importance. The Contractor will take no action which would jeopardize the safety of the Owner's students, employees and guests and, without the Owner's written approval, shall take no action which would interfere with the Owner's activities. Without limiting the foregoing sentence, the Contractor shall comply with all laws applicable to student and/or school safety.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 ~~The~~ To the extent specified in the Contract Documents, the Contractor is responsible for compliance with any requirements ~~included in the Contract Documents~~ regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the

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Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect in writing of the condition.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. ~~The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection.~~ When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional ~~costs of~~ costs, as they relate to payment of staff and extended general conditions, to address shutdown, delay, and start-up.

§ 10.3.3 To the ~~fullest~~ extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the ~~site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.~~site. To the extent the Contract Documents require the removal, transport and disposal of hazardous materials, the Contractor agrees that it assumes responsibility for said tasks as part of the Contract.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence or attributable fault of any kind on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's reasonable discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7. Nothing in this paragraph will be construed as relieving Contractor from the cost and responsibilities for emergencies covered hereby.

§ 10.5 Notification of Utility Companies

§ 10.5.1 At least five (5) working days prior to the start of work in areas which may involve existing utility lines, the Contractor shall notify the MISS DIG notification system, as legally required and, if applicable, any Registered Utility Protection Service of the utility company possibly affected by the planned work by certified mail with return receipt requested.

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§ 10.5.2 The utility company should, upon receipt of notice, stake, mark or otherwise designate the location (and depth) of their lines, or temporarily move the line(s). The Contractor shall wait for the applicable utility to stake and/or mark its utility lines before commencing the relevant Work

§ 10.5.3 The Contractor shall immediately report to the respective utility company any break or leak in its lines, or any dent, gouge, groove or other damage to the utility line or to its coating or cathodic protection made or discovered in the course of the Work.

§ 10.5.4 The Contractor shall immediately alert the Owner, Architect and occupants of nearby premises of any and all emergencies caused or discovered in the utility line(s) in the course of the Work.

§ 10.6 Security

§ 10.6.1 All construction participants, including the Contractor, Architect, Subcontractors, etc., shall cooperate with the Owner's security personnel and shall comply with all of the Owner's security requirements. Such requirements shall include, without limitation, if requested by the Owner, delivering to the Owner's security personnel, prior to the commencement of the Work on each day, a list of all personnel who will be permitted access to the Work. The foregoing, however, shall not relieve the Contractor of any obligation to provide a safe and secure workplace for all parties entering the Project Site. The Contractor shall be responsible to implement commercially reasonable data security protection measures to protect the Owner's networks and data when performing technology-related Work.

§ 10.7 Fire Protection

§ 10.7.1 The Contractor shall maintain free access to the building areas for firefighting equipment and shall at no time block off main roadways or fire aisles without providing adequate auxiliary roadways and means of entrance for firefighting equipment, including heavy fire department trucks, where applicable.

§ 10.7.2 The Contractor shall at all times cooperate with the Owner and kept the municipal fire department informed of the means of entrance and changes to the roadways or fire aisles as needed to provide fire department access to or around the Project Site.

§ 10.7.3 The Contractor shall, during the entire construction period and until the completion of the Work, provide and maintain all material, equipment, and services necessary for an adequate fire protection system, which shall meet the approval of the Owner and/or the Architect. The system shall, at a minimum, meet the requirements set forth in the Contract Documents and of applicable laws. These requirements shall be augmented and/or the installations relocated, as may be necessary to meet, at all time, the demands of adequate protection in all areas and shall not be reduced prior to the completion of the Work with the written approval of the Owner and/or the Architect.

§ 10.8 Environmental Statement and Responsibility of Contractors and Sub-Contractors

§ 10.8.1 It shall be the responsibility of the Contractor to pay any and all costs incurred in any way related to clean up related to any environmental hazard created by means of release, spill, leak or any other means of contamination caused by accident or negligence that is the responsibility of Contractor or its subcontractors or other agents.

§ 10.8.2 It shall be the responsibility of the Contractor to dispose of any product(s) and/or material in strict compliance with applicable federal, state, and local laws (e.g., Environmental Protection Agency, Michigan Department of Natural Resources, etc.).

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as required by law and as otherwise described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies rated A- or better by A.M. Best Company and lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The ~~Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents.~~ Owner hereby requires the Contractor to furnish bonds covering

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faithful performance of the Contract and payment of obligations arising thereunder, each in the penal sum of 100% of the Contract Sum and in accordance with applicable law, on the date of execution of the Contract. The Owner may also require, through the Contract Documents or otherwise, that any contract valued at $50,000 or less shall also include payment and performance bonds each in the penal sum of up to 100% of the Contract Sum. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located. The Contractor shall obtain and provide to the Owner copies of any and all bonds required by the Contract prior to Contractor beginning performance pursuant to the Contract. The Contractor's obligation to provide such bonds shall not be waived in any fashion, including any failure to secure such bonds prior to Contractor beginning performance pursuant to the Agreement.

§ 11.1.2.1 The Contractor's liability insurance shall be not less than the following:

.1	General Requirements		
	a. Worker's Compensation	-	Statutory
	b. Employer's Liability	-	$1,000,000 Each Accident
		-	$1,000,000 Each Employee
		-	$1,000,000 Policy Limit
.2	Comprehensive General Liability		
	a. Bodily Injury	-	$1,000,000 Each Occurrence
		-	$2,000,000 Aggregate
	b. Personal Injury	-	$1,000,000 Each Occurrence
		-	$2,000,000 Aggregate
.3	Automobile Liability		
	a. Bodily Injury	-	$1,000,000 Each Person
		-	$1,000,000 Each Occurrence
	b. Property Damage	-	$1,000,000 Each Occurrence
.4	Independent Contractors	-	$1,000,000 Each Occurrence
.5	Products and Complete Operations	-	$1,000,000 for one (1) year, commencing with issuance of final Certificate for Payment
.6	Contractual Liability	-	$1,000,000 Each Occurrence
.7	Asbestos Abatement Liability	-	$1,000,000 Per Claim
		-	$2,000,000 Aggregate
.8	Pollution	-	$1,000,000
.9	Umbrella Coverage	-	$4,000,000

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 ~~**Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.~~For all insurances for which the Contractor is obligated to have its insurance company name the Owner, Architect and Architect's consultants as additional insured, the Contractor shall require such insurance company to add to the policy the following clause: "The insurance afforded to the Additional Insured is primary insurance. If the Additional Insureds have other insurance which is applicable to the loss on an excess or contingent basis, the amount of the insurance company's liability under this policy shall not be reduced by the existence of such other insurance." Insurances provided on a "claims-made" basis shall be enforceable upon commencement of services and maintained for six years following substantial completion. Insurances provided on an "occurrence" basis shall be enforceable upon commencement of services and maintained for one year following substantial completion. Should the Contractor's insurance costs increase due to adding the Architect and/or Architect's Consultants as additional insureds, and should such costs be passed on to the Owner, the Architect and Architect's Consultants, as applicable, shall reimburse the Owner for such additional costs.

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§ 11.1.5 Notice of Cancellation or Expiration of Contractor's Required Insurance. Immediately after the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, but in no event less than the sooner of three (3) days after becoming aware or the coverage actually lapsing, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration, including the Contractor's plan to immediately procure replacement insurance as required by the Contract Documents to avoid any lapse in coverage. Contractor's failure to do so is a material breach of this Agreement, shall entitle the Owner to purchase replacement insurance at Contractor's sole cost, and shall subject the Contractor to any and all damages related to its failure to comply with its required insurance obligations. Further, upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right, but not the obligation, to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. This policy will exclude any tools, equipment, scaffolding, glass breakage, etc., owned or rented by the Contractor or Subcontractors and materials stored on the site, but not incorporated into the Project. The Contractor shall be responsible for protecting all product until the Date of Final Completion is established by the Architect/Engineer. The Contractor shall replace any Work if damaged before Final Completion. The Contractor may assume the risk itself or obtain insurance in amounts it deems sufficient.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may ~~delay commencement of the Work and may obtain insurance~~ obtain insurance of reasonable type and coverage amount that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the ~~Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.~~Work and the parties shall negotiate an adjustment to the Contract Sum and Contract Time. Property Insurance provided by the Owner will cover only Work incorporated into the construction and will not cover tools, equipment, or other property owned, leased, rented, or borrowed by the Contractor, Subcontractor, Sub-Subcontractor, or others.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the ~~Contractor;~~ Contractor and (2) the Contract Time and Contract Sum shall be ~~equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled.~~ negotiated. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 ~~The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages~~

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~~caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.~~All parties referenced in this General Conditions or otherwise related to this Project acknowledge and agree that the Owner is not waiving any rights its insurer(s) may have to subrogation. To the extent any term in the Contract Documents contrary to this provision, such term is void and unenforceable.

§ 11.3.2 ~~If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.~~**NOT USED.**

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss.~~The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.~~

~~**§11.5 Adjustment and Settlement of Insured Loss**~~

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner. The Owner shall use its best efforts, with consultation of the Architect, to reach a quick and fair settlement for all interested parties, with the insurance companies after a loss.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article ~~15.~~15 if the Contractor timely and properly files a claim under Article 15.. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract ~~Time.~~Time or Contract Sum.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request with the Owner's consent to see such Work and it shall be uncovered by

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the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to ~~an equitable~~ a negotiated adjustment to the Contract Sum and Contract Time as may be appropriate. At the time the Owner's consent is sought as described herein, the Architect shall notify the Owner that additional costs may apply if the Work is in accordance with the Contract Documents. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

It is understood that the correction of work, either before or after Substantial Completion, shall occur without extension of the Contract Time, without increase in the Contract Sum, and without use of any contingency, unless the need for corrections is due to acts of the Owner, Architect, or others who are acting under the Owner's control.

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including work of other Contractors and Subcontractors, compensation of consultants, any delay or related damages, attorneys' fees incurred by the Owner, additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense. The Owner shall have the right to charge the Contractor for any such costs and expenses and to deduct such amounts from any future payments due the Contractor.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. ~~During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty.~~ If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 or other provisions of the Contract Documents establishing a "correction warranty" or other similar concept shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract ~~Documents.~~ Documents, including, without limitation, Section 3.5. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

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§ 12.2.6 The Contractor shall respond immediately to correct Work deficiencies and/or punch list items. Failure to correct Work deficiencies and/or punch list items in a timely fashion shall be a substantial breach, and the Owner may terminate the Contract immediately. The Owner's right of termination in this Section 12.2.6 is separate and distinct from the right of termination in Section 14.2. Whether or not the Contract is terminated, if the Contractor fails to make corrections in a timely fashion, such Work may be corrected by the Owner, in its sole discretion, at the Contractor's expense and the Contract Sum may be adjusted by back charge and/or withholding future payments due the Contractor accordingly. The Contractor shall promptly notify the Architect in writing when Work deficiencies and/or punch list items are completed. If upon review of the Work by the Architect, after such notification by the Contractor, Work deficiencies and/or punch list items shall continue to exist, the Contractor shall reimburse the Owner for any costs incurred by the Owner, plus ten percent (10%) overhead and profit, as well as the Architect's fees for reinspections of the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made. The acceptance of nonconforming Work by the Owner shall be by written Change Order signed by the Owner's authorized representative. Acceptance of nonconforming Work may only occur pursuant to such written Change Order.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the ~~place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.~~State of Michigan in all respects, except that Claims and causes of action for breach of the Contract Documents brought by the Owner shall not be deemed untimely if filed within six (6) years of Substantial Completion of the entire Project.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The ~~Owner~~ Contractor shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

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§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract ~~Documents,~~ Documents or applicable law, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located. For any late payments by the Owner, the interest rate shall not exceed five percent (5%) per annum (see MCL 438.31).

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days for reasons within the Owner's control and through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** ~~An act of government, such as a declaration of national emergency, that requires all Work to be stopped;~~
- **.3** Because the ~~Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the~~ Owner has not made payment on ~~a~~ an undisputed Certificate for Payment within the time stated in the Contract Documents, subject to justifiable withholding of payment as described herein or in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days for reasons within the Owner's control and through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other

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persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** ~~repeatedly~~ refuses or fails to supply enough properly skilled workers or proper ~~materials;~~materials to the point of negatively impacting the Project and/or the related schedule;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** ~~repeatedly~~ disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority;~~or~~
- **.4** otherwise is guilty of substantial breach of a provision of the Contract ~~Documents.~~Documents; or
- **.5** the Contractor fails to prosecute the Work or any part thereof with promptness and diligence or goes into bankruptcy, liquidation, makes an assignment for the benefit of creditors, enters into a composition with its creditors, or becomes insolvent.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, ~~seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:~~three (3) business days' notice, terminate the Contractor's right to proceed with the Work, or such part of the Work as to which such defaults have occurred, and may take any one or more of the following actions:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

In the event the Contractor's surety bond requires notice of intent to declare a default of the Contractor and if such bond notice is provided by the Owner, such notice shall be adequate to satisfy the three (3) day written notice described above in this Section.

The three (3) day notice period identified in this Section does not give rise to an opportunity for the Contractor to cure the cause for termination. Further, the Owner's failure to properly follow the termination procedure shall not be a substantial or material breach of the Contract or the Owner's obligations.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner in pursuing termination and completion of the Work, including actual attorney and legal fees and costs, and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

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.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly ~~executed;~~ executed and costs incurred by reason of the ~~termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.~~termination.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the ~~Contract.~~ Contract, including, but not limited to, additional sums, additional time for performance, or damages for delay. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents. The Contractor shall not knowingly (as "knowingly" is defined in the Federal False Claims Act, 31 USC 3729, *et seq.*) present or cause to be presented a false or fraudulent Claim. As a condition precedent to making a Claim by the Contractor, the Claim shall be accompanied by an affidavit sworn to before a notary public or other person authorized to administer oaths in the State of Michigan and executed by an authorized representative of the Contractor, which states that, "The Claim which is submitted herewith complies with subparagraph 15.1.1 of the General Conditions, as amended, which provides that the Contractor shall not knowingly present or cause to be presented a false or fraudulent claim." Claims of the Owner shall be governed by the relevant Michigan statutory limitations period, excepting Warranty claims which shall be controlled by the warranty documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims as set forth herein and subject to law and shall pursue all causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2. The Owner shall commence all claims and causes of action in accordance with Section 13.1 and Section 15.1.2.1, regardless of any other time frames identified in the Contract Documents. The Contractor shall commence all Claims and causes of action in accordance with Section 15.1.2 and Section 15.1.3, other provisions of the Contract, and in accordance with Michigan law.

§ 15.1.2.1 Regardless of any provisions to the contrary, the limitations period with respect to any Claim or cause of action by the Owner with respect to defective or nonconforming Work shall not commence until the discovery of such defective or nonconforming Work by the Owner. See also Section 13.1.

§ 15.1.2.2 Surety Notice and Prior Approval

Except where otherwise expressly required by the terms of the Agreement or the General Conditions, exercise by the Owner of any contractual or legal right or remedy without prior notice to or approval by the Contractor's surety shall in no way prohibit the Owner's ability to pursue such right or remedy. Further, pursuit of such a right or remedy

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without prior notice to or approval of surety shall in no way compromise, limit or bar any claim by the Owner against a surety bond of the Contractor.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by ~~either~~ the ~~Owner or~~ Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the ~~other party~~ Owner and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by ~~either party under this Section 15.1.3.1~~ the Contractor shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the ~~claimant~~ Contractor first recognizes the condition giving rise to the Claim, whichever is later. The Contractor's failure to timely and properly initiate a Claim shall be an absolute and irrevocable waiver of such Claim and any cause of action. Claims and causes of action by the Owner shall be governed by the applicable statute of limitations period. The parties acknowledge, understand, and agree that the Contractor's required prompt filing of a Claim is critical to the Project, as Contractor Claims often affect the Project schedule and/or Project budget, and that the deadline and waiver applicable to Contractor Claims is a material inducement to the Owner entering into an agreement with the Contractor.

§ 15.1.3.2 ~~Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.~~**NOT USED.**

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a ~~Claim,~~ Claim or cause of action, including mediation, arbitration and/or litigation, as applicable, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make undisputed payments in accordance with the Contract Documents.

§ 15.1.4.2 ~~The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.~~**NOT USED.**

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Failure to provide such notice shall serve as an absolute bar against a Claim or cause of action for such an increase in the Contract Sum. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4. A Project delay shall not be a basis for a Claim or cause of action for additional cost by the Contractor, except for costs related to payment of staff and extended general conditions.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of ~~the Work.~~ the Work due to the increase in Contract Time and allowable costs (e.g., payment of staff and general conditions) sought. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

~~The~~ As permitted by law, the Contractor and Owner waive Claims and/or causes of action against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 , without limitation damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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This mutual waiver is applicable, without limitation, to all consequential damages due to either party's ~~termination in accordance with Article 14.~~ termination. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 ~~Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall~~ Claims of the Contractor shall, and Claims of the Owner may, be referred to the Initial Decision Maker for initial ~~decision.~~ interpretation. The Architect will serve as the Initial Decision ~~Maker, unless otherwise indicated in the Agreement.~~ Maker. Except for those Claims excluded by this Section 15.2.1, an initial ~~decision~~ interpretation shall be required as a condition precedent to ~~mediation of any Claim. If an initial decision~~ mediation, arbitration and/or litigation of any Claim brought by the Contractor against the Owner. If an initial interpretation has not been rendered within 30 days after ~~the~~ a Contractor-required or Owner-requested Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without ~~a decision~~ an interpretation having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to ~~resolve the Claim.~~ interpret the Claim. Within ten (10) days of a written request, the Contractor shall make available to the Owner or its representative all of its books, records, or other documents in its possession or to which it has access relating to a Claim and shall require its Subcontractors, regardless of tier, and suppliers to do the same.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering ~~a decision.~~ an interpretation. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker ~~will~~ will, based on its interpretation, either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial ~~decision~~ interpretation approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial ~~decision~~ interpretation shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any recommended change in the Contract Sum or Contract Time or both. ~~The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.~~ If the Claim is timely and properly asserted, the initial interpretation shall be subject to the parties' agreed-upon dispute resolution process.

§ 15.2.6 ~~Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.~~ **NOT USED.**

~~**§ 15.2.6.1** Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.~~

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§ 15.2.7 In the event of a Claim against the Contractor, the ~~Owner~~ Owner, Architect or Initial Decision Maker may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the ~~Owner~~ Owner, Architect or Initial Decision Maker may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

~~**§ 15.2.8** If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.~~

§ 15.3 Mediation

§ 15.3.1 Except as stated in this Agreement or otherwise agreed in writing by the parties, Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections ~~9.10.4, 9.10.5, and 15.1.7,~~ 9.10.4 and 9.10.5, shall be subject to mediation as a condition precedent to ~~binding dispute resolution.~~the parties' agreed-upon dispute resolution process.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the ~~filing of binding~~ commencement of the parties-agreed-upon dispute resolution proceedings but, in such event, mediation shall proceed in advance of ~~binding dispute resolution~~ such proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. ~~If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.~~ All limitations periods shall be tolled during the mediation process.

§ 15.3.3 ~~Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.~~**NOT USED.**

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

~~**§ 15.4 Arbitration**~~

~~**§ 15.4.1** If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.~~

~~**§ 15.4.1.1** A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.~~

~~**§ 15.4.2** The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.~~

~~**§ 15.4.3** The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.~~

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§ 15.4.4 Consolidation or Joinder

The Contractor further agrees to include similar dispute resolution provisions in all agreements with the Subcontractors, suppliers, and independent contractors and consultants retained for the Project and to require them to include a similar dispute resolution provision in all agreements with Subcontractors, all subconsultants, suppliers or fabricators so retained, thereby providing for a consistent method of dispute resolution between the parties to those agreements. Subject to the other limitations periods identified in these General Conditions which are understood to govern over this sentence, no demand for mediation or arbitration shall be made after the date when the applicable statutes of limitation would bar legal or equitable proceedings. During the pendency of any mediation or arbitration, all applicable limitations periods shall be tolled until the conclusion of that process.

The Owner reserves the right in its discretion to require consolidation or joinder of any mediation or other legal proceeding arising out of or relating to this Agreement or any of the agreements incorporated by reference with another mediation or other legal proceeding involving (i) a person or entity not a party to this Agreement or (ii) an independent contractor or consultant engaged by the Owner in connection with the Project, in any event the Owner believes such consolidation or joinder is necessary in order to resolve a dispute or avoid duplication of time, expense or effort. In the event the Owner is involved in a dispute which is not subject to mediation or arbitration involving a person or entity not a party to this Agreement, the mediation and arbitration provisions of this article shall be deemed to be void and nonexistent in the event Owner, in its discretion, determines the Contractor should become a party to that dispute by joinder or otherwise. Any mediation or arbitration hearing shall be held in the general location where the Project is located, unless another location is mutually agreed upon.

Modified: 09/26/22; 11:22 am~~**§ 15.4.4.1** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).~~

~~**§ 15.4.4.2** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.~~

~~**§ 15.4.4.3** The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.~~

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_____

(Signed)

_____

(Title)

_____

(Dated)

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Section 00210 - Special Provisions

1. General - All Bidders are responsible to review all work categories descriptions, and report any conflicts or ambiguities which may affect the execution of their Work Categories. All Bidders are responsible to review all Bidding Documents and become familiar with them to coordinate their work accordingly. Work Category descriptions should in no way be construed as being all-inclusive. Should a conflict exist between the Work Category description and other Bidding Documents, the Work Category description shall prevail and take precedence. Bidders are required to bid the entire Work Category and may bid more than one Work Category.

2. Electronic Documentation – In an effort to promote sustainability, information shall be conveyed electronically to the greatest extent possible.

3. Pre-approved contractors – The invitation procedure requires that each primary bidder be pre-qualified by the Construction Manager. If you are unsure if you are pre-qualified please contact Jason Lovett immediately at 517-482-1488. Subcontractors and vendors responding to the primary bidders do not need to be pre-qualified. To become pre-qualified, please visit the following link - (http://www.christmanco.com/documents_forms.asp) and fill out the "Trade Contractor Information Request" form.

4. Construction Waste Management And Disposal – Review Spec Section 017419 Construction Waste Management And Disposal.

5. General Commissioning Requirements – Review Spec Section 019113 General Commissioning Requirements.

6. Indoor Air Quality Management Plan – During Construction. Comply with site specific IAQ Management Plan for this project.

7. Parking – Limited parking is available on-site. Additional parking is available on side streets.

8. Project Scheduling - A preliminary project schedule has been included within the Bidding Documents for your review and use. As input from the Trade Contractors is provided and as progress begins, this schedule will be periodically updated and re-issued. Each Trade Contractor is required to become familiar with the preliminary schedule and sequence their work accordingly. Activity durations shall be maintained regardless of actual start dates.

9. Post Bid interviews – We will be holding post bid interviews for the low qualified bidders immediately after bids are received. It is essential to the interview process that the primary and secondary Trade Contractors are included in the meeting, as well as the intended project foreman and project manager. The purpose of the interview will be to discuss the bids but will also focus on schedule, submittals, safety, site utilization and unique project requirements.

10. Shop Drawings & Submittals – The Trade Contractor shall review, approve in writing, and submit through the Construction Manager all submittals within two weeks after contract award at the latest, as to cause no delay in the work or in the work of any separate Trade Contractor. Shop drawings, product data and samples shall be properly identified as specified or as the Construction Manager may require. At the time of submission, each Trade Contractor shall inform the Construction Manager in writing of any deviation in the shop drawings, product data or samples from the requirements of the Bidding Documents.

    For Re-Submittals – Each Trade Contractor shall make any corrections required by the Construction Manager or Architect and shall resubmit the shop drawings, product data or new samples until

approved. Each Trade Contractor shall direct specific attention, in writing or on resubmitted shop drawings, product data or samples, to revisions other than those requested by the Construction Manager or Architect on previous submittals. Refer to Section 01300 Submittals for definitions of Action Markings.

11. Mockups

    a. A full mockup of a reading nook (style A) will be constructed for approval shortly after the submittal stage (see schedule for timing). This mock up to include structural steel, metal studs, acoustical panels, sheathing, plywood, wood finish, insulation, window, minimal masonry on all sides, weather barriers and sealant. Once approved, if the mockup can be salvaged without damage, contractors can use the material for final installation.

    b. Unistrut Mockup – All ceiling mounted support systems (Unistrut, hangers, clips, etc.) that will be used in a typical exposed ceiling classroom will be mocked up before installation. The mockup will be done in a single classroom using non destructive methods (ie. tape cardboard to indicate Unistrut location). Once approved, then overhead installation in exposed ceiling areas can commence.

12. Procore –The Christman Company has set up the project to use the Procore software platform for the construction documents for the project. Procore be used for (not limited to) the following:

    a. Submittal upload and approvals
    b. RFI upload and approvals
    c. Updated drawings
    d. Updated schedule
    e. Meeting minutes
    f. Project directory
    g. Testing reports
    h. Notice of commencement
    i. Safety Information
    j. Quality Control Logs
    k. Punch Lists

13. Submittal Uploads – All submittals must be submitted to The Christman Company via Procore and must be the original PDF document. Hard copies or re-scanned documents will not be accepted. The only exception is actual samples (paint draw downs, masonry, etc.); however, all brochures and product data related to these samples must be submitted electronically.

    For any questions regarding this process, email Andrew.dobbs@christmanco.com

14. Schedule of Values (SOV) – Per Section 01370 Schedule of Values, submit for approval through the Trade Contractor Portal. Once approved, adhere to the Application for Payment process. The SOV must be divided up type of work, general conditions, supervision, insurance, material and labor, submittals, closeouts. No single item can be greater than $100,000.

15. Application for payment – Create and Submit the Pay Application through the Trade Contractor Portal. Payment period: Signed payment applications are due the 25th of each month. Each request for

payment shall be provided with a fully executed sworn statement along with its relative unconditional waivers. All subcontractors and suppliers are to be listed on the sworn statement.

16. Change Management – Refer to Sections 01150 and 01019 for definitions, but the following change management documents will be utilized on this project: Bulletins, Subcontractor Change Orders (SCOs).

17. Existing Services – The existing utilities (power, water, gas) have been disconnected and are not available for use. A temporary electrical service will be set up and limited power will be available. The owner will pay for all power consumed for the temporary electrical service, all natural gas consumed for temporary heat, and all water consumed for temporary potable water.

    Under conditions where tie-ins to existing services/utilities are required, each Trade Contractor will be required to notify Construction Manager five (5) working days in advance. Pre-Task planning and shut-down notifications will be required to assure minimum interruptions to Owner operations, including performing required tie-ins after normal working hours. Trade Contractors are responsible to cover premium time costs to complete required tie-ins.)

18. Temporary Power – Please note that there will be no temporary power/lighting provided on site. All site contractors will be responsible for providing their own temporary power and lighting within MIOSHA standards. WC 28 will set up power and lighting within the building immediately after concrete has been installed. Temp power will include 20 AMP 120-V-I-P. Any additional power needed is the responsibility of the contractor needing the power.

19. Hoisting – In general, any hoisting activities required to be used on-site must be reviewed in advance with Construction Manager for coordination of site logistics, safety procedures, access, lift swing areas, duration, and overall activities relating to the hoisting equipment.

20. Equipment – Contractors need to ensure equipment being used to perform work will not damage the finishes, including concrete flooring.

21. Site Boundaries – Reference included site logistics plan. No swinging or staging of any materials shall extend beyond the project boundaries. Special care must also be taken where there are overhead electrical lines. These power lines will be marked by the utility company, but no equipment or materials should be within 10 feet of the power lines (or as MIOSHA dictates).

22. Existing Facilities – Portable chemical toilets will be provided and are to be utilized for the duration of the project.

23. Material Deliveries and Staging – Due to the limited lay-down area available, all material deliveries must be coordinated with the Construction Manager a minimum of 24-hours in advance of said delivery. At no time, will delivery trucks be allowed to stage or park on existing roads and parking lots. Queuing for trucks will be available on-site at designated locations as coordinated with the Construction Manager. If deliveries require traffic control, the Trade Contractor is required to provide flagmen accordingly. All Trade Contractors are responsible for directing responsible trucks into project site, unloading of materials, handling, protection and storage of all received equipment. The Owner and Construction Manager will not accept deliveries.

24. Communication and Phones – All Trade Contractor field supervision shall have cellular phones available for communication with The Christman Company's field personnel. All project managers shall have email access for communications with The Christman Company's office personnel. Cell phone use by trade personnel (non-supervisory) will not be permitted, except during breaks or lunch.

25. Independent Testing, Inspections and Commissioning – The Owner has arranged independent testing for certain portions of the project. All Trade Contractors are to cooperate and provide access and assistance for the independent testing and inspections to be performed. These services include at a minimum: soil/material testing and commissioning.

26. Layout – The Construction Manager will provide two perpendicular control lines and one benchmark indicated on the documents. Prior to commencing with the Work, verify all field conditions and measurements and report any discrepancies to The Christman Company.

27. Noise, Odors & Vibration – Due to close proximity of adjacent existing facilities, vibration must be closely monitored as to not cause any damage to the existing building and facilities. Odor causing chemicals, adhesives, paints, cleaning supplies must have SDS sheets submitted and approved by the Construction Manager prior to use. All equipment shall be self powered and all diesel powered equipment shall be operated with "Bio-diesel" fuels and/or emission "scrubbers" to reduce exhaust fumes.

    a. All contractors must abide by any noise ordinances this project is within. The Lansing, MI construction noise ordinance reads:

        i. Operating or permitting the operation of any tools or equipment used in construction, drilling or demolition work between 8:00 p.m. and 7:00 a.m. of the following day on weekdays, or at any time on weekends or holidays, such that the sound therefrom creates a noise disturbance across a residential real property boundary or within a noise sensitive zone, except for emergency work of public service utilities or by a temporary or special permit issued pursuant to Section 654.10 or 654.11;

28. Jobsite Safety Orientation – All Trade Contractors of any tier and visitors entering this jobsite will be required to check-in with the Construction Manager upon arrival at the project site. Check-in procedures will include the review and acknowledgement of the Construction Managers Project Specific Safety Orientation and Policies. All construction personnel will be required to wear The Christman Company issued safety sticker when working on or visiting this jobsite).

    a. Safety (see contract form section for project safety program) - It is a fundamental value of the Construction Manager that safety is always a primary consideration. There is no phase of the project that has greater importance than accident prevention and the preservation of human resources. The Construction Manager's safety program is stringent and rigorous. The following represents a few important pre-construction requirements that apply to this project. Before any awarded Trade Contractor starts work on-site, the following requirements shall be satisfied:

        i. Provide a copy of Trade Contractor's site specific safety program.

        ii. Attend Construction Manager's project specific safety orientation program, which includes review of our safety video, review of project specific written safety program, review of Project Specific Infection Control Policy, sign-in and badging requirements.

        iii. No tobacco products, including but not limited to cigarettes, cigars, chewing tobacco, etc. are permitted on Lansing School District premises.

        iv. Provide a copy of Safety Data Sheets (SDS) for all proposed materials.

        v. Hardhats, High Vis, and safety glasses are to be worn at all times. Additional personal protection equipment will be worn appropriately based on the work performed.

vi. Designate a Safety Representative(s) who will be working on-site – Provide telephone numbers and emergency telephone numbers.

vii. Hoisting over occupied areas will not be permitted unless areas are vacated or a controlled access program initiated.

viii. Hot work permits shall be obtained as required, including fire watch requirements.

ix. Shut down notifications shall be obtained as required with a minimum of five (5) working days advance notice.

x. An understanding of our safety program and specifically our policy that in the event of an injury or near miss, all parties involved will be required to take a drug screening test immediately. Failure to perform the required test will result in removal from the site.

xi. Fall protection shall be worn and used, 100% of the time, by all persons when there is exposure to a fall greater than six (6) feet unless other provisions such as guardrails, safety nets, or fall restraints have been provided. This includes, but is not limited to, steel erection (including connecting, bolting-up, decking, welding or any other steel erection activity), pre-cast erection, roofing activities and masonry work including overhand laying operations.

xii. Hot Work Permits - Hot work permits will be required during all cutting, grinding, welding and torch cutting activities, including fire watch requirements. These permits are to be filled out in the jobsite trailer with a copy of it to be placed at the place of hot work.

29. Unsupported Masonry Walls – This project will include unsupported masonry walls exposed to wind during construction. All contractors working within the restricted zones will be required to have proper training per the MIOSHA Part 2 Masonry Wall Bracing requirements.

30. Progress Cleanup – A composite clean-up crew will be assembled each Wednesday immediately after lunch. Each Trade Contractor shall provide labor and supplies as directed by the Construction Manager to support this effort. This does not relieve any Trade Contractor of their responsibility to cleanup all debris resulting from their own operations on a daily basis and discard waste into jobsite dumpsters provided by the Construction Manager (as identified in section 01524), Each Trade Contractor shall clean all surfaces and leave the work area "broom clean" or its equivalent, unless otherwise specified.

    If contractors do not maintain their work areas or provide the proper resources for our daily clean up, The Christman Company will provide one warning to the contractor. If the problem continues after the warning, The Christman Company will provide labor for the relative clean-up at the cost of the contractor.

31. Drug Testing – Drug testing is mandatory in the event of an incident or accident that question the sobriety of the individual.

32. As-Builts – As-Builts must be accurately updated throughout the project. At the end of the project, the trade contractor must update the As-Builts and forward the following to The Christman Company: PDF file and two full size hard copies.

33. Warranties – The contractor shall guarantee all materials and work for a period of two years from Substantial Completion. Before final payment, Contactor must provide a letter of guarantee confirming the effective date and duration of the guarantee.

34. Waste Management/Indoor Air Quality Plan – The Construction Manager's Waste Management Plan and Indoor Air Quality plan will be strictly adhered to for this project. Please pay special attention to these specifications (01410 and 01524). The trade contractors are responsible to provide the necessary resources to follow these guidelines.

35. RFI's – All pre-bid RFIs are to be submitted to projects@lansingschools.net before the pre-bid RFI cutoff deadline. All RFIs during construction will be done via Procore.

36. Work Hours –

    a. Sitework & Building Structure: Common jobsite working hours shall be 7:00am to 3:30pm, Monday through Friday. Any overtime requires advance approval by Construction Manager.

    b. Once Building Is Enclosed: Common jobsite working hours shall be 6:00am to 4:30pm, Monday through Thursday. Any overtime requires advance approval by Construction Manager.

37. Hazardous Materials – Reference section 01300 for requirements if hazardous materials are encountered and report to the Construction Manager.

38. Alternates

    - **Alternate 1** – Public Address System - The base bid PA system is an Audio Enhancement Epic System using classroom sound amplification systems with amplifiers, speakers, etc. for non-classroom spaces. This alternate is to install a Carehawk PA system in lieu of the Audio Enhancement System in classrooms. Classrooms will still require a sound-field amplification system but it does not need to be the Audio Enhancement Epic System.

    - **Alternate 2** – Five vs Three Year Warranty – The base bid is to include a 3-year manufacturer and contractor warranty on all equipment and installation related to the audiovisual, clock, PA, and security systems. This alternate extends the manufacturer and contractor warranty to 5 years. Owner expects the contractors to resolve issues and replace defective equipment throughout the warranty period.

    - **Alternate 3** – Surveillance Camera Type - The base bid video surveillance cameras do not need built-in analytics. This alternate adds analytic functionality to the cameras. At a minimum provide object tracking, object identification (eg: gender and clothing, vehicle type and color, etc.). Provide Hanwha P-Series, Avigilon H5 Series, or equivalent by Axis.

39. Sealant Schedule - Sealants are to be installed as listed in the schedule below. If sealants are required by the specification for a specific system that is not listed, then the Trade Contractor installing the product shall be responsible for the associated caulking. For two systems that abut that are installed by two different WC's, it is the responsibility of the later WC to install sealant (for example gypsum board buts up to masonry, the gypsum board contractor would caulk).

Sealant Schedule		
Item to be sealed	Responsible WC	Comments
Door Frames	24	
Plumbing fixtures	27	

Glazing Systems, Storefront, Curtainwalls, Translucent Wall Panels	18	
Masonry Systems	11	
Countertops	20	
Metal Panel Systems	15	
Roofing Systems	14	
Top of Base	22	
Monument Sign	20	
Gypsum Walls	21	
Exterior Concrete	05	Including concrete that abuts to masonry.
Interior Concrete	10	
Exposed Structural Steel	24	
Wall Protection	20	
Lockers	20	

End of Special Provisions Section 00210

SITE IMPROVEMENT NOTES

1. ALL AREAS SHOWN NOT BUILT, PAVED OR OTHERWISE COVERED BY CONSTRUCTION SHALL BE HYDROMULCH SEEDED, REFER TO SPECS FOR DETAILS.
2. ALL AREAS DISTURBED BY CONSTRUCTION WHICH ARE OUTSIDE THE CONSTRUCTION LIMITS SHALL BE RESTORED TO A CONDITION EQUAL TO, OR BETTER THAN EXISTING CONDITIONS.
3. THE SITE CONTRACTOR SHALL COORDINATE WORK WITH ALL ADJACENT CONSTRUCTION BY OTHERS.
4. REFER TO SHEET C-104 FOR SITE GRADING DESIGN.
5. REFER TO SHEET C-105 FOR SITE UTILITY DESIGN.

CONSTRUCTION NOTES

1. CONTRACTOR SHALL CONTACT MISS DIG AT 811 OR (800)-482-7171, 72 HOURS IN ADVANCE OF CONSTRUCTION, FOR EXISTING UNDERGROUND UTILITY LOCATIONS.
2. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF LANSING'S CURRENT STANDARDS AND SPECIFICATIONS.
3. THE CONTRACTOR SHALL NOTIFY THE CITY ENGINEER AND/OR THE AUTHORITY HAVING JURISDICTION, 48 HOURS PRIOR TO BEGINNING CONSTRUCTION.
4. IN ORDER TO VERIFY COMPLIANCE WITH THE APPROVED PLANS, FULL-TIME CONSTRUCTION OBSERVATION SHALL GENERALLY BE REQUIRED OF THE CONTRACTOR DURING ALL PHASES OF UNDERGROUND SITE CONSTRUCTION INCLUDING INSTALLATION OF SANITARY SEWER, STORM SEWER, DRAINS, WATERMAIN AND APPURTENANCES AS WELL AS PRIVATE STREET CURBING AND PAVING CONSTRUCTION. INTERMITTENT OBSERVATIONS WILL BE MADE FOR SITE GRADING, PARKING LOT CURBING AND PAVING, RETAINING WALL CONSTRUCTION AND OTHER SURFACE ACTIVITY.
5. FOR LAYOUT POINT COORDINATES SEE SHEET C-503

SITE IMPROVEMENT LEGEND

- CONSTRUCTION LIMITS
- MDOT TYPE F4 CONCRETE CURB AND GUTTER — 6 / C-501
- MDOT TYPE F4 CONCRETE CURB AND GUTTER – WASH OUT GUTTER PAN. TRANSITION FROM STANDARD GUTTER TO WASH OUT 10' EACH SIDE OF LIMITS NOTED. — 5 / C-501
- MDOT TYPE D2 MOUNTABLE CURB AND GUTTER — 1 / C-501
- HMA PAVEMENT
- CONCRETE PAVEMENT
- CONCRETE SIDEWALK
- × 1 SITE LAYOUT POINT COORDINATE NUMBER

SITE IMPROVEMENT KEY

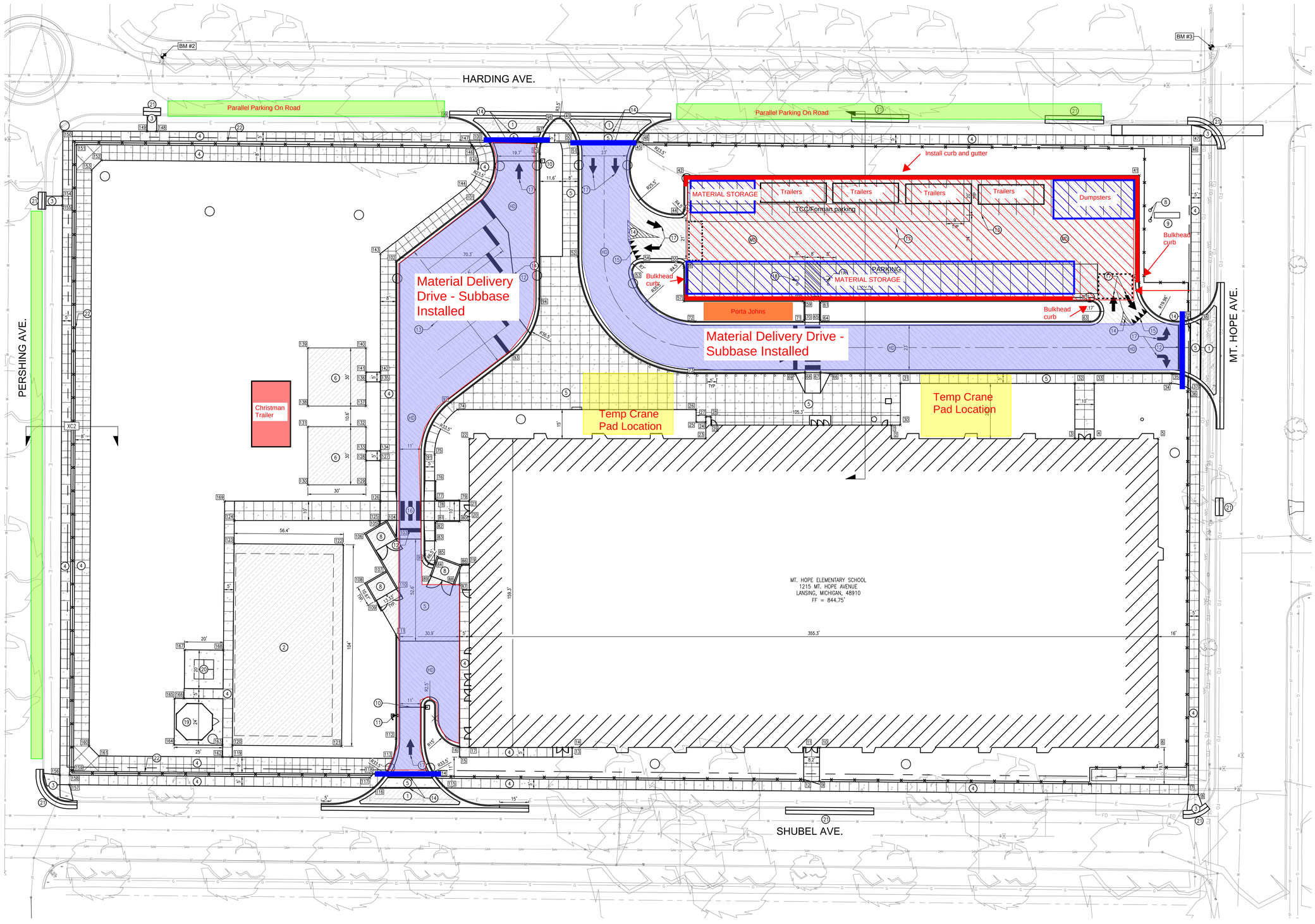
1. CONCRETE PAVEMENT — 28 / C-504
2. BASKETBALL COURT — # / C-XXX
3. ADA RAMPS — 1-16 / C-500
4. 4" CONCRETE SIDEWALK — 4 / C-501
5. 6" CONCRETE SIDEWALK — 4 / C-501
HD. HEAVY DUTY PAVEMENT STRUCTURAL SECTION — 30 / C-504
MD. MEDIUM DUTY PAVEMENT STRUCTURAL SECTION — 30 / C-504
XC1. DROP-OFF/PICK-UP AND PARKING LOT CROSS SECTION — 30 / C-504
XC2. SIDEWALK CROSS SECTION — 27 / C-504
6. OUTDOOR CLASSROOM, SEE STRUCTURAL PLANS FOR MORE INFORMATION
7. DUMPSTER ENCLOSURE — # / A-XXX
8. FLAG POLE — 10 / C-501
9. SIGN — 23 / C-503
10. VEHICLE GATE — 12 / C-501
11. SECURITY PODIUM — # / C-503
12. PAVEMENT MARKING, WATERBORNE, 12" STOP BAR (2 COATS)
13. PAVEMENT MARKING, WATERBORNE, 4" WHITE (2 COATS)
14. PAVEMENT MARKING, WATERBORNE, 6" CROSSWALK (2 COATS)
15. PAVEMENT MARKING, WATERBORNE, WHITE YIELD BAR (2 COATS)
16. PAVEMENT MARKING, WATERBORNE, WHITE HIGH EMPHASIS CROSSWALK, 12" (2 COATS) — # / C-###
17. PAVEMENT MARKING, WATERBORNE, WHITE TRAFFIC ARROW SYMBOL (2 COATS)
18. PAVEMENT MARKING, WATERBORNE, BLUE ADA PARKING SYMBOL (2 COATS) — # / C-###
19. GAGA PIT — 7 / C-501
20. FOUR SQUARE COURT — 9 / C-501
21. CURB AND GUTTER REPLACEMENT — 11 / C-501
22. FENCE MAINTENANCE STRIP — 24 / C-501
23. BUILDING MAINTENANCE STRIP — 25 / C-503
24. BOLLARD; SENTINEL BY LANDSCAPE FORMS OR APPROVED EQUAL; EMBEDDED, MITER TOP STYLE; — 26 / C-503

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE

0 10 20 40 Feet
5 15 30



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Stantec

LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

SITE IMPROVEMENTS PLAN

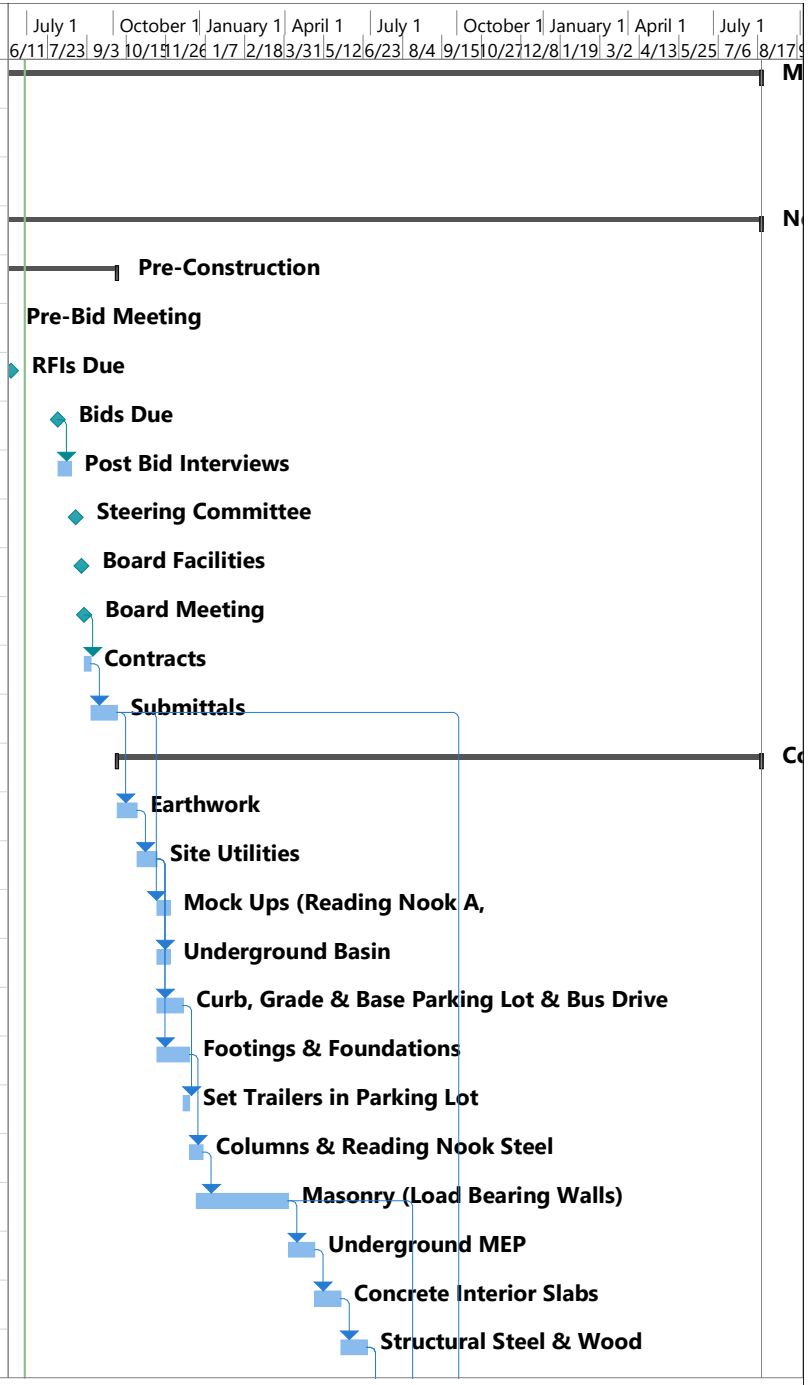
REVISIONS

REV	DESCRIPTION	DATE

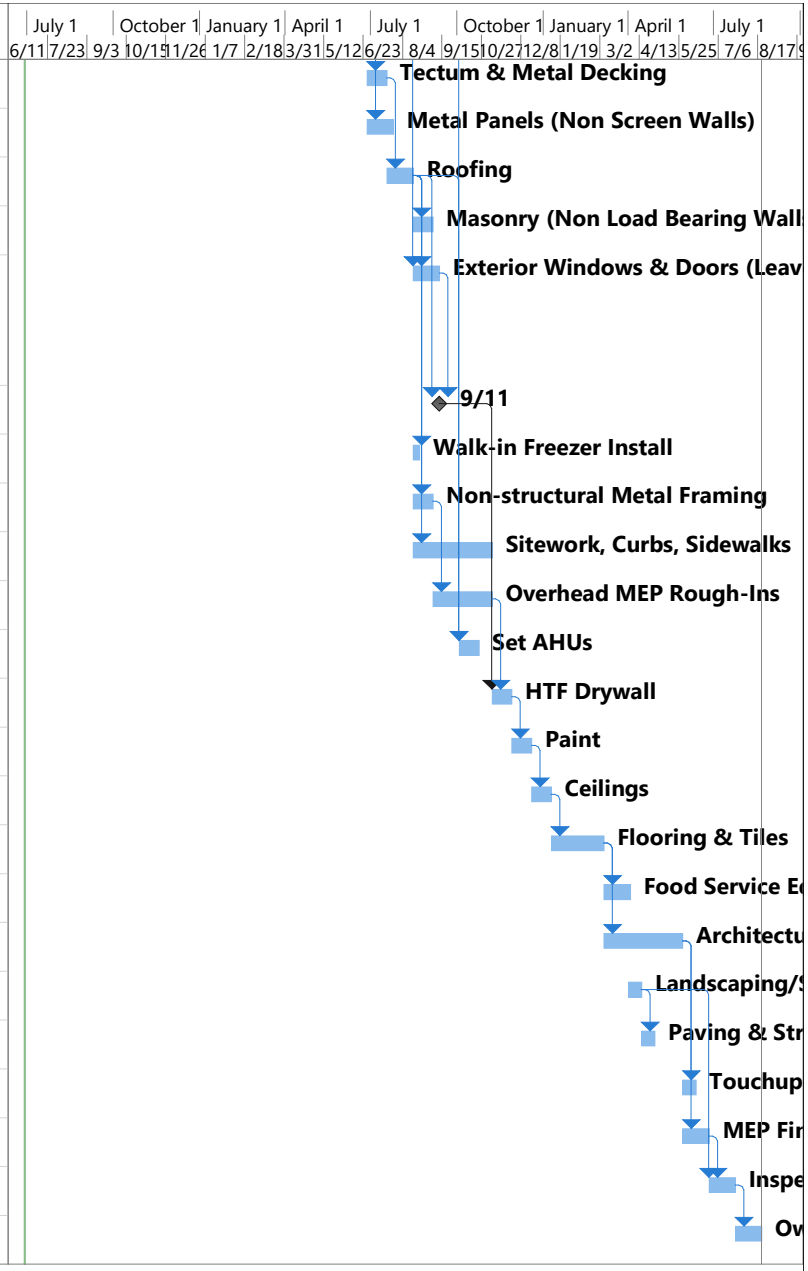
PROJ. #: 220118
DATE: 20-JAN-2023
SHEET
C-103

100% DESIGN DEVELOPMENT

ID	Task Name	Duration	Start	Finish
1	**Mt Hope Elementary**	**732 days**	**Tue 11/1/22**	**Wed 8/20/25**
2	**Demo**	**132 days**	**Tue 11/1/22**	**Wed 5/3/23**
17				
18	**New Build**	**575 days**	**Thu 6/8/23**	**Wed 8/20/25**
19	**Pre-Construction**	**85 days**	**Thu 6/8/23**	**Wed 10/4/23**
20	Pre-Bid Meeting	0 days	Thu 6/8/23	Thu 6/8/23
21	RFIs Due	0 days	Wed 6/14/23	Wed 6/14/23
22	Bids Due	0 days	Thu 8/3/23	Thu 8/3/23
23	Post Bid Interviews	10 days	Thu 8/3/23	Wed 8/16/23
24	Steering Committee	0 days	Tue 8/22/23	Tue 8/22/23
25	Board Facilities	0 days	Mon 8/28/23	Mon 8/28/23
26	Board Meeting	0 days	Thu 8/31/23	Thu 8/31/23
27	Contracts	5 days	Thu 8/31/23	Wed 9/6/23
28	Submittals	20 days	Thu 9/7/23	Wed 10/4/23
29	**Construction**	**490 days**	**Thu 10/5/23**	**Wed 8/20/25**
30	Earthwork	15 days	Thu 10/5/23	Wed 10/25/23
31	Site Utilities	15 days	Thu 10/26/23	Wed 11/15/23
32	Mock Ups (Reading Nook A,	10 days	Thu 11/16/23	Wed 11/29/23
33	Underground Basin	10 days	Thu 11/16/23	Wed 11/29/23
34	Curb, Grade & Base Parking Lot & Bus Drive	20 days	Thu 11/16/23	Wed 12/13/23
35	Footings & Foundations	25 days	Thu 11/16/23	Wed 12/20/23
36	Set Trailers in Parking Lot	5 days	Thu 12/14/23	Wed 12/20/23
37	Columns & Reading Nook Steel	10 days	Thu 12/21/23	Wed 1/3/24
38	Masonry (Load Bearing Walls)	70 days	Thu 12/28/23	Wed 4/3/24
39	Underground MEP	20 days	Thu 4/4/24	Wed 5/1/24
40	Concrete Interior Slabs	20 days	Thu 5/2/24	Wed 5/29/24
41	Structural Steel & Wood	20 days	Thu 5/30/24	Wed 6/26/24



ID	Task Name	Duration	Start	Finish
42	Tectum & Metal Decking	15 days	Thu 6/27/24	Wed 7/17/24
43	Metal Panels (Non Screen Walls)	20 days	Thu 6/27/24	Wed 7/24/24
44	Roofing	20 days	Thu 7/18/24	Wed 8/14/24
45	Masonry (Non Load Bearing Walls)	15 days	Thu 8/15/24	Wed 9/4/24
46	Exterior Windows & Doors (Leave out Main Entrance Vestibule Framing & Doors, Will Be Temp Doors)	20 days	Thu 8/15/24	Wed 9/11/24
47	Temp Heat Install	0 days	Wed 9/11/24	Wed 9/11/24
48	Walk-in Freezer Install	5 days	Thu 8/15/24	Wed 8/21/24
49	Non-structural Metal Framing	15 days	Thu 8/15/24	Wed 9/4/24
50	Sitework, Curbs, Sidewalks	60 days	Thu 8/15/24	Wed 11/6/24
51	Overhead MEP Rough-Ins	45 days	Thu 9/5/24	Wed 11/6/24
52	Set AHUs	15 days	Thu 10/3/24	Wed 10/23/24
53	HTF Drywall	15 days	Thu 11/7/24	Wed 11/27/24
54	Paint	15 days	Thu 11/28/24	Wed 12/18/24
55	Ceilings	15 days	Thu 12/19/24	Wed 1/8/25
56	Flooring & Tiles	40 days	Thu 1/9/25	Wed 3/5/25
57	Food Service Equipment	20 days	Thu 3/6/25	Wed 4/2/25
58	Architectural Finishes	60 days	Thu 3/6/25	Wed 5/28/25
59	Landscaping/Seeding	10 days	Tue 4/1/25	Mon 4/14/25
60	Paving & Striping	10 days	Tue 4/15/25	Mon 4/28/25
61	Touchup Paint	10 days	Thu 5/29/25	Wed 6/11/25
62	MEP Finishes	20 days	Thu 5/29/25	Wed 6/25/25
63	Inspections & Punchlist	20 days	Thu 6/26/25	Wed 7/23/25
64	Owner Move In	20 days	Thu 7/24/25	Wed 8/20/25



CHRISTMAN
SINCE 1894

PROJECT SAFETY MANUAL

Lansing School District
MT. Hope
Lansing, Michigan

June 26th, 2023

Statement of Safety Program

It is a fundamental value of The Christman Company that safety always is a primary consideration. It is our policy and a top priority to do all in our power to provide a safe work place for all workers and to mandate the use of good safety practices. Adherence to established safety standards and procedures is required of everyone at all times on the MT. Hope Project site.

There is no phase of the operation that has greater importance than accident prevention and the preservation of human resources.

This Project Specific Safety Program has been developed in support of these concepts to serve as a reference in assisting all project trade contractors in satisfying their responsibility "to provide a safe, healthful work place, free of recognized hazards."

The Christman Company
Mark Hietala
Project Superintendent

The Christman Company
Andrew Dobbs
Project Manager

The Christman Company
Rob Crowe
Vice President/Principal

The Christman Company
Donald V. Staley
Vice President/Safety Director

Date: June 26, 2023

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I. Introduction

This Project Safety Manual provides an administrative structure within which The Christman Company and subcontractors present on the Project site shall provide for the safety and health of their employees and other individuals affected by their activities and for the protection of property. This Manual does not relieve subcontractors of any of their traditional or specific legal responsibilities with respect to occupational safety and health or the protection of property. Instead, this Manual provides for coordination among the various subcontractors' individual programs, monitoring of subcontractors' conformance with their individual programs, and the requirements of this Manual, initiation of corrective actions when nonconformances are identified, and documentation of safety related programs, meetings, and incidents. This Project Safety Manual for Mt. Hope has been developed to assist all subcontractors working at the Project site in satisfying their responsibility to provide a safe and healthful work place, free of recognized hazards, for their employees.

All employees, subcontractors, trades people, and visitors are required to watch The Christman Company Safety Orientation Video prior to performing work at the site. The video may be viewed at the site office.

At Mt. Hope we will be abating, demolishing, then constructing an entire new building along with implementing a new playground. Abatement has been conducted and completed based of Environmental Resource Group's (ERG) multiple surveys. Following a successful final report from ERG, the remainder of the existing building, and paved areas will be demolished. Throughout the entire duration of the project there is to be no smoking in any area of the project site, this is a school property, and it will not be tolerated. Throughout demolition, it will be vital to be cautious. A silt fence has been put in place in compliance with the SESC plan. If the silt fence obtains any cuts, breaks, or rips, immediately report them to The Christman Company. If there are an unknows prior to breaking ground, the proper organizations will be contacted. Proper excavation and back-fill of the existing buildings basement will be vital to a successful project. After a successful demolition, construction of the new 60,000 SF building will commence. The new playground area will consist of a 3-way basketball court, "Gaga Pit", and a four-corner court. All grass will be preserved and restored per the specifications of the project. The building itself will consist of 16 classrooms, media centers, project rooms, a music studio, and a modern gymnasium. There will also be two additional "Outdoor Classrooms" constructed near the playground area. A new parking lot and bus loop will be constructed as well. The new Mt. Hope will be a single-story building that will comply with all the proper safety requirements when being worked on. Proper tie-off measures will be taken when work on the roof is being performed. Appropriate PPE is required once entered onto the site. Adequate measures will be accounted for when exceptional noise is encountered on the job-site. This project will last a duration of roughly 26 months. Throughout, and at the conclusion, of this project the proper inspections, testing, and observations will be completed to ensure all materials constructed are performing in their expected manners.

A. PRIOR TO WORKING ON SITE:

(1) Provide a written copy of your company's project specific safety program for our review and use. Copy shall remain on-site until completion of project.

(2) Provide a written copy of your company's Silica Exposure Control Plan for our review and use. Copy shall remain on-site until completion of project.
(3) Attend The Christman Company's project specific safety orientation program which includes: review of our safety video, and that each worker has signed in and received site identification requirements.
(4) Provide a copy of Safety Data Sheets (SDS) for all materials prior to delivering such materials on site.
(5) Sign and return the last page of this project safety manual.

B. WHILE WORKING ON SITE:

(1) This project is being constructed within the existing property lines of 1215 E Mount Hope which will have a perimeter of an "in-ground" construction fence, as such all workers are to remain in designated construction area's. Any work outside of the designated construction areas must be coordinated with The Christman Company prior to start. Work taking place outside of designated construction area contractor needs to ensure area is cleaned after completing work.
(2) Any contractor creating a hazard is responsible to abate the hazard in accordance with OSHA, MIOSHA, and TCC standards.
(3) Handrail, barricades and warning line maintenance shall be reviewed by each subcontractor, minimum daily, where these systems are in place.
(4) **Project Security** – Each trade contractor is responsible for the protection of their own equipment and materials. There will be no security watch on this project.
(5) **No Smoking / Tobacco** – There will be no smoking or chewing tobacco usage allowed on the project site or on the Mount Hope property. This includes e-cigarettes and any other tobacco product. NO EXCEPTIONS
(6) Shut down notification processes will be required prior to any tie-in work with new-to-existing work. This includes site utilities, structural, architectural, MEP, Fire/Life/Safety systems points of interface, and all work within existing spaces that require occupant evacuation. Shut down notification processes will follow The Christman Company's procedures and will be submitted fourteen (14) calendar days in advance of starting such work. Approval will be required by both The Christman Company and Lansing School District prior to executing.
(7) 100% fall protection required when working 6'-0" above.
(8) Hard hats, safety glasses, safety vests and/or bright hi-visibility clothing are required to be worn at all times when working on site.
(9) Report un-safe potential fall conditions immediately to The Christman Company. There will be no perimeter guardrails at the roof level. All contractors performing work at the roof level will be required to provide their own OSHA compliant fall protection systems.
(10) Do not modify existing perimeter protection, guardrails, perimeter site fencing, floor covers and/or temporary weather protection, unless specifically approved in advance by The Christman Company.
(11) Working hours are TBD extended hours will require advance approval by The Christman Company.

(12) Designate a safety representative(s) who will be working on site (individual must be trained in first aid and CPR). Submit emergency contact information of safety representative, including cell phone # and second person in charge cell phone #.

(13) Jobsite radios, i-pods, and headphones are not allowed within areas of construction.

(14) Cell Phones – Use of cell phones in areas of construction is to be kept to a minimum. At no time are employees allowed to use the cell phone while performing work. Cell phone use by trade personnel (non-supervisory) will not be permitted, except during breaks or lunch.

(15) The emergency evacuation, action and crisis management plan is available at The Christman Company site office. It is important that no one from any company speaks to the media. Please ask any unauthorized person to leave the site for their own safety. All inquiries are to be directed to The Christman Company's Superintendent.

(16) Emergency numbers – Local emergency and governing agency contact numbers – **See Attachment VII, Emergency Contact List**

(17) Employee Emergency Action Plan – An emergency evacuation and general action plan for the site has been established that shall be adhered to – **See Attachment VIII, Evacuation Plan**

(18) JHA - A Job Hazard Analysis (JHA) format will be used on this project. All subcontractors will be responsible to complete and submit a JHA on a daily basis prior to performing that day's operations. **– See Attachment X, Job Site Hazard Analysis**

(19) Daily Reports are required to be completed on a daily basis by all subcontractors. Reports must be submitted to The Christman Company on a daily basis.

(20) **Cleanup is required on a daily basis** – Trash and debris must be picked up and disposed of immediately, sweep floors, keep stored materials and tools cleaned up and organized.

(21) **Signage** – Signage for the occupants/construction personnel of the building must be displayed in visible locations at all times. If intermittent closures of any access/egress routes are required, The Christman Company must be notified and approved signage must be in place.

(22) **Excavation Work** – Prior to any trade contractor excavating, it is imperative that Miss Dig be contacted. Arrangements must be made three (3) days prior to starting work by contacting (800) 482-7171. There are known underground utilities in this area, including power, gas, cable and water.

(23) **Hot Work** for all welding, cutting, grinding and torching activity: All hot work is to be monitored very closely. All trade contractors shall implement and follow the hot work program as defined in Section XXI of this project safety manual

(24) **Storage/Lay Down -** The project site is limited in the amount of space for lay down and storage of materials. Lay down and materials storage areas are to be coordinated with the Site Superintendent.

(25) **Roofing Work** –Any work on the roof shall be planned for by the approved trade contractor and reviewed with The Christman Company and any other trades that this affects prior to any work taking place. **No perimeter guardrail/cable**

will be provided. Proper means of fall protection are to be supplied and utilized by any contractor performing work on the roof. A monitor system will not be allowed. See section X.I for specific details.

(26) **Egress Plan** – Emergency exits will be clearly marked with signage; a clear route of evacuation from these exits must be maintained at all times. Contractors working at or near these emergency exits will be responsible for ensuring clear egress in the event of an emergency. A floor plan will be posted at each stairway.

(27) **Masonry & Concrete Cutting** – If wet cutting methods cannot be utilized for cutting, proper measures must be implemented to contain dust. This includes use of proper PPE per the employer's plan and necessary engineering controls to protect ALL employees. It will be the responsibility of subcontractor generating dust to plan all proposed engineering control measures prior to starting their work.

(28) **Cold Weather** – If work will be performed in cold weather it will be the responsibility of the subcontractor to take the necessary precautions to protect workers.

(29) **Access** – Access to the jobsite outside working hours is prohibited without prior authorization from The Christman Company.

(30) **Hardhat Sticker** – The hardhat sticker will be issued to each tradesperson after safety orientation is completed. All trades people will be required to display at all times, issued hardhat sticker whenever working at the jobsite.

(31) **Crane & Hoisting guidelines:**

i. Riggers / Crane Operators – The Christman Company requires the use of qualified Riggers / Certified Crane Operators (CCOs) on all cranes on its jobsites. Qualified riggers / CCOs on all cranes is a requirement for each project thereby ensuring minimum rigger/operator qualifications and operating standards are meant to protect the safety of all workers and the public.

ii. Submit Map/plan of site showing exactly where the crane will be set up, it's swing radius, etc.

iii. Copy of specs on the crane showing charted capacity being utilized

iv. Copy of crane annual inspection

v. Operator certification card

vi. **Crane Inspections**

1. Each crane used at the Project site shall have a current annual crane inspection report, which documents that the crane has been inspected within the current year in accordance with established MIOSHA / OSHA standards.
2. A daily crane inspection is required to be completed by the operator at the start of each shift. <u>REFERENCE ATTACHMENT V – DAILY CRANE INSPECTION</u>
3. All rigging will be checked prior to usage. Any equipment found to be damaged will be removed from service. Wire rope with one or more defects will be removed or replaced immediately.

vii. **Critical Lifts** - A critical lift is defined as any crane lift that meets one or more of the following conditions:

- Any lift exceeding 80% of the crane lifting capacity.
- Lift routes that intersect a public right of way. (i.e. roads, sidewalks, occupied structures, railroad tracks.)
- Any lift that brings equipment or material within 20 ft of an energized overhead power line.
- When equipment being lifted exceeds $10,000 in replacement cost.
- When material being lifted requires a month or more lead time for replacement.
- When material being lifted is defined as a critical path item.
- If the lift is a tandem type lift.
- If the lift is defined as segmented and requires rigging changes between start and finish.
- If the lift requires specialized, custom or engineered rigging.

Any lift that meets one or more of the above referenced conditions will require a critical lift permit and a detailed lift plan. REFERENCE ATTACHMENT VI CRITICAL LIFT

Critical Lift permits can be obtained from The Christman Company (TCC) and must be submitted to the site General Superintendent and site Safety Manager. Critical lift permits must be obtained, completed and reviewed with TCC prior to attempting a critical lift. Critical lift permits must be readily available for review in the field prior to and during a critical lift.

All members of the lift team must review and assist in the completion of the critical lift permit. The lift team includes the following members:

- Crane Operator – All crane operators of cranes with a capacity of 150 tons or more must be certified. NCCCO certification is acceptable.
- Riggers and Signalers – All riggers and signalers must be trained and authorized by their company. A copy of the rigging and signaler authorization should be submitted to TCC.
- Contractor Supervisor – The contractor supervisor must review and authorize the lift plan and critical lift permit.

All lifts must be done in accordance with all applicable OSHA and MIOSHA rules. All members of the lift team have the authority and responsibility to insure the lift is compliant and in accordance with established site procedures including the access agreement between the project site and adjacent railroad company.

Successful completion of the critical lift permit will require the following:

- Determining the maximum weight and center of gravity of the load to be lifted.
- Determine the proper size, configuration and placement of the rigging.
- Calculating the combined weight of the load, rigging, load blocks and crane jibs.

- Ensure the rigging and crane or cranes are adequate and safe for the weight of the device to be lifted.
- Determining the required boom angle and swing radius.
- Selecting the proper crane(s) for the lift.
- Inspecting the lift site to determine the soil condition to decide whether matting and/or soil stabilization is needed.
- Determine the lifting route and required restricted area needed during the lift. (The contractor performing the lift is responsible for maintaining and enforcing the restricted zone.)
- Properly describing the material being lifted.
- Determining the communication plan between the equipment operator and lift team.
- Weather conditions.
- Overhead and underground utility considerations.
- Notification method to other trades within or near to the lifting route.
- Submit Map/plan of site showing exactly where the crane will be set up, it's swing radius, etc.
- Copy of specs on the crane showing charted capacity being utilized
- Copy of crane annual inspection
- Operator certification card

After a careful review of the job site, the lifting device and plan are complete; the Rigging Project Manager will record the project data on the Critical Lifting Permit. The equipment operator will sign and date the completed form and submit it for review to TCC's superintendent and site safety manager.

At any time during a lift, the equipment operator has the authority and responsibility to insure the lift is proper and in accordance with established procedures.

At no time should a lift be made or allowed if:

- The lift route travels over occupied areas.
- Weather conditions exhibit lightning. (A crane must halt 30 minutes after a lightning strike has been confirmed before a lift can commence.).
- Heavy winds are present that make controlling the load difficult for the operator or lifting team.
- The travel path of the crane or load comes within 20 ft of an overhead power line.
- The soil conditions underneath the crane have not been reviewed and determined capable of supporting the intended load.
- Communications are lost between the equipment operator and lifting team.

After the critical lift has been performed, a copy of the critical lift permit will be retained on file by TCC at the project site.

Contractor failure to comply with the critical lift permitting procedure will result in a safety violation and will require a near miss investigation report to be completed by the contractor and submitted to TCC.

Reference ATTACHMENT VI Critical Lift Permit

viii. Jobsite hazardous analysis (JHA), including proper safe operation of equipment and safe coordination and use with other trades working on site, prior to hoisting. Crane hoisting guidelines will be followed.
ix. All employees who rig loads to be hoisted by cranes must be "qualified" by industry definition. Qualified is defined as: (1) experience in that job task and (2) has attended training on inspection and use of rigging devices, such as nylon slings, cable chokers, et. (3) attaches tag lines to loads. Proper documentation/certification of qualifications must be on hand at all times.
x. All lifts shall be planned and reviewed by all personnel involved in rigging, hoisting or receiving loads.
xi. The operator and rigger shall be in direct communication with each other by the use of designated radio communication channel provided by the subcontractor who's material is being hoisted.
xii. All riggers will instruct the operator to sound an audible horn (minimum 80 decibels) prior to lifting and/or swinging into the intended work/receiving area – if the operator observes workers within the intended swing path.
xiii. All workers should look overhead when the horn is sounded. Observe the intended path of travel and ensure they are not standing in the fly zone and in harm's way.
xiv. All employees will be instructed on this procedure in the new hire orientation.
xv. Certified riggers and signal men are to be provided by the subcontractor who's material is being hoisted. Designated riggers and signal men are to be set apart visually from the other members of the crew (different colored hard hat, vest etc.)
xvi. At no time is hoisting permitted over occupied areas of the building without prior notice, coordination, and approval by The Christman Company. Hoisting of precast panels over occupied areas is not permitted at any time.

II. Implementation Responsibility

Each and every person working at the Project site shall be responsible to be knowledgeable of the contents of this Manual and comply with every requirement contained herein.

III. Subcontractor Safety Programs

Each subcontractor is required to submit a copy of its written safety program to The Christman Company prior to commencing work at the Project site. Each program shall meet the requirements of the codes and regulations of OSHA, local and other authorities having jurisdiction over the work to be performed and shall include disciplinary procedures and safety orientation training procedures applicable to subcontractor personnel.

Each subcontractor safety program shall include, as a minimum, the following requirements:

A. All trades are to complete a Jobsite Hazards Analysis (JHA) form every day for all work activities.

B. Conduct weekly safety (Tool Box) meetings.

C. Monitor jobsite safety issues daily.

D. Conduct fire inspections.

E. Review project specific requirements with employees.

F. Conduct tool and equipment inspections.

G. Review all personal protective equipment with employees.

H. Address fall protection measures.

I. Address Right-To-Know regulations, including Safety Data Sheets (SDS')

J. Provide hazardous material awareness training.

IV. Discipline Policy

All Subcontractors entering onto this Project are required to comply with all aspects of the project safety program requirements. Those that do not adhere to this program will be subject to this discipline policy. The Project will utilize a three step process for minor infractions; repeat or major offenses of the safety program are subject to immediate removal from the Project.

1. Any re-entry employment programs for safety violations will be initiated only by The Christman Company Superintendent and Project Manager.

2. Verbal warning - The verbal warning **shall be considered given** at the signing of the contract. This warning is to be communicated by the Subcontractor to **all** Subcontractor personnel prior to entering this Project.

3. Written warning - The second warning will be a written warning, documented, with a copy sent to the employee's Supervisor and Corporate Office.

4. A written warning, at the discretion of The Christman Company Superintendent, can result in either removal from the Project or re-orientation of the safety program. The re-orientation will be attended by both the violator and his/her Foreman. This re-orientation may consist of:

- Video training in the related area of the violation
- Written verification by the employee that he/she is capable of identifying the hazards related to the violation.
- The completion of a written Job Hazard Analysis by the employee and his Foreman for the task in which the violation occurred.

5. In addition, any Foreman that has had his/her crew members attend three (3) re-orientation sessions for any reason is subject to removal from the Project.

6. The third infraction of the same safety program issue will result in removal from the Project.

7. Any Foreman, General Foreman, or Superintendent who forces or directs any employee to violate a safety procedure, will be removed from the Project immediately.

8. Any violation deemed threatening to life, limb or major property damage will be grounds for immediate removal from the Project.

Subcontractors will comply with all provisions of The Christman Company's safety program. In the event of Subcontractor's noncompliance, the Subcontract may be canceled, terminated, or suspended, in whole or in part, and The Christman Company may complete the work at the cost of the Subcontractor in accordance with the Subcontract Agreement.

V. Weekly Safety Meetings

The Christman Company will hold weekly construction coordination/safety meetings every Tuesday at 9:30AM on-site in person. All active, on-site subcontractors shall be represented at these meetings. At the beginning of each meeting current safety topics, issues, concerns and problems will be discussed.

Each active, on-site subcontractor shall conduct weekly toolbox meetings. Every worker active on site shall attend. Each subcontractor shall furnish the following documentation to The Christman Company after each toolbox meeting: date, topic(s) discussed, names of attendees, subcontractor's name, and any safety concerns noted.

VI. Safety Inspections

The Christman Company's Project Superintendent will conduct informal inspections of conditions, practices and equipment on a daily basis. The Christman Company's Safety Manager shall schedule visits to the Project site, unannounced, to inspect the work in progress. All safety discrepancies noted shall be reviewed with the Project Superintendent responsible to ensure that corrective measures are implemented.

Supervisors of all active on-site subcontractors are responsible to conduct daily inspections of conditions, practices, and equipment relating to their work areas/activities. Safety discrepancies

discovered, along with the corrective measures taken, shall be reviewed with The Christman Company Project Superintendent.

VII. Drug/ Substance Abuse Testing Program

A. **Any employee injured at the Project site and needing offsite medical attention will be tested for alcohol and drugs.** If the injured party was hurt by the action of another person who was not injured, this person must also submit to substance abuse testing. Additionally, any employee causing or contributing to a major incident not resulting in injury will be tested for alcohol and drugs. An employee who tests positive for illegal substances or alcohol will not be allowed to return to the project site. Any employee who refuses to submit to substance abuse testing will not be allowed to work at the project site.

B. It is the responsibility of the employer to make sure that the testing is performed at the time of the incident. It is also the responsibility of the employer to cover any costs incurred due to the testing. Results of the testing will be considered confidential. **An employee that is tested late (not within 8 hours of the incident) will be considered as "not tested" and will not be allowed to return to work on the project site.**

Notes:

1. Visitors and delivery personnel are not included.
2. The drug-screening test shall include testing for cannabinoids, depressants, dissociative anesthetics, hallucinogens, opioids and morphine derivatives, and stimulants. **Refer to Attachment I.**

VIII. Hazardous Material Control Program

Each subcontractor is responsible for the safe storage, use and disposal of any hazardous material required to perform their scope of work. Each subcontractor using such materials shall provide The Christman Company with a copy of their Hazardous Material Control Program before any of his material is delivered to the Project site. Each program shall, at a minimum, include the following:

A. Identification and classification of hazardous materials
B. Safety and health precautions
C. Training in safe storage, handling and use
D. Transporting, labeling, packaging, documenting and disposal requirements
E. Safety Data Sheets (SDS) for all chemicals

Each subcontractor is to submit to The Christman Company a complete list of hazardous chemicals that may be used at the Project site along with a copy of a Safety Data Sheet (SDS) for each. Copies of any subsequent SDS amendments, additions, or corrections shall also be promptly submitted. Additionally, a list of the chemicals that are on site is to be submitted to The Christman Company.

The Christman Company will maintain a master file of all jobsite SDS' for every subcontractor in the on-site Project office. This information will be made available to any employee upon request.

It is the responsibility of each subcontractor to provide proper and adequate employee training as required under this Act.

Compliance with the storage, use and disposal requirements as outlined on labels and SDS's is mandatory for all users; full understanding of these requirements is expected of all users and suppliers of hazardous materials.

IX. Existing Hazardous Material

The Christman Company Site Manager and / or Superintendent and Owner/Client shall review all areas of the Project site for existence of hazardous materials, such as asbestos and lead. If asbestos exists in areas that involve construction work, the Owner/Client shall arrange to remove the asbestos before any construction work takes place in each area.

If lead-based paint exists in areas, which involve construction work, each Subcontractor working in the areas shall be responsible for complying with the requirements of the OSHA standard for lead exposure. The recognition of possible contaminated areas is key to avoiding exposure. If you discover an area that you suspect lead may be present you are to bring it to the attention of The Christman Company Project Superintendent.

Proper communication regarding the hazardous materials is to be conveyed to all people that may possibly be exposed to the hazard.

Remember - If a suspect hazardous material is discovered notify The Christman Company's Project Superintendent immediately.

X. Personal Protective Equipment and Clothing

Each subcontractor shall supply each of their workers with the proper safety equipment, take any necessary precautions to maintain the equipment according to current regulations and specifications and accept responsibility to assure that proper safety equipment is used when required. All workers shall be required to wear appropriate personal protective equipment and clothing where there is an exposure to hazardous conditions and where needed to reduce hazards to the worker. The following list represents the minimum requirements:

A. Outer Garments

1. Suitable outerwear is defined as clothing designed to protect from expected hazards. Outer garments should be well fitting. Short sleeve garments may be worn where no hazards to exposure exist. **High Visibility Shirts or Vests must be worn at all times.** For daytime and nighttime work within the right-of-way, apparel shall be labeled as meeting the requirements of ANSI 107-1999 standard performance for Class 2 risk exposure. For the same condition described above but the activity is flagging traffic, a type 3 is to be used.

Tank tops or "muscle shirts" are not permitted. Full pants are to be worn. Neckties should not be worn when working around moving machinery. All employees are to avoid loose sleeves, frills or trims that could present hazards. Racist or profane slogans on outer garments are not permitted.

B. Gloves
Hands are to be protected as dictated by working conditions. Gloves, mittens or hand leathers will be of the type consistent with the hazards present.

C. Hardhats
Hardhats must be worn on site at all times. Acceptable hardhats must meet the requirements of ANSI Standard Z89.1 – Type 1 Class E.

D. Eye and Face Protection
   A. Safety glasses are required at all times. Acceptable safety glasses must meet the requirements of the most current ANSI Standard Z87.1.
   B. Employees shall be required to wear proper eye and face protection during operations where a hazard or risk of injury exists from flying objects or particles, harmful contacts, exposures such as glare, liquids, injurious radiation, electrical flash, or a combination of these hazards.
   C. Contact lenses or US food and drug administration standard hardened lenses shall not be considered as eye protection.
   D. An employee who needs corrective lenses in spectacles where eye protection is required shall be protected by one of the following:
      a. Spectacles whose protective lenses provide optical correction.
      b. Goggles that can be worn over the corrective lenses without disturbing the adjustment of the spectacles.
      c. Goggles that incorporate corrective lenses mounted behind the protective lenses.
   E. Face and eye protection equipment shall be of proper size to fit the employee and protect against the intrusion of foreign objects. Face and eye protection shall be kept clean and in good repair. Equipment with structural or optical defects shall not be used.
   F. Face shields and goggles shall be used, as required, to provide eye and face protection when safety glasses are insufficient.
   G. Employees shall wear welding helmets with filter lenses when engaged in welding, cutting, or burning operations or the employee shall wear safety glasses with side shields or goggles under the shield when the shield is raised and is exposed to flying objects. Manufactured welding shields shall be placed around the work area to prevent flash exposure to other employees.

E. Jewelry
Bracelets, necklaces, rings and earrings are not to be worn during operations where they present hazards to the wearer.

F. Foot Protection
Work boots or approved safety shoes are to be worn at all times on the project. Special safety footwear for protection against exposure to electrical shock, chemicals,

acids, caustics, and hot or molten materials may be required and it is the responsibility of the employer to provide their employees with the appropriate "special footwear" if it is deemed necessary. If an employee is using a Jack Hammer toe guards are required.

G. Personal Protective Equipment
The use of personal protective gear, such as gloves, respirators, coveralls, safety glasses, ear protection, and the like, will be required as conditions demand and shall be reviewed at the time of employee orientation or when assigning duties. The contractor is required to supply all required PPE to their employees.

H. Respirators
Any Subcontractor responsible to perform work that requires respiratory protection shall have a written respiratory program in place. A copy of the program shall be submitted to The Christman Company's Superintendent before commencement of any work activities that require the use of respirators. At a minimum, each respiratory protection program shall provide each employee with training relative to the need for use, fitting, fit testing, cleaning and storage of respirators.

I. Fall Protection
Policy: Fall protection shall be worn and used, 100% of the time, by all persons when there is exposure to a fall greater than six (6) feet unless other provisions such as guardrails, safety nets, or fall restraints have been provided. This includes, but is not limited to, steel erection (including connecting, bolting-up, decking, welding or any other steel erection activity), precast erection, roofing activities and masonry work including overhand laying operations.

Exceptions: The safe use of ladders up to twenty-four (24) feet in length.

Unacceptable means of compliance: Safety monitors.

Example of an acceptable means of compliance: A warning barrier fifteen (15) feet from the potential fall hazard. The exception to this will be for roofers performing roofing activities. They will be allowed to move closer to the edge and establish their warning barrier at six (6) feet. Anyone required to cross the fifteen (15) foot or six (6) foot barrier line must comply with the fall protection policy. The barrier shall consist of ropes, chains or wires supported by stanchion posts erected as follows:

- The system shall be flagged at no more than six (6) foot intervals with a high-visibility material.
- The system shall be rigged and supported in such a way that its lowest point (including sag) is no less than thirty-four (34) inches from the walking/ working surface and its highest point is no more than thirty-nine (39) inches from the walking / working surface.
- After the system is erected, the stanchions shall be capable of resisting, without tipping over, a force of at least sixteen (16) pounds applied

horizontally against the stanchion, thirty (30) inches above the walking / working surface, perpendicular to the warning line, and in the direction of the floor, roof or platform edge.

- The system line shall have a minimum tensile strength of 500 pounds and after being attached to the stanchions, shall be capable of supporting without breaking, the loads applied to the stanchions noted in the above item.
- The line shall be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.

XI. Emergency Telephone Numbers

Emergency telephone numbers for the ambulance, hospital, fire department, and police shall be posted in each jobsite office at each phone. Each contractor shall furnish The Christman Company with the emergency contact phone numbers for all key project personnel (e.g. jobsite supervisors, project managers, foreman, etc.). Contact numbers shall include mobile home, pager and other phone numbers available and necessary to access key personnel in the event of a project emergency. Distribution of these numbers will be limited and considered confidential.

XII. First Aid

Each subcontractor shall provide The Christman Company with the name or names of each designated first-aid certified worker. Each subcontractor is required to have at least one (1) certified worker on site during periods when the subcontractor is active.

The Christman Company will have a first aid kit on site at the Project office. Each subcontractor shall also provide a first aid kit on site.

XIII. Injury/ Accident Reporting and Investigation

Any worker incurring an injury while working at the **MT. Hope** Project site shall report the injury to his supervisor immediately. **All injuries shall be verbally reported to The Christman Company the day of the incident/accident, followed up in writing on the proper forms, within twenty-four (24) hours.** Each incident/accident shall be documented using an accident investigation report similar to The Christman Company report (refer to Attachment II). In the event of an accident, the following steps shall be taken:

A. Make sure that accident victim receives appropriate medical attention. This may involve calling paramedics, arranging transportation to a hospital, or sending victim to a clinic depending on severity of injury.
B. Notify The Christman Company's Superintendent immediately regardless of the seriousness of the incident or accident. This includes property damage.
C. Perform a thorough investigation of all facts and circumstances surrounding the accident. This should include:

1. Photographs of the accident site and any other pertinent areas or conditions, which document the circumstances existing at the time of the accident.
2. Determine who, if anyone witnessed the accident. Obtain names, addresses and phone numbers and get written statements from them as to what they saw and any other facts they may be aware of regarding the accident and its cause.
3. Interview the accident victim to hear his/her explanation of how the accident occurred.
4. Fully complete an accident investigation report and submit a copy to The Christman Company's Superintendent.

All accidents resulting in property damage shall be reported immediately to The Christman Company Project Superintendent in order to allow for documentation of the extent of damage and determination of any required corrective action.

XIV. Assured Grounding Program

This program may be used to ensure that the scheduled inspection and safety condition of construction electrical equipment grounding conductors is satisfactory. The program applies to all extension cords and receptacles not part of the permanent building or structural wiring.

A. Inspection Procedure

The inspection procedure for all extension cords, attachment caps, plug/receptacle sets and equipment powered by a plug-in cord will include visual inspection at the beginning of each shift for signs of damage, defects, missing pins or insufficient insulation. Defective equipment will be removed from service until repaired and / or replaced.

B. Test Procedure

The test procedure for all extension cords and receptacles that are not permanent wiring includes testing for electrical conduction and correct attachment to the equipment ground conductor. The frequency of these tests will be as follows:

1. Prior to the first use.
2. Before equipment is returned to service following any repairs.
3. Before equipment is used following an incident which may have resulted in equipment damage.
4. At intervals not exceeding three months. Quarters and tape color should be coded following inspection. Winter (January through March) will be coded in white; Spring (April through June) will be coded in green; Summer (July through September) will be coded in red; and Fall (October through December) will be coded in brown.

Testing for each quarter is expected to occur between 15 days prior to and 15 days after the beginning of that quarter.

Each subcontractor is responsible for assigning a properly qualified person to coordinate their Assured Grounding Program and ensure compliance with this procedure and any other applicable codes and regulations.

Other forms of testing will be accepted as long as the record documentation of the testing can be provided upon request.

XV. General Jobsite Safety Rules

Violation of any of the following general jobsite safety rules is considered to be extremely serious and a detriment to the safety and welfare of all workers. Violation of these safety rules will be cause for disciplinary action up to and including permanent removal from the project.

A. Report all injuries to the field office. Get first aid promptly.
B. Keep your mind on your work at all times. No horseplay on the job.
C. Personal safety equipment must be worn as prescribed for each job, such as: safety glasses for eye protection when sawing or chipping concrete or masonry; hard hats at all times within the confines of the Project site; gloves when handling materials that are harmful to the skin; safety shoes for protection against foot injuries – no tennis shoes, sneakers, or other light duty shoes.
D. Keep your shirt on to prevent sunburn and to protect against acid burns, steam burns, weld splatter and cuts. Minimum clothing for upper body is a "T" shirt. Legs to be protected by long pants – no shorts allowed.
E. If any part of your body should come in contact with an acid or a caustic substance, rush to the nearest water available and flush over the affected part. Secure medical aid as soon as possible.
F. Watch where you are walking. Don't run.
G. The unauthorized use, sale, possession or distribution of alcohol, narcotics, drugs or controlled substances while working or working while under the influence of these substances is prohibited.
H. Do not distract the attention of fellow workers – to do so may cause injury.
I. Sanitation facilities are provided for your use. Use them.
J. Good housekeeping is a must. Keep your work area free from rubbish and debris. Keep materials, tools, and equipment in a neat and orderly fashion.
K. Do not use a compressor to blow dust or dirt from your clothes, hair, face, or hands.
L. Use a respirator when working on operations where dust or fumes are present.
M. Never work aloft if you are afraid to do so, are subject to dizzy spells, or if you are apt to be nervous or sick.
N. In case of injury to a fellow worker, go for help. Never move an injured person unless it is absolutely necessary – further injury may result. Keep the injured as comfortable as possible and utilize jobsite first aid supplies until medics arrive.
O. Know where firefighting equipment is located and learn how to use it.
P. Learn to lift correctly – with the legs, not the back. If a load is too heavy, GET HELP.
Q. Riding material hoists, crane ball, and sideboards or with your legs dangling over the ends or sides of trucks is not permitted.

R. Do not use power tools and equipment until you have been properly instructed in their use and operation. Be sure that all guards are in place. Do not remove, displace, damage, or destroy any safety device or safeguard furnished or provided for use on the job, nor interfere with the use thereof.
S. Rope off or barricade danger areas. Do not enter an area, which has been roped off or barricaded.
T. If you must work around backhoes, cranes, trucks, and dozers, make sure operators are aware of your presence. All mobile equipment must have backup alarms.
U. Never oil, lubricate or fuel equipment while it is running or in motion.
V. Trenches 4 ft. in depth must have a ladder and over 5 ft. must be shored or sloped as required. Keep out of trenches or cuts that have not been properly sloped or shored. Inspect trenches and banks daily. Backfill material must not be stored closer than two feet from top of bank.
W. Use the "four and one" rule when using a ladder – one foot of base for every four feet of height. Always secure the bottom of the ladder with cleats and/or safety feet. Lash off the top of the ladder to avoid shifting. Ladders must extend three feet above a landing for proper use. Defective ladders must be properly tagged and removed from service.
X. Erect scaffolds according to manufacturers' recommendations.
Y. Use only extension cords of the three prong type and protected with a GFCI.
Z. The use of fall protection with safety lines when working from unprotected high places is mandatory. Always keep your lines as tight as possible.
AA. Never throw anything "overboard". Someone may be passing below.
AB. Open fires are prohibited.
AC. Floor perimeter and floor openings shall be properly guarded at all times. Perimeter cabling must be flagged. All covers for floor openings must be secured and marked, "Hole Cover Do Not Remove". A "hole" means a gap or void 2 inches or more in its least dimension, in a floor, roof, or other walking/working surface. Note – this includes mechanical and electrical sleeves.
AD. All personnel operating a manlift or forklift must be certified.
AE. No radios, MP3 players or personal listening devices are allowed on site.

XVI. Housekeeping

A clean work place is a safe work place. Every subcontractor and worker shall be responsible to adhere to the following housekeeping guidelines:

A. Pick up and dispose of trash and debris on a daily basis. A sufficient number of trash receptacles shall be provided and emptied with regularity.
B. **Work areas are to be kept clean, orderly and floors are to be swept daily.**
C. Leads, hoses, and extension cords shall be hung up with a nonconductive material, off all floors, stairways, and walkways.
D. Trash such as drinking cups, cans, and scraps from lunch are not to be thrown down, but disposed of properly in marked containers.

E. Materials, equipment, concrete forms, pipe, etc., are to be orderly stacked so as not to obstruct walkways, doors, stairways, ladders, other points of access or egress, etc.
F. Oil, grease, and other such liquid spills shall be cleaned up at the time of spill and are not to be left unattended.
G. Participation in mandatory cleanup programs if the project requires it.

XVII. Ancillary Safety Procedures

A. Lockout/Tagout – a procedure for cutting off all sources of energy or flow of medium to a piece of equipment or system. Refer to Attachment III.
B. Confined Space Entry – a procedure to assure that workers who perform work in a confined space is protected. Refer to Attachment IV.
C. Cranes – all cranes and cable (wire rope), rigged hoisting equipment shall have a current annual inspection by an accredited agency prior to working at this site. Contractors also are required to maintain a current annual inspection for the duration of the work. An accredited agency is a third party, which is recognized by the Department of Labor, Occupation Safety and Health Agency. A copy of the annual certification must be submitted to the respective general contractor immediately upon arrival on site. Rigging must be inspected and have required capacity tags.
D. Powder-Actuated Tool Operator – each powder-actuated tool operator will be certified in accordance with OSHA requirements. Operators will carry their certification card on their person while operating powder-actuated tools.
F. Hole Covers – Any contractor / trade that creates or exposes a hole or opening in a floor or wall is responsible to immediately protect the opening in accordance with OSHA regulations. At a minimum the hole is to be protected by barricades or a secured cover that is sufficient in strength to support any potential load that may be imposed. Additionally, anyone who removes a hole cover is responsible to protect the area while the exposure is present and to re-secure the cover or protection once the work is completed for that shift.

XVIII. Tobacco Use Protocol

Smoking and the use of all other tobacco products, is STRICTLY PROHIBITED anywhere on this job site. Violation of this policy will be cause for disciplinary action up to and including permanent removal from the project.

XIX. Crane Inspections

Each crane used at the Project site shall have a current annual crane inspection report, which documents that the crane has been inspected within the current year in accordance with established OSHA standards.

XX. Visitor Policy

All visitors to the Project site must report to The Christman Company Project Office upon arrival. All visitors shall comply with the policies and procedures of this Project Safety Manual while on site. Visitors are required to watch The Christman Company safety orientation video and sign the visitor release form. Visitors not sufficiently familiar with the jobsite shall be accompanied at all times by employees familiar with the Project. Visitors must wear a hardhat, Hi-Visibility shirt or safety vest, and proper footwear at all times while on site. Other PPE such as safety glasses are to be worn when the conditions warrant such protection. The contractor requesting approval of the visitor is responsible to issue the proper PPE that may be required.

XXI. Fire Prevention and Protection

A. Fire Prevention

1. Housekeeping
   Proper Housekeeping practices by all subcontractors will help to establish and maintain free and unobstructed egress from the project site. Housekeeping of the project is to be maintained by all subcontractors performing work on the site. It is each subcontractor's responsibility to report areas of the jobsite that present a likelihood of fire to The Christman Company superintendent. Depending on the type of construction and the participation of the subcontractors in daily housekeeping efforts, The Christman Company may create and enforce a mandatory cleanup policy that will be adhered to by all subcontractors.

2. Storage of Flammable and Combustible Liquids

   A. General Requirements
      1. Only approved containers and portable tanks will be used for storage and handling of flammable and combustible liquids.
      2. Approved metal safety cans will be used for handling and use of flammable liquids in quantities greater than one gallon. Plastic containers are prohibited. Flammable liquid materials may be used and handled in original shipping containers.
      3. For storage, use and handling of flammable liquids in quantities of one gallon or less, only the original container or approved metal safety cans may be used.
      4. Flammable or combustible liquids are not to be stored in areas used for exits, stairways or other high-traffic areas.
      5. No storage of flammable or combustible materials is to occur on any roof.

   B. Indoor Storage

      1. No flammable materials may be stored inside.
      2. Materials, which will react with water and create a fire hazard, shall not be stored in the same room with flammable or combustible liquids.

C. Outdoor Storage

1. All storage areas are to be created as to prevent the contamination of surrounding areas in the event of a spill. Proper consideration is to be given to the runoff of rainwater vs. the control of spilled or leaking materials.
2. Containers less than 60 gallons in size are to be placed in areas not to exceed a total of 1,100 gallons. Containers are to be separated by a five feet clearance and will not be nearer than 20 feet to a structure.
3. Portable tanks will not be nearer than 20 feet from any structure.

D. Gas and Oxygen Bottles

1. Full and/or partially used compressed gas cylinders must be attached to approved carts and turned off after each use.
2. All compressed gas cylinders regardless of content amount (full, partially full or empty), shall be properly stored and secured in the area designated by The Christman Company.
3. Valve protecting caps shall always be in place when cylinders are not connected for use.
4. When moving a cylinder, be sure to remove all gauges prior to the move. Be sure to use a rack when lifting a cylinder to and from upper elevations. Never move a cylinder by rolling it or by dropping it down to lower elevations.
5. Oxygen cylinders must be stored 20 feet away from fuel cylinders or separated by a solid 1- hour divider. Storage is considered as not being used within the next shift of work or 24-hour period, which is ever shorter. Oil and grease must be kept away from oxygen cylinders.
6. Compressed gas cylinders shall be legibly marked with the chemical or trade name of the gas. Marking shall be by stenciling, stamping, or labeling and shall not be readily removable.
7. All L.P.G. not connected for use <u>must</u> be properly stored in the designated area. NO EXCEPTIONS!

E. Temporary Heat

1. Temporary heaters must be installed and serviced by authorized technicians only.
2. Housekeeping in the area of the heater is extremely important and all subcontractors are responsible to insure that no materials are stored near the heater or in such a fashion that they may create a hazardous condition.
3. All temporary fuel burning heaters are to have functioning safety valves that will eliminate fuel flow in the event of flame outage.

4. If a heater is to operate for an extended period of time it must have a daily scheduled inspection to insure that it is operating correctly and that the area is clear of possible obstructions.
5. The Christman Company superintendent may assign maintenance, operation, and inspection responsibilities to a subcontractor.
6. All subcontractors are responsible to notify The Christman Company immediately in the event of a malfunctioning heater or potential for a hazardous condition.

F. Hot Work Operations and Permit Procedures

Many of Christman projects are within existing operating facilities. Clients may have established procedures at their facilities to ensure all safety precautions have been taken prior to initiating operations involving Hot Work. Additionally, Hot Work permits may be issued by Client operations personnel to control the work within operating areas and ensure that operator/maintenance/construction personnel are aware of client required safe work practices. It is the responsibility of all personnel entering client controlled operating areas to obtain the proper Client authorization and appropriate work permits. The Christman Company shall be informed of any intended Hot Work prior to initiating. The Christman Company will coordinate our Hot Work permitting program with any other existing program being implemented by the Client. Regardless if the Client has a Hot Work procedure, NO Hot Work shall take place without first coordinating with The Christman Company.

The purpose of this procedure is to eliminate the potential for injury to personnel and damage to equipment and property due to fire, sparks, heat or explosion resulting from cutting, welding and similar hot work.

A "Hot Work Permit" will be required by The Christman Company when using any equipment, tools or apparatus capable of generating heat, sparks or flames in any restricted areas; enclosed interior areas or as determined by the project superintendent or site safety manager (Refer to attached Hot Work Permit). The Christman Company, through designation of a Permit Authorizing Individual (PAI), will ensure adherence to this Hot Work permit procedure. Failure to comply with this Hot Work Permit procedure may result in immediate and permanent removal from the project. The discipline policy as described in section IV of the project specific safety manual will be enforced.

Upon issuance of the proper work permit by Christman or the Client's representative, the PAI shall completely perform the required actions indicated on the permit, check all boxes on the permit, and sign off on it. The PAI shall print their name and sign the work permit verifying he has reviewed the permit and understands the limitations and requirements within.

Upon receiving the permit, it is the responsibility of the PAI to review the permit with his employees/crew explaining the precautions and limitations of the proposed task and assure that the permit system is implemented correctly.

The following conditions apply to all hot work permits:

- The contractor will be responsible for providing all the required training, materials, personnel and protective equipment to conduct all hot work.
- Contractor personnel who perform fire watch duties must be trained to perform the task and trained to use a fire extinguisher.
- A permit is not valid for more than one shift. In any case, the duration of the Hot Work Permit shall not exceed 12 hours. A new permit is to be issued if the job/task duration exceeds 12 hours.
- Prior to starting operations, the working areas and any levels below must be reviewed to assure that flammable material and equipment has been removed from harm's way.
- Adjacent contractors have been informed of the impending hot work.
- Contractor supplied firefighting equipment must be in place and readily available for worker use.
- A restricted zone must be established outside of the working area and at any areas levels accessible below.
- A fire watch must be established and maintained for a designated period after hot work has been completed. The duration of the fire watch is dependent upon the type of hot work being performed and the working area. Fire watch can range from one (1) to two (2) hours.
- Hot work permits must be prominently displayed within the hot work area and available for review. Workers assigned to fire watch duty must be readily identifiable and within the area. Fire watch must be maintained through break and lunch periods.

Occasionally Special conditions may apply to hot work permits, based on the environment of the work area and the type of operations being performed. Special conditions to the permit may include the following:

- Fume monitoring and control measures.
- Flame retardant ground and wall coverings.
- Extended fire watch
- Dosing or spray down of work areas after hot work completion.
- Use of smoke and carbon monoxide detectors.
- Oxygen and gas monitoring.

Hot work permits are to be collected by the PAI at the expiration of the permit, conclusion of task or end of shift. After the permit has been closed out they are to be submitted to The Christman Company superintendent or site safety manager for review.

Copies of the permit will be retained by The Christman Company for the duration of the project.

B. Fire Protection

1. A means of egress shall be established and maintained. Each subcontractor is responsible to notify The Christman Company if the means of egress is not obvious or if it is obstructed.

2. The rules for evacuation will be posted on the project bulletin board area adjacent to the other OSHA required postings. A copy of this emergency evacuation plan is included in this manual. It is the responsibility of each subcontractor to make their employees aware of any such posted or otherwise conveyed rules, maps or procedures for the safe and orderly evacuation of the project.

3. Emergency phone numbers shall be posted next to each phone in the jobsite trailer or office.

4. Firefighting equipment shall be provided by the subcontractor for protection of their employees. In some cases, The Christman Company may provide "common area" protection. Each subcontractor is to coordinate their efforts to comply with this rule with The Christman Company superintendent. Defective equipment shall be immediately replaced and brought to the attention of The Christman Company superintendent.

5. Fire walls and exit stairways required for the completed buildings are given construction priority. Fire doors with automatic closing devices shall be hung on openings as soon as practicable.

6. Retain existing fire separations in buildings undergoing alterations or demolition until operations necessitate their removal.

C. Employee Emergency Action Plan

The Christman Company's project superintendent shall be the person in command in the event of a fire or other emergency. It shall be his responsibility to oversee that employees are evacuated and the emergency response team is notified. The superintendent shall designate another employee as second in command. Fires and other emergencies shall be reported to the superintendent immediately. All employees are required to familiarize themselves with the evacuation plan for the site and with the designated contacts for emergency response team.

In the event of a fire or other emergency, employees shall evacuate the building through the nearest exit after determining it is safe to do so. Upon exit from the unsafe area, the employee should contact his superintendent and coordinate efforts

to call the emergency response team (911). Each foreman or superintendent is responsible for a head count of their employees after evacuation. The Christman Company superintendent is to be notified of any missing employees.

If critical operations must be conducted or continued within or near an unsafe area during a fire or other emergency and the superintendent deems that limited activity may continue in the area, the superintendent shall establish a plan to monitor those employees in the unsafe area as well as a way to quickly evacuate them should the conditions become worse. If monitoring and quick evacuation are not possible, the operations shall be abandoned until conditions improve.

All employees are responsible for the joint welfare of all other employees. During evacuation, ambulatory employees trained in first-aid/CPR are responsible to assess the conditions of non-ambulatory employees and assist in their evacuation. Employees who cannot be moved must be reported to the superintendent upon evacuation.

PROJECT SAFETY MANUAL

SUBCONTRACTOR AND TRADE CONTRACTOR ACKNOWLEDGEMENT

I hereby acknowledge receipt and comprehension of the policies and procedures set forth in this Manual and agree to comply with its directives.

In addition, I hereby agree to comply with any field or trade-related guidelines as they apply to the portion of work for which I have been contracted and will incorporate them into the ongoing safety effort. I also understand and agree to comply with any State and Federal OSHA and ANSI regulations, standards, codes and rules as they apply to my portion of the work.

_____
(Signed)

_____
(Print Name)

_____
(Title)

_____
(Company Name)

_____
(Date)

Please sign and fill out the information requested above and return to The Christman Company.

Drug Screening List

A. Any employee injured at the project site and needing offsite medical attention will be tested for alcohol and drugs. If the injured party was hurt by the action of another person who was not injured, this person must also submit to substance abuse testing. An employee who tests positive for illegal substances or alcohol will not be allowed to return to the project site. Any employee who refuses to submit to substance abuse testing after an injury/accident which involves offsite medical attention will not be allowed to work at the project site.

Notes:

a. All staff/trades working at the project site shall be subject to the provisions of this program. Visitors and delivery personnel are not included.
b. Substance abuse testing shall include the drugs listed in c (below) and alcohol.
c. The drug-screening test shall include testing for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, methadone, methaqualone, opiates, phencyclidine, and propoxyphene. Refer to the following listing, commonly referred as a Panel 10 Drug Screening:

DRUG GROUP	COMMON NAME	DRUG OR METABOLITE DETECTED
Amphetamines	Speed, Eve, Crystal	Amphetamines, Methamphetamines
Barbiturates	Secobarbital, Pentobarbital, Phenobarbital, Butabarbital	Diverse
Benzodiazepine	Valium, Librium	Oxazepam
Cannabinoids	Marijuana, Pot, Smoke, Weed, Mary Jane, Ganja	Delta-9-THC-9-COOH
Cocaine	Coke, Blow, Crack, Tool	Benzoylecgonine
Methadone	Methadone, Met	Methadone
Methaqualone	Quaalude, Ludes	Methaqualone
Opiates	Morphine, Codeine, Heroin, Horse	Codeine, Morphine
Phencyclidine	PCP, Angel Dust, Acid, Ecstasy	PCP
Propoxyphene	Darvon	Propoxyphene

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ATTACHMENT II

ACCIDENT INVESTIGATION REPORT

Employee Name _____ Date of Birth _____
Home Street Address _____ Male or Female _____
City, State, Zip _____ Date Hired _____
Home Phone _____ Date of Injury or Illness _____
Emergency Phone _____ Time Employee Began Work _____
Case # From Log _____ Time of Event _____

If a subcontractor on job, please fill out the following information:

Employer Name _____ Position _____
Work Comp Insurance _____ Policy # _____

Project Name & Location _____ Project # _____

Did injury result in a fatality? _____ Date of Death _____ Did injury result in lost time? ____ # of Days of Lost Time _ _____

Drug test given? _____ Did injured seek medical attention offsite? _____ Name of Physician _____
Name and address of facility _____
Was person treated in emergency room? _____ Was person hospitalized overnight as in-patient? _____

What was injured doing just before incident occurred? (Describe activity as well as tools or equipment used. Be specific.)

_____
_____

Describe the injury. (Be specific: cut, fracture, burn, strain, body part affected.)

_____
_____
_____

Describe events causing injury. (who, what, where, when, why, how)

_____
_____
_____

Identify unsafe acts, conditions, contributory factors, environmental conditions.

_____
_____

Witnesses to accident. (name, address, phone number)

_____
_____

Describe steps taken to prevent future accidents of this nature.

_____
_____

Severity Potential: _____ Major _____ Serious _____ Minor Have similar accidents occurred before? _____

_____ _____
Superintendent Signature & Date Injured Signature & Date

Date: June 26,2023

Lockout/Tagout Procedure

Requirement

Whenever service, maintenance, or inspection is performed on machines, equipment, electrical circuits, or systems, it must be done with the machine, equipment, electrical circuit, or system stopped and isolated from all sources of energy or flow of medium. The energy isolation device(s) or isolation values for that machine, equipment, electrical circuits, or systems must be locked out and tagged out in accordance with a documented procedure. Employees involved in the energy control program must be given training. When subcontractor employees are performing work at the Project site, they must coordinate with The Christman Company and any other employer to ensure that no employees are endangered. When a group of employees is performing a service, maintenance, or inspection activity, each employee must be afforded protection equivalent to the utilization of individual lockout/tagout.

Lockout/Tagout Procedure

This procedure establishes the minimum requirements for the lockout/tagout of energy isolating devices and flow isolation values whenever maintenance, servicing, or inspection is done on machines, equipment, electrical circuits, or systems. It shall be used to ensure that the machine, equipment, electrical circuit, or system is isolated from all potentially hazardous energy sources or flows, and locked out before employees perform any servicing, maintenance, or inspection where the unexpected energization or startup of the machine, equipment, electrical circuit, or system or release of stored energy/flow could cause injury.

All subcontractors are required to comply with the restrictions and limitations imposed upon them during the use of this procedure. All employees are required to perform the lockout in accordance with this procedure. All employees, upon observing a machine, piece of equipment, or system which is locked out to perform servicing, maintenance, or inspection, shall not attempt to start, energize, or use that machine, equipment, or system. Failure to follow this procedure will result in disciplinary action.

Sequence of Lockout

1. Notify all affected employees that servicing, maintenance, or inspection is required on a machine, equipment, electrical circuit, or system and that the machine, equipment, electrical circuit, or system must be shut down and locked out to perform the servicing, maintenance, or inspection.
2. The employee shall refer to any and all sources to identify the type and magnitude of the energy that the machine, equipment, or electrical circuit utilizes, shall understand the hazards of the energy, and shall know the methods to control energy. The type and source of medium which is flowing in a system to be worked on shall be identified and system isolation values located. All flows shall be stopped and the lines to be worked on purged prior to the commencement of work.

3. If the machine, equipment, or electrical circuit is operating, shut it down by normal stopping procedure (depress stop button, open switch, close valve, etc.).
4. Deactivate the energy isolation device(s) so that the machine, equipment, or electrical circuit is isolated from all energy sources. Close isolation values or shut down equipment which is used to provide flow to the system.
5. Lock out the energy isolation device(s) with assigned individual lock(s). Tagout isolation values and/or equipment.
6. Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc.) must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down, etc.
7. Ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed, then verifying the isolation of the equipment by operating the push button or other normal operating control(s) or by testing to make certain the equipment will not operate.

   CAUTION: Return operating control(s) to neutral or "off" position after verifying the isolation of the equipment.
8. The machine, equipment, electrical circuit, or system is now locked and/or tagged out. The employee(s) that installed a lock shall apply tag(s) identifying who locked the piece out, the date, and the time.

Restoring Equipment/System to Service

When the servicing, maintenance, or inspection is complete and the machine, equipment, electrical circuit, or system is ready to return to normal operating condition, the following steps shall be taken:

1. Check the machine, equipment, or electrical circuit and the immediate area around the machine, equipment, or electrical circuit to ensure that nonessential items have been removed and the machine, equipment, or electrical circuit components are operationally intact.
2. Check the work area to ensure that all employees have been safely positioned or removed from the area.
3. Verify that the controls are in neutral.
4. Remove the lockout/tagout devices and re-energize the machine, equipment, or electrical circuit.
5. Notify affected employees that the servicing, maintenance, or inspection is complete and the machine, equipment, or electrical circuit is ready to use.

CONFINED SPACE ENTRY PROCEDURE

I. Definitions

A. Confined Space
Confined space means any space having a limited means of egress which is subject to the accumulation of toxic or flammable contaminants or has an oxygen-deficient atmosphere. Confined spaces include, but are not limited to: storage tanks, tunnels, pipelines and open top spaces such as pits, tubs, vaults, caissons and vessels.

B. Hazardous Atmosphere
Hazardous atmosphere means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (escape unaided from a permit space), and injury or illness from one or more of the following causes:

1. Flammable gas, vapor, or mist in excess of 10% of its lower flammable limit (LFL).
2. Airborne combustible dust at a concentration that meets or exceeds its LFL. Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of five (5) feet or less.
3. Atmospheric oxygen concentration below 19.5% or above 23%.
4. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published as subpart "G", Occupational Health and Environmental Control, or in subpart "Z", Toxic and Hazardous Substances which could result in employee exposure in excess of its dose or Permissible Exposure Limit.
5. Any other atmospheric condition that is immediately dangerous to life or health.

II. Owner/Client's General Requirements

A. The owner/client shall evaluate the work place to determine if any spaces are permit-required workspaces.
B. If the work place contains permit spaces, danger signs shall be posted at all points of entry to each space. Example: Danger, Permit Required Confined Space, Do Not Enter.
C. Identify the elements, hazards, and previous experience with each space that make it a permit space.
D. Identify any implemented precautions and procedures used by the owner/client to protect his employees in or near each space.

III. Subcontractor Requirements

A. Each subcontractor shall obtain any available information regarding permit space hazards and entry operations from the owner/client and coordinate employee entry operations in or near permit spaces.
B. Each subcontractor who performs any work in permit required work spaces shall be responsible to follow the requirements of this confined space entry procedure.

Each subcontractor shall provide training for each employee involved with work located in permit required work spaces.

C. Subcontractors must provide documentation that training has been given. Said documentation shall contain each employee's name, ID of trainer, and dates of training. Subcontractor employee duties relative to this procedure are as follows:

1. Entry Supervisors Duties
    a. Identify the need to implement this procedure.
    b. Responsible to follow the procedure requirements.
    c. Complete safe entry checklist.
    d. Complete a confined space entry permit for each 8-hour period.
    e. Knows, understands and insures training of the authorized entrants and attendants.
    f. Checks appropriate permit information, assuring all tests have been made and recorded. Knows the hazards that may be faced during entry, including mode information, signs or symptoms, and exposure consequences.
    g. Terminates the permit if required.
    h. Verifies rescue services are available.
    i. Removes unauthorized individuals from the permit space.

2. Attendant Duties
    a. Knows the hazards that may be faced during entry, including mode information, signs or symptoms, and exposure consequences.
    b. Is aware of possible behavioral effects of hazard exposure of entrants.
    c. Continuously maintains a count and identification of who is in the permit space. Verifies that all entrants have exited the confined space at the end of the work shift.
    d. Remains outside the space until properly relieved by another attendant.
    e. Monitors activities inside and outside the space to determine if it is safe for entrants.
    f. If the attendant detects behavioral effects of hazard exposure, he/she must be knowledgeable to:
        i. Summon rescue and other emergency services.
        ii. Warn authorized entrants.
        iii. Perform non-entry rescues.
        iv. Perform no duties that might interfere with the primary duty to protect authorized entrants.

3. Authorized Entrant Duties
    a. Know the hazards that may be encountered.
    b. Know how to properly use protective and emergency equipment required.

c. Know how to communicate with attendant.

IV. Procedures

A. General

All employees required to enter into a confined space shall be instructed in:

1. The nature of the hazard involved.
2. The precautions required.
3. The use of personal protective equipment and emergency equipment required. No employee shall be permitted to enter a confined space unless the following steps have been completed:
    a. A tested ventilation system is in place to ensure the removal of harmful gases, vapors, smoke, fumes, mists or dusts from within the confined space.
    b. The employee has been provided with and is wearing appropriate respiratory protective equipment.
    c. Where presence of toxic gas is suspect, appropriate gas tests shall be performed immediately prior to entry to determine the presence of any harmful gases, fumes, mists, vapors, smoke, dusts or an oxygen deficiency. Re-testing shall be done at least every four (4) hour intervals. During the presence of employees in the confined space, to ensure harmful concentrations of gases, vapors, smoke fumes, mists or dusts or any oxygen deficiency has not developed, gas test results shall be taken and logged.

B. Environmental Testing

Before entry into any confined space suspected of having mixtures or concentrations of flammable and/or toxic air contaminants or oxygen deficiencies, appropriate tests of the atmosphere shall be made by a qualified person to assure that, explosive limits are less than 10% LEL, that toxic gas levels (TLVs) as specified by established health data sheets are not exceeded and that oxygen concentrations are greater than 19.5% but less than 23% of the total air mixture.

A confined space found to have or suspected of having oxygen deficiency or exceeding flammable or toxic limits shall be:

1. Reported promptly to The Christman Company Supervisor on site.
2. Posted with the appropriate warning signs.
3. Ventilated or exhausted.
4. Re-checked by a qualified person prior to entry.

During inert gas welding, portable and/or fixed oxygen analyzers with visual/audible, alarms shall be provided in areas where oxygen deficient atmospheric conditions may

develop. Continuous oxygen monitors, equipped with alarms shall be provided in areas designated.

All monitoring and testing equipment shall be maintained in accordance with the manufacturer's specifications.

C. Personal Protective Equipment

Work and/or rescue equipment shall be immediately available at all times and shall be selected with the potential hazards or possible contingencies determining the equipment which may be required during the work operations.

Appropriate eye, face, and ear protection and the designated protective clothing shall be worn by employees exposed to physical hazards.

Where air sampling has determined that flammable or toxic limits have been exceeded or an oxygen deficiency exists and accepted engineering control measures such as general and local ventilation are not feasible, air supplying respiratory protection shall be worn.

Employees entering a confined space where a harmful or potentially harmful atmosphere exists, shall wear an approved safety harness attached to a life line which is attended at all times by another worker stationed outside the confined space entrance. The outside worker shall be equipped to be capable of immediately rescuing the worker in the confined space. A mechanical device shall be available to retrieve personnel from vertical spaces more than 5 feet deep.

When an employee enters a confined space from the top, the employee shall wear a safety harness, which will keep the individual in a vertical position if a rescue is required.

Where the work being performed requires more than one worker to enter the confined space, provisions shall be made to prevent safety lines or air hoses from becoming entangled.

Where air sampling has determined flammable or toxic limits have been exceeded or an oxygen deficiency exists, and acceptable engineering controls such as general or local ventilation is not feasible, appropriate respiratory protection for the identified hazards shall be worn.

D. Ventilation/ Exhaust

When ventilation is used as a control method in maintaining acceptable concentrations of flammable and toxic contaminants, this section will be used as a guide in the installation and operation of ventilation systems.

1. Ventilation/exhaust will be constructed, maintained and operated to ensure the required protection, by maintaining a volume and velocity of exhaust air sufficient to gather dusts, fumes, vapors or gases from the confined or enclosed space and to convey them to suitable points of safe disposal.
2. Periodic air sampling for flammable and toxic materials and oxygen deficiencies shall be performed before and during employee work assignments in the confined or enclosed space to ensure a safe environment is maintained.

E. Lighting/ Electrical

1. Lighting will be provided in areas where there is insufficient natural light.
2. For work areas that may contain concentrations that exceed safe limits of flammable or combustible materials, appropriate lighting systems such as explosion-proof fixtures, switches or equipment shall be used. All electrical equipment is to conform to article 500 of the National Electrical Code.
3. Emergency lighting shall be provided at all points of access and egress. When this is not practical, explosion-proof flashlights shall be provided to persons required to enter confined or enclosed spaces, which are subject to blackout.
4. In areas of high moisture, portable electric lighting shall be operated at a maximum of 12 volts.

F. Communications

Constant communications shall be maintained with all personnel in confined spaces by personnel outside those areas. This shall be accomplished by utilizing one or more of the following methods:

1. Visual surveillance
2. Voice communication
3. Telephone communication
4. Two-way radio communication

Note: Proper method(s) will vary depending on whether an explosive atmosphere exists.

G. Fire Protection

Fire protection shall be assured in confined spaces at all times. This shall be accomplished by adherence to the following:

1. Safe access and egress will be maintained at all times when work is being performed in a confined space. Access ladders, floors and components that are constructed out of combustible materials shall be protected, covered or wrapped with a flame-retardant material.
2. Flammable liquids (i.e. acetone, alcohol, etc.) must be stored in approved (UL or FM) flammable liquid containers or dispensers. The amount of such flammable

liquid(s) in a confined space shall not exceed the amount necessary to perform the work each day.

3. Properly rated fire extinguishers shall be immediately available. In instances where extreme fire potential exists, a charged fire hose shall be readily available for immediate use.
4. Cylinders containing oxygen, acetylene or other fuel gases shall not be taken into confined spaces.
5. All rags, brushes, wipes, gloves, etc. shall be stored in metal containers with lids.
6. A person shall be stationed during all welding, burning and heating operations to monitor for fires and to ensure that, during and after the work has ceased or at the end of a work shift, there are no fire conditions present. A thorough check of welding and cutting areas is to be made at the end of each welding operation to assure NO fires have been started.
7. All flammable gas equipment, hoses, torches, etc. shall be free of defects and are to be inspected prior to each use.
8. To eliminate the risk of fire in confined spaces because of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch shall be shut off whenever the torch is left unattended for long periods of time. Fuel gas and oxygen hoses shall be immediately removed from confined spaces before they are disconnected from the torch or other gas-consuming device, and at the end of each work shift.

H. Lockout Procedure

All lines, pipes or other conveyance of flammable and/or toxic materials into a confined space shall be positively locked out and tagged in accordance with the Project Lockout/ Tagout Procedure.

I. Recordkeeping Requirements

1. A safe entry checklist (example attached) shall be completed and reviewed with The Christman Company Supervisor on Site.
2. A properly executed confined space work permit (example attached) is to be obtained before work may begin in a confined or enclosed space. All entrances into the confined space shall be posted with a copy of the permit.
3. A file of sampling results will be kept for each confined space and will be maintained by The Christman Company Supervisor on Site.

J. Rescue

Whenever work is to be performed in a confined space, emergency rescue must be anticipated and a rescue plan developed. In the event of an emergency, The Christman Company Supervisor on Site will coordinate and work with emergency medical and rescue personnel. Rescue plans will encompass all foreseeable contingencies that might occur when working in confined spaces. The Christman Company Supervisor on Site

will be responsible for training employees in emergency procedures such as rescue and escape.

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Confined Space Safe Entry Checklist

DO NOT ENTER A CONFINED SPACE UNTIL YOU HAVE CONSIDERED EVERY QUESTION AND HAVE DETERMINED THE SPACE TO BE SAFE.

Description of confined space _____
Subcontractor involved _____ Date _____
Subcontractor Supervisor _____

YES	NO	
[ ]	[ ]	Is entry necessary?

TESTING

YES	NO	
[ ]	[ ]	Are the instruments used in atmospheric testing properly calibrated?
[ ]	[ ]	Was the atmosphere in the confined space tested?
[ ]	[ ]	Was oxygen at least 19.5% - not more than 23%?
[ ]	[ ]	Were toxic, flammable, or oxygen-displacing gases/vapors present?

- Hydrogen sulfide
- Carbon dioxide
- Carbon monoxide
- Other (list) _____
- Methane

MONITORING

YES	NO	
[ ]	[ ]	Will the atmosphere in the space be monitored while work is going on?
[ ]	[ ]	Continuously?
[ ]	[ ]	Periodically? (If yes, give interval:) _____

REMEMBER – ATMOSPHERIC CHANGES MAY OCCUR DUE TO THE WORK PROCEDURE OR THE PRODUCT STORED.

CLEANING

YES	NO	
[ ]	[ ]	Has the space been cleaned before entry is made?
[ ]	[ ]	Was the space steamed?
[ ]	[ ]	If so, was it allowed to cool?

VENTILATION

YES	NO	
[ ]	[ ]	Has the space been ventilated before entry?
[ ]	[ ]	Will ventilation be continued during entry?
[ ]	[ ]	Is the air intake for the ventilation system located in an area that is free of combustible dusts and vapors and toxic substances?
[ ]	[ ]	If atmosphere was found unacceptable and then ventilated, was it retested before entry?

ISOLATION

YES	NO	
[ ]	[ ]	Has the space been isolated from other systems?
[ ]	[ ]	Has electrical equipment been locked out?
[ ]	[ ]	Have disconnects been used where possible?
[ ]	[ ]	Has mechanical equipment been blocked, chocked, and disengaged where necessary?

[ ] [ ] Have lines under pressure been blanked and bled?

CLOTHING/ EQUIPMENT

YES NO

[ ] [ ] Is special clothing required (boots, chemical suits, glasses, etc.)? (If so, specify:) _____

[ ] [ ] Is special equipment required (e.g. rescue equipment, respirators, communications equipment, etc.)? (If so, specify:) _____

[ ] [ ] Are special tools required (e.g. spark-proof)? (If so, specify:) _____

RESPIRATORY PROTECTION

YES NO

[ ] [ ] Are MSHA/NIOSH-approved respirators of the type required available at the work site?

[ ] [ ] Is respiratory protection required (e.g. air purifying, supplied air, self-contained breathing apparatus, etc.)? (If so, specify type:) _____

TRAINING

YES NO

[ ] [ ] Have you been trained in proper use of a respirator?

[ ] [ ] Have you received first aid/CPR training?

[ ] [ ] Have you been trained in confined space entry and do you know what to look for?

STANDBY/RESCUE

YES NO

[ ] [ ] Will there be a standby person on the outside in constant visual or auditory communication with the person on the inside?

[ ] [ ] Will the standby person be able to see and/or hear the person inside at all times?

[ ] [ ] Has the standby person(s) been trained in rescue procedures?

[ ] [ ] Will safety lines and harness be required to remove a person?

[ ] [ ] Are rescue procedures available and can they be followed in the event of an emergency?

[ ] [ ] Are you familiar with emergency rescue procedures?

[ ] [ ] Do you know who to notify and what to do in the event of an emergency?

PERMIT

(This permit is an authorization in writing that states that the space has been tested by a qualified person, that the space is safe for entry; what precautions, equipment, etc. are required; and what work is to be done.)

YES NO

[ ] [ ] Has a confined space entry permit been issued?

[ ] [ ] Does the permit include a list of emergency telephone numbers?

REVIEWED: _____ DATE: _____

The Christman Company

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Confined Space Entry Permit
(Permit valid for 8 hours only)

Site Location and Description	Date:	
	Time:	AM/PM
Purpose of Entry	Expires:	AM/PM
Name of Employer (Subcontractor)		

SUPERVISOR(S) IN CHARGE OF CREWS	TYPE OF CREW	PHONE NUMBER

Italic print areas denote minimum requirements to be completed and reviewed prior to entry

REQUIREMENTS COMPLETED	DATE	TIME	REQUIREMENTS COMPLETED	DATE	TIME
Lockout/De-Energize/Tryout			***Full Body Harness with "D" Ring***		
Line(s) Broken/Capped/Blanked			***Emergency Escape Retrieval***		
Purge/Flush/Vent			***Life Lines***		
Ventilation			Fire Extinguishers		
Secure Area (Post and Flag)			Lighting (Explosive Proof)		
Breathing Apparatus			Protective Clothing		
Resuscitator/Inhalator			Respirator(s) Air Purifying		
Standby/Safety Personnel			Burning and Welding Permit		

Note: Items that do not apply, enter N/A in the box. ***Record continuous monitoring results every 2 hours.**

CONTINUOUS MONITORING TEST(S) RESULTS:	PERMISSIBLE ENTRY LEVEL	TIME:	TIME:	TIME:	TIME:	TIME:	TIME:
Percent of Oxygen (O_2)	19.5% - 23.5%						
Lower Exposure Limit (LEL)	Under 10%						
Carbon Monoxide (CO_2)	+35 PPM						
Hydrogen Sulfide (H_2S)	+10 PPM						
Other							

NOTE: "+" denotes 8-hour time weighted average. Employee can work in area 8 hours (longer with appropriate respiratory protection).

ATTENDAT/GAS TESTERS	INSTRUMENT USED	MODEL AND/OR TYPE	SERIAL OR UNIT NO.

Attendant Standby Person is Required for all Confined Space Work

NAME OF CONFINED SPACE ENTRANTS(S)	NAME OF CONFINED SPACE ENTRANTS(S)

Supervisor Authorizing Entry: _____ Emergency Phone Number: _____

Reviewed by: _____
The Christman Company

Issue Date: 5/25/2023

MT. HOPE
IN CASE OF EMERGENCY CALL 9-1-1

NON-EMERGENCY CONTACTS

Emergency	Responder	Location	Phone
Fire	Lansing Fire Department	120 Shiawassee St, Lansing, MI 48933	(517) 483-4200
Police	Lansing Police – South Precinct	5815 Wise Rd, Lansing MI 48911	(517) 483-4660
Ambulance	Mercy Ambulance	1422 E Michigan Ave, Lansing, MI 48912	(517) 482-1245
Hospital	E.W. Sparrow Hospital St. Lawrence	1210 W Saginaw St, Lansing, MI 48915	(517) 364-1000

Directions to Hospital: INSERT DIRECTIONS. Report to the hospital registration/information desk or the emergency room in the event of an emergency.

ADDITIONAL PHONE CONTACTS

Lansing Board of Water & Light (Electricity)(Water & Sewer)	(517) 702-6000
Consumers Energy (Gas)	(517) 373-6100
Ingham County Treasurer's Office	(517) 483-6503
Lansing City Clerk Office	(517) 483-4131

NON-EMERGENCY CONTACTS

The Christman Company

On-Site Contact(s):	Mark Hietala, Superintendent	(810) 599-5299
	Austin Brown, Project Engineer	(517) 505-9401
	Noah Bush, Assistant Project Engineer	(517) 499-1410
Off-Site Contact(s):	Andrew Dobbs, Project Manager	(517) 230-5953
	Rob Crowe, Vice President	(517) 482-1488
	Don Staley, Vice President/Safety Director	(517) 819-9166

Date: June 26, 2023

EVACUATION PLAN

EVACUATE	**NON-EVACUATE**
Fire	Weather Conditions (Tornado)
Chemical Spills (interior)	Chemical Spills (exterior)
Earthquake	Civil Disorder
Bomb Threat	
Violence	
Bio Terrorism	

Designated Horn Signals

Stop Work Order- Repeated blasts of the Air Horn
Evacuation Order- Repeated two (2) pulse blast of the Air Horn
All Clear Order- Repeated three (3) pulse blast of the Air Horn

Non- Evacuate Plan

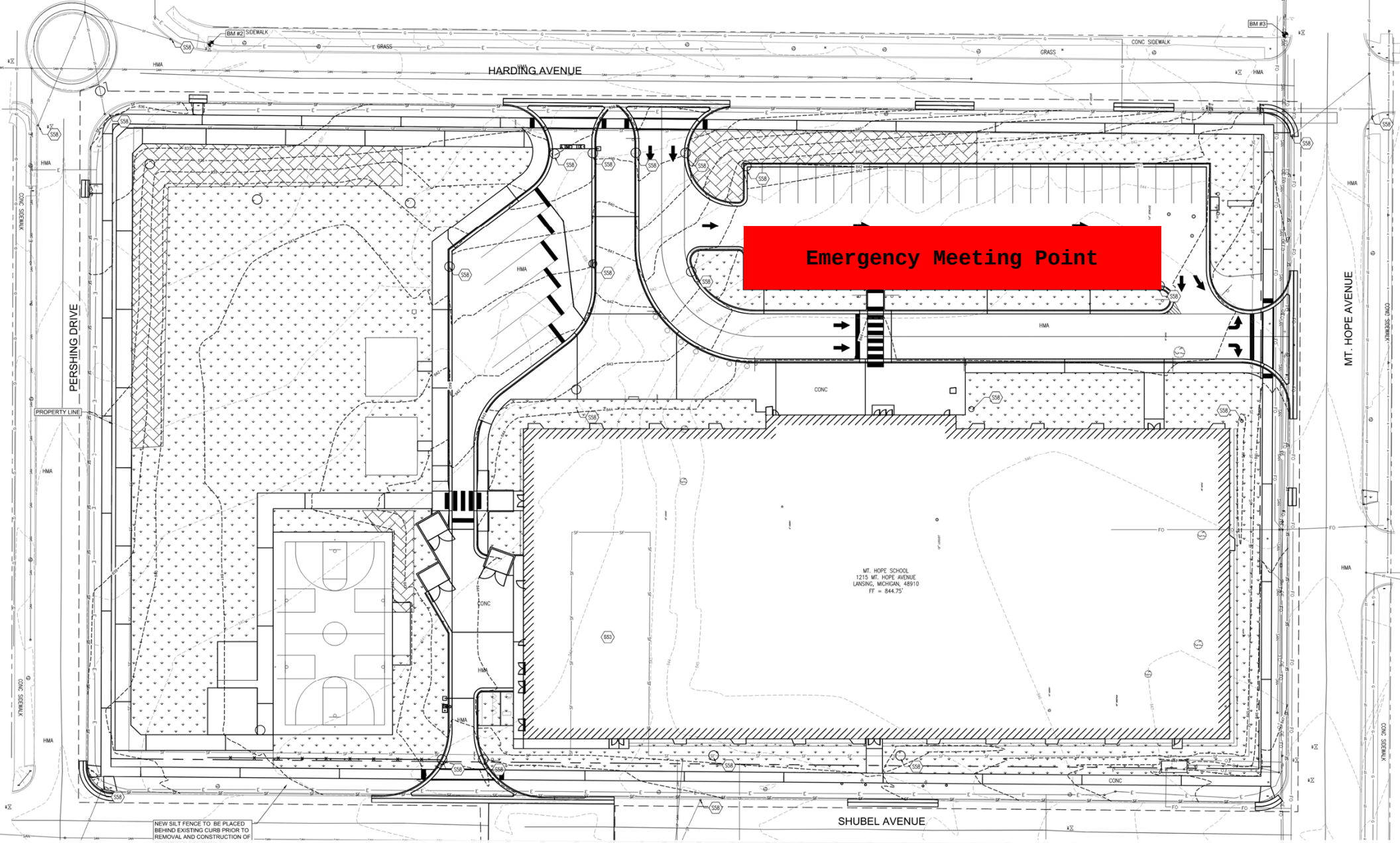
Repeated blasts from the air horn, work is stopped. Workers are to gather at their immediate location of work and report to their foreman for a head count.

Evacuation Plan

Upon enclosure of structure, emergency escape routes shall be posted for the exit ways. The procedure to be used for employee accountability after an emergency evacuation shall be as follows: Upon sounding of repeated two (2) pulse Air Horn blasts, all employees must immediately exit the building and report to their foreman, and assemble at the muster point as indicated on the Emergency Evacuation Map.

All Clear

Repeated three (3) pulse blasts form the air horn signals that everything is all clear. Work may resume and/or workers may re-enter the building.



Lansing School District

Mt. Hope
Emergency Evacuation Map

CHRISTMAN SINCE 1894

01010 SUMMARY OF WORK

01011 RELATED DOCUMENTS

1.1 Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections, apply to work specified in this section.

1.2 Information given in the Division 1 General Requirements shall supplement information given in the General and Supplementary Conditions. The most stringent provision in the General Conditions, General Requirements, Contract Drawings and Specifications shall govern the execution of any work or requirement.

01012 CONSTRUCTION MANAGER

1.1 The Christman Company is the Construction Manager. Wherever the term General Contractor or Contractor (in the context of the General Contractor) is used, it shall be given the same meaning as Construction Manager.

1.2 The Trade Contractor and his sub-Trade Contractors shall agree to and accept the same responsibility and follow the same terms of the Conditions of the Contract as the Construction Manager for the work for which he is under contract.

01013 PROJECT

1.1 The Work as defined in the General Conditions and described in the Contract Document.

01014 RELATED WORK NOT-IN-CONTRACT (NIC)

1.1 Reference Section 00210 for any work that will be performed by the Owner or accomplished under separate contract.

01015 REPLACEMENT MATERIAL (For Owner's future use)

1.1 If any specific amounts are called for in the individual Sections, provide the specified amounts. If none are specified and a surplus is left, request instructions from the Construction Manager before discarding the surplus.

01016 LABOR, MATERIALS, TAXES & WORKMANSHIP

1. LABOR AND MATERIALS

1.1 Unless otherwise specified in these Contract Documents, all materials and workmanship shall be new and of the best grade of their respective kind for the purpose.

1.2 Unless otherwise specifically provided in the Contract Documents, the Trade Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

1.3 The Trade Contractor shall at all times enforce strict discipline and good order among his

employees and shall not employ on the Work any unfit person or anyone not skilled in the task assigned to him.

2. TAXES

2.1 Unless tax exempt status is specifically noted, it is understood that the bid prices stated shall include all applicable Federal, State or other Governmental division taxes and assessments. Also, all contributions for unemployment compensation, health and welfare, old age benefits or other purposes now or hereafter effective during the term of the contract, and the Owner and Construction Manager shall not be liable for any additional charges therefore.

01017 CRITICAL PHASING & STAGES OF CONSTRUCTION

1. INTRODUCTION

1.1 Critical phasing and critical stages of construction have been established herein for the project. It is extremely important that the "Critical Phasing & Stages of Construction" requirements be understood and complied with.

1.2 The Construction Manager shall coordinate detailed critical phasing and sequencing and scheduling with the Owner's representative.

1.3 The Construction Manager shall provide overall scheduling and coordination for the entire project. All Trade Contractors shall acknowledge the Construction Manager's right to establish and set up, or subsequently modify, the sequencing and scheduling of all Work on this project for the earliest completion and/or benefit to the Owner.

1.4 All Trade Contractors shall expedite the ordering and delivering of materials and equipment, etc. to meet these critical phasing and staging requirements and to make every effort possible to minimize disruption of normal building usage.

2. BID SCHEDULES

2.1 The preliminary construction schedule narrative included in the Contract Documents represents the general order and time frames for work to be followed by the Construction Manager in coordinating the project. Trade Contractors are to assume that their work will be coordinated in a manner consistent with industry practice, and the efficient coordination of all other trades. Trade Contractors recognize and accept their work may be sequenced and paced by other trades.

2.2 Please note that although the schedule defines the planned order of construction, Bidders should not assume that any assurance is given or implied as to the calendar dates associated with completion of the work of a particular contract.

2.3 All Trade Contractors and Trade Subcontractors recognize and shall accept modifications to the schedule which are reasonable, in the opinion of the Construction Manager, for the general interest of the project as a result of allowable time extensions (formally or informally approved) in any contract, and such modifications are inherent to the construction process and shall not qualify as a basis for extra compensation from the Construction Manager or Owner.

2.4 The Trade Contractor, in submitting a proposal for the work of a particular work category, agrees to commit the necessary resources to complete the work activities of that work category, within a time span not greater than the planned duration. Work included within a work category, but not specifically defined by a particular work activity, is to be accomplished in a reasonable manner in conjunction with other work of the work category, and in such a way as

to avoid complication of or to delay the work of other Trade Contractors.

3. PROJECT SEQUENCING

3.1 GENERAL SEQUENCING

3.1.1 The overall project sequencing is indicated within the Preliminary Construction Schedule. Refer to Section 00200 and Section 01310.

3.2 RESTRICTIVE SEQUENCING & SCHEDULING

3.2.1 More restrictive sequencing to coordinate the Owner's on-going operations and/or for the coordination of the various trades shall be identified in Section 00210 SPECIAL PROVISIONS or as otherwise directed by the Construction Manager; All Trade Contractors agree to cooperate and alter their operations to maintain these more specified restrictions and sequences of the work.

3.3 SPECIFIC PROJECT REQUIREMENTS

3.3.1. Refer to the work category description and Section 00210 for specific information on scheduling requirements.

4. MUTUAL COOPERATION

4.1. Mutual cooperation between the Owner, the Architect, the Construction Manager, and the Trade Contractors to coordinate these construction and building operation requirements is anticipated and expected.

01018 USE OF SITE

1.1 Trade Contractor shall limit his use of the premises for his work and for storage to allow for (I) work by other Trade Contractors; (ii) Owner occupancy; and (iii) public use.

1.2 Limitations on site usage as well as specified requirements that impact site utilization are indicated on the drawings and by other contract documents. In addition to these limitations and requirements, the Construction Manager will administer allocation of available space equitably among entities needing both access and space so as to produce the best overall efficiency in performance as the total work of the project. Schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

1.3 Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.4 Trade Contractor shall assume full responsibility for the protection and safekeeping of products under his contract, stored on the site.

1.5 Move any stored products, under Trade Contractor's control, which interfere with operations of the Owner or separate Contractor.

1.6 Obtain and pay for the use of additional storage or work areas needed for operations.

1.7 Nonsmoking Property: Smoking is not permitted on Lansing School District Property.

01019 OWNER'S RIGHT TO OCCUPY

1.1 The Owner, at his election, may from time to time occupy any parts of the project as the work in connection therewith is completed to such a degree as will, in the opinion of the Owner, permit of their use for the purposes for which they are intended. The Owner will, prior to any such partial occupancy, give notice to the Construction Manager thereof and such occupancy shall be based upon the following:

a. Such occupancy shall not constitute an acceptance of work not performed in accordance with the Contract Documents or relieve Trade Contractors of liability to perform any work required by their Contract but not completed at the time of occupancy.

b. Trade Contractors shall be relieved of all maintenance costs on the units or parts occupied under this agreement.

c. Owner shall assume the risk of loss with respect to any unit or part occupied under the terms of this agreement.

d. The Trade Contractor shall not be required to furnish heat, light and water or other such services used in the units or parts occupied, without proper re-numeration therefore.

END OF SECTION

01019 CONTRACT CONSIDERATIONS

SECTION INCLUDES:

1.1 Inspection and Testing Allowance

1.2 Schedule of Values

1.3 Application for Payment

1.4 Change Procedures

1.1 INSPECTION & TESTING ALLOWANCES

If inspection and testing allowances have been assigned to the Trade Contractors, the following shall apply:

1.1.1 Costs included in allowances

a. Cost of engaging an inspection or testing firm, execution of inspection or tests, reporting results.

1.1.2 Costs not included in the allowance:

a. Incidental labor and facilities required to assist inspection or testing firm.

b. Costs of testing laboratory services required by Contractor separate from Contract Document requirements.

c. Costs of retesting upon failure of previous tests as determined by Architect-Engineer.

1.1.3 Payment Procedures:

a. Submit one copy of the inspection or testing firm's invoice with next application for payment.

b. Pay invoice on approval by Architect-Engineer.

1.1.4 Funds will be drawn from inspection and testing allowances only by Change Order.

1.2 SCHEDULE OF VALUES

1.2.1 Submit schedule through Contractor's Trade Contractor Portal. Application for Payments cannot be processed until Schedule of Values is approved. Without prior approval of the Construction Manager, **no single line item can exceed $100,000. Unless indicated otherwise, allowances and change orders must be listed as separate line items.**

The schedule of values must be itemized as follows:

1.2.2 Format: Unless instructed otherwise, utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section. Identify bonds, insurance, and permits separately.

1.2.3 Allowances should be added as individual line items for each section in the Schedule of Values.

1.2.4 Include within each line item, a directly proportional amount of Contractor's overhead and profit.

1.2.5 Approved Change Orders will automatically be added as a line item in the Schedule of

Values through the Trade Contractor Portal.

1.3 APPLICATIONS FOR PAYMENT

1.3.1 Pay Applications are to be created and submitted through the Trade Contractor Portal which conforms to the AIA G702 Form. The Trade Contractor Portal is the exclusive method of submitting a payment application.

1.3.2 Payment Period: First of month to first of month unless agreed to otherwise.

1.3.3 Waiver of liens and Sworn Statements shall accompany all Payment Requests unless agreed to otherwise. Also to be produced and submitted through the Trade Contractor Portal.

1.4 CHANGE PROCEDURES

1.4.1 The Architect-Engineer will advise of minor changes in the Work not involving an adjustment to Contract Sum/Price or Contract Time as authorized by AIA A201, 1987 Edition, Paragraph 7.4.

1.4.2 The Architect-Engineer may issue a change management document which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor will prepare and submit an estimate within five (5) calendar days.

1.4.3 The Contractor may propose a change by submitting request for change to the Architect-Engineer, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Sum/Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Sections 01600 and 01600A.

1.4.4 Stipulated Sum/Price Change Order: Based on change management document and Contractor's fixed price quotation; or, Contractor's request for a Change Order as approved by Architect-Engineer.

1.4.5 Unit Price Change Order: For pre-determined unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of work, which are not pre-determined, execute Work under a change management document. Changes in Contract sum/Price or Contract Time will be computed as specified for Time and Material Change Order.

1.4.6 Change Management Document: Architect-Engineer may issue a change authorization signed by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute the change.

1.4.7 Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract. Architect-Engineer will determine the change allowable in Contract Sum/Price and Contract Time as provided in the Contract Documents.

a. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate

costs for changes in the Work.

b. Execution of Change Orders: Architect-Engineer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

c. Overhead and Profit: Overhead and Profit shall include the following:

d. Supervision, Superintendents, Commercial General Liability and Umbrella Insurances, Wage of Time Keepers, Watchmen and Clerks, Small tools with material value of less than $1,500.00, Incidentals, General Office Expense, and all other expenses not included in Labor Rates. The percentage fee for Overhead and Profit on the Contractor's own work shall be 15% of net cost. The percentage fee for Overhead and Profit on Subcontractor's work shall be 5%.

END OF SECTION

01020 ALLOWANCES

1. GENERAL

1.1 Allowances will be established as directed in the Work Category Descriptions and are required to be included within the Trade Contractor's base bid. The amount included is an actual cost and does not include overhead and profit. Overhead and profit shall be included in the Trade Contractor's base bid, not in the allowance. Charges against the allowances will be at the Trade Contractor's net rate without overhead and profit as it is already included in the Contractor's base bid. These allowances are set up to be used only when authorized by the Construction Manager. Labor charged against the allowances will be in accordance with mutually accepted labor rates listed in each Trade Contractor's respective contract. Work expended by use of the allowances may be billed for each month in the Trade Contractor's monthly billing provided proper documentation and allowance authorizations are provided. In the event a balance remains within a specific allowance at the end of the project, a change order will be issued deducting the balance remaining in the allowance from the Trade Contractor's contract. All savings as a result of the Trade Contractor's non-use of these allowances will be the Owner's.

END OF SECTION

01030 SPECIAL PROJECT PROCEDURES

01031 ALTERATIONS

1.1 ASBESTOS ADVISORY

1.1.1 All asbestos contaminated materials shall be removed by the Owner.

1.2 NON-ABATEMENT TRADE CONTRACTOR RESPONSIBILITIES

1.2.1 Some areas of this project may contain asbestos in some locations. The Owner will attempt to remove or encapsulate all known asbestos prior to the start of renovations. This section contains the asbestos related requirements of all Trade Contractors working on this project.

1.3 GENERAL REQUIREMENTS

1.3.1 All Federal, State and local laws, rules, regulations and ordinances for asbestos related work shall be adhered to, including but not limited to, OSHA, MIOSHA, EPA and DEQ.

1.3.2 All Non-Abatement Trade Contractors working around asbestos containing materials are to have a minimum of 2-hours of awareness training on the health and safety aspects of asbestos.

1.3.3 All Non-Abatement Trade Contractors involved with the disturbance of Category 1 non-friable asbestos (roof felts, floor tile, transit chimney, etc.) are required to have all workers receive a minimum of 8-hours "hands-on" OSHA approved training prior to beginning work.

1.3.4 In addition a Non-Abatement Trade Contractor involved with the removal of Category 1 non-friable asbestos will have at least one on-site worker, employed by the Non-Abatement Trade Contractor, who has successfully completed an asbestos "Supervisor" course and received accreditation. The course shall meet the criteria of EPA's Model Accreditation Plan (40CFR Part 763) for Supervisor or its equivalent.

1.3.5 Documentation of said training must be posted at the job site during the removal of asbestos containing material(s), disposal, and/or handling.

1.3.6 Monitoring will be conducted pursuant to OSHA regulation 29 CFR 1926.1101.

1.3.7 **THE NON-ABATEMENT TRADE CONTRACTOR IS TO STOP WORK AND NOTIFY THE CONSTRUCTION MANAGER ANY TIME SUSPECTED ASBESTOS CONTAINING MATERIALS ARE ENCOUNTERED BY ANY OF HIS/HER WORKERS.**

1.3.8 All Non-Abatement Trade Contractors that will be removing Category 1 non-friable asbestos containing materials are to contact the Owner who will arrange and pay for the Environmental Consultant to provide air monitoring services.

1.4 EXCLUSIONARY STATEMENT FOR BUILDING CONSTRUCTION/RENOVATION MATERIALS

1.4.1 All building materials/products used for renovations or replacement purposes are to be asbestos and lead-free. Asbestos and lead-free is to be defined as materials that contain 0% asbestos or lead. All Contractors are to be prepared to submit data, for a building

material/product that he/she is proposing or required to use, to verify the absence of asbestos and lead.

1.4.2 The Non-Abatement Trade Contractors are to complete and sign the form titled "Exclusionary Statement for Building Construction/Renovation Materials".

1.5 NOTIFICATION

1.5.1 All Non-Abatement Trade Contractors that are required to remove Category I non-friable asbestos are to fill out and submit to the Michigan Department of Natural Resources, the "**NOTIFICATION OF INTENT TO RENOVATE/DEMOLISH**", in accordance with the Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) and the Department of Labor and Economic Growth (DLEG).

END OF SECTION

01040 COORDINATION

01041 GENERAL

1.1 The Construction Manager is ultimately responsible for coordination to complete all work shown on the drawings and specified herein independent of the location of the work on drawings and within the specifications. The arrangement of work within the specifications into Divisions and Sections shall be considered as given for convenience of reference only and shall not be held to conform to jurisdictional rules which may prevail in any particular trade. It shall be the responsibility of the Construction Manager to so arrange or group items of work under a particular trade to conform with the prevailing customs of that trade and best interest of the Owner.

01042 GENERAL INSTALLATION PROVISIONS

1.1 PRE-INSTALLATION CONFERENCES: The Construction Manager shall hold pre-installation meeting at the project site well before installation of each unit of work, which requires coordination with other work. Installer and representatives of the manufacturers and fabricators who are involved in or affected by that unit of work, and with its coordination or interpretation with other work that has preceded or will follow shall attend this meeting. The Construction Manager will advise the Architect/Engineer of scheduled meeting dates.

a. The Construction Manager shall record significant discussions of each conference, and record agreements and disagreements, along with the final plan of action. The Construction Manager shall then distribute the record of meeting promptly to everyone concerned, including the Owner and Architect/Engineer.

b. Do not proceed with the work if the pre-installation conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the work and reconvene pre-installation conference at the earliest possible date.

1.2 Installer's Inspection of Conditions: Require the installer of each major unit of work to inspect the substrate to receive work and conditions under which the work is to be performed. The installer shall report all unsatisfactory conditions in writing to the Construction Manager. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1.3 Coordinate enclosure of the work with required inspections and tests so as to minimize the necessity of uncovering work for that purpose.

1.4 Mounting Heights: Where mounting heights are not indicated. Refer to the Construction Manager for decision. Products installed at a location not indicated or approved by the Architect or Construction Manager shall be relocated at the Trade Contractor's expense.

01043 COORDINATION OF PERMANENT UTILITY CONNECTIONS

1.1 New utility connections shall be coordinated with local utilities and the Project Superintendent.

01044 MECHANICAL & ELECTRICAL COORDINATION

1.1 All Trade Contractors shall make arrangements with the Construction Manager before connecting to existing facilities. If interruption of service is required, it shall be done at the convenience of the Owner as scheduled by the Construction Manager / General Contractor.

END OF SECTION

01045 CUTTING AND PATCHING

1. GENERAL

1.1 RELATED DOCUMENTS

Drawing and general provisions of contract, including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this Section.

1.2 DESCRIPTION OF REQUIREMENTS

1.2.1 Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

a. "Cutting and patching" is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.

1.3 RELATED WORK SPECIFIED ELSEWHERE

1.3.1 Refer to mechanical and electrical specifications sections for additional requirements and limitations on cutting and patching of mechanical and electrical work.

1.4 QUALITY ASSURANCE

1.4.1 Requirements for Structural Work: Do not cut and patch structural work in a manner that would result in a reduction of load-carrying capacity or of load-deflection ratio.

a. Before cutting and patching the following categories of work, obtain the Construction Manager's approval to proceed:

- Structural Steel - Miscellaneous structural metals, including lintels, equipment supports, stair systems and similar categories of work.
- Structural Concrete - Foundation construction, Retaining walls, Structural decking, Exterior wall construction, Piping, ductwork, vessels and equipment. Reinforcing steel shall not be heated to bend or reshape a bar.

b. Visual Requirements: Do not cut and patch work exposed on the building's exterior or in it's occupied spaces, in a manner that would, in the Architect/Engineer's opinion, result in lessening the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patch work. Remove and replace work judged by the Architect/ Engineer to be cut and patched in a visually unsatisfactory manner.

2. PRODUCTS

2.1 MATERIALS

2.1.1 General: Use materials for cutting and patching that are identical to existing materials. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal-or-better performance characteristics.

3. EXECUTION

3.1 INSPECTION

3.1.1 Inspect existing conditions of the project, including elements subject to damage or to movement during cutting and patching.

3.1.2 After uncovering work, inspect the conditions affecting the installation of products or performance of the work.

3.1.3 Report unsatisfactory or questionable conditions to the Construction Manager in writing; do not proceed with the work until the Construction Manager has provided further instructions.

3.2 PREPARATION

3.2.1 Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work.

3.2.2 Provide devices and methods to protect other portions of the project from damage.

3.2.3 Provide protection from the elements for that portion of the project, which may be exposed by cutting and patching work, and maintain excavations free from water.

3.3 PERFORMANCE

3.3.1 Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation or repairs. Cutting and patching shall be performed by individuals certified, licensed, or otherwise qualified as experienced and with sufficient training to perform the required task.

3.3.2 Execute excavating and backfilling by methods which will prevent settlement or damage to other work.

3.3.3 Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.3.4 Restore work which has been cut or removed; install new products to provide complete work in accord with requirements of Contract Documents.

3.3.5 Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

3.3.6 Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

3.3.7 For continuous surfaces refinish to nearest intersection. For an assembly, refinish the entire unit.

3.4 CLEANING

3.4.1 Thoroughly clean areas and spaces where work is performed or used as access to work. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

4. CUTTING & PATCHING FOR MECHANICAL WORK

4.1 The Mechanical Contractor shall be responsible for all cutting, core drilling, and patching for their work. Cutting and patching shall be performed by individuals certified, licensed, or otherwise qualified as experienced and with sufficient training to perform the required task.

4.2 The Mechanical Contractor shall be responsible for the accurate location of all openings

necessary for the installation of the mechanical work. Any additional openings required to move his work due to an error in the initial layout shall be made at the expense of the Mechanical Contractor.

5. CUTTING & PATCHING FOR ELECTRICAL WORK

5.1 The Electrical Contractor shall be responsible for all cutting, core drilling, and patching for their work. Cutting and patching shall be performed by individuals certified, licensed, or otherwise qualified as experienced and with sufficient training to perform the required task.

5.2 The Electrical Contractor shall be responsible for the accurate location of all openings necessary for the installation of the electrical work. Any additional openings required to move his work due to an error in the initial layout shall be made at the expense of the Electrical Contractor.

END OF SECTION

01049 MECHANICAL & ELECTRICAL COORDINATION

SECTION INCLUDES:

1.1 Mechanical and Electrical Coordinator

1.2 Submittals

1.3 Coordination Required

1.4 Coordination Documents

1.5 Coordination of Submittals

1.6 Coordination of Substitutions and Modifications

1.7 Observation of Work

1.8 Documentation

1.9 Equipment Start-Up

1.10 Inspection and Acceptance of Equipment

1.1 MECHANICAL & ELECTRICAL WORK COORDINATOR

1.2.1 Employ and pay for services of a person, technically qualified and experienced in field coordination for the type of mechanical and electrical work required for this Project, for the duration of the work.

1.2.2 Qualified person may be already part of staff, verify in writing, person's qualifications.

1.3 SUBMITTALS

1.3.1 Submit name, address and telephone number of coordinator and name of principle officer to Architect-Engineer for review of his/her qualifications.

1.3.2 Submit coordination drawings and schedule prior to submitting Shop Drawings, Product Data and Samples.

1.4 COORDINATION REQUIRED

1.4.1 Coordinate work of all applicable divisions.

1.4.2 Coordinate progress schedules, including dates for submittals and for delivery of products.

1.4.3 Conduct conferences among subcontractors and others concerned with the Work to establish and maintain coordination and schedules, and to resolve coordination materials in dispute.

1.4.4 Participate in progress meetings. Report on progress of Work to be adjusted under coordination requirements, and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.

1.5 COORDINATION DOCUMENTS

1.5.1 Prepare coordination drawings to organize installation of Products for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.

1.5.2 Prepare a master schedule to identify responsibilities under each section of Divisions 1 through 16 of the Specifications for activities which directly relate to this work, including submittals and temporary utilities. Identify electrical power characteristics and control wiring required for each item of equipment.

1.5.3 Maintain documents for the duration of the Work, recording changes due to site instructions, modifications or adjustments.

1.5.4 After Architect-Engineer review or original and revised documents, reproduce and distribute copies to concerned parties.

1.6 COORDINATION OF SUBMITTALS

1.6.1 Review Shop Drawings, Product Data and Samples for compliance with Contract Documents and for coordination among work of all sections of the Project Manual. Transmit to Contractor for review, and then transmit to Architect-Engineer.

1.6.2 Check field dimensions and clearances and relationship to available space and anchors.

1.6.3 Check compatibility with equipment and Work of other sections, electrical characteristics, and operational control requirements.

1.6.4 Check motor voltages and control characteristics.

1.6.5 Coordinate controls, interlocks, wiring of pneumatic switches and relays.

1.6.6 Coordinate wiring and control diagrams.

1.6.7 Review the effect of any changes on work of other sections.

1.6.8 Verify and coordinate maintenance of record documents.

1.7 COORDINATION OF SUBSTITUTIONS & MODIFICATIONS

1.7.1 Review proposals and requests from subcontractors.

1.7.2 Verify compliance with Contract Documents and for compatibility with Work and Products of other sections.

1.7.3 Submit to Contractor with recommendation for action.

1.7.4 Coordinate with Sections 01600 and 1600a.

1.8 OBSERVATION OF WORK

1.8.1 Observe Work for compliance with Contract Documents.

1.8.2 Maintain a list of observed deficiencies and defects; promptly submit to contractor.

1.9 DOCUMENTATION

1.9.1 Observe and maintain a record of tests. Record:

a. Specification section number, product and name of subcontractor.

b. Name of testing agency and name of inspector.

c. Name of manufacturer's representative present.

d. Date, time and duration of tests.

e. Retesting required.

f. Type of test and results.

1.9.2 Assemble background documentation for dispute and claim settlement by Architect-Engineer.

1.9.3 Submit copies of documentation to Architect/Engineer upon request.

1.10 EQUIPMENT START-UP

1.10.1 Verify utilities, connections and controls are complete and equipment is in operable condition as required by Sections 01039, 01650, and 01700.

1.10.2 Observe start-up and adjustments; record time and date of start-up and results.

1.10.3 Observe equipment demonstrations to Owner; record times and additional information required for Operation and Maintenance Manuals.

1.10.4 Submit an approved Balance Report of HVAC System.

1.11 INSPECTION & ACCEPTANCE OF EQUIPMENT

1.11.1 Prior to inspection, verify that equipment if tested and operational and clean.

1.11.2 Assist Architect-Engineer with inspection. Prepare list of items to be completed and corrected.

2.1 PRODUCTS

3.1 EXECUTION

END OF SECTION

01050 FIELD ENGINEERING

01051 LAYOUT

1.1 Under the supervision and with the assistance of the Construction Manager, each Trade Contractor will be responsible for the layout of his particular portion of the work. Checking of layout and any assistance provided by the Construction Manager shall in no way be construed to relieve the Trade Contractors of their responsibilities for layout dimensions, tolerances, and accuracy of their work as set forth in the Contract Documents.

1.2 Each Trade Contractor shall carefully protect monuments, stakes, and benchmarks. If destroyed or disturbed by the Trade Contractor or his employees, the cost of replacing them shall be charged against the Trade Contractor and shall be deducted from the Trade Contractor's contract amount.

1.3 Except as otherwise noted, each Trade Contractor shall obtain his own field measurements and establish lines, grades, levels, and measurements shown on the drawings, and reconcile all measurements and conditions shown on the drawings with existing conditions at site, from the site survey provided and building corner indications and ground floor elevation designated by the Construction Manager.

1.4 Before custom fabricating any materials, the Trade Contractor shall verify all dimensions of any existing and new work, and shall be responsible for their accuracy. Any differences found shall be submitted to the Architect through the Construction Manager, for consideration before proceeding with the work. No extra compensation will be permitted because of differences between actual dimensions and measurements indicated on the project drawings.

END OF SECTION

01060 REGULATORY REQUIREMENTS

01061 APPLICABLE CODES

1.1 Reference section 00210 for the list of applicable codes.

01062 WAGES, LABOR & EQUAL EMPLOYMENT OPPORTUNITY

1.1 The Trade Contractor shall provide for labor needs from the ranks of working labor locally. The Trade Contractor shall enforce the same conditions upon all Trade Subcontractors engaged by the Trade Contractor for the performance of any portion of the work.

1.2 Successful bidders shall be required to subscribe to the principles of equal opportunity in its employment practices, and shall be required to enforce the same conditions upon all Trade Subcontractors engaged by the Trade Contractor for the performance of any portion of the work.

01063 FIRE HAZARD CLASSIFICATION

1.1 Fire hazard classifications for materials as specified in the technical specification shall be those established by publication in Current Building Materials List published by Underwriters' Laboratories, Inc., or certified to by notarized affidavit from Southwest Research Institute, or other agency acceptable to the State Construction Code Commission.

1.2 Where compliances are established by publication in Building Materials List, Trade Contractor shall so represent in writing to the Construction Manager. Where compliances are to be established by affidavit, Trade Contractor shall submit properly notarized affidavit that the material has been tested in accordance with requirements of ASTM E84, ASTM E119, or other specified standard, and found to qualify for the specified classifications. Affidavit shall state the name of the testing agency. The affidavit for testing is to be certified by the manufacturer for material and by the installer for installation.

1.3 Six copies of affidavits and other representations of compliance shall be submitted to the Construction Manager at time of shop drawing or sample submittal, whichever comes first.

1.4 In addition, the Construction Manager and Trade Contractor shall have the said materials inspected upon receipt, also before installation, and shall submit upon request prior to final acceptance of project, six copies of properly notarized affidavits by the Construction Manager and Trade Contractor as to the inspection (naming the inspector and other witnesses), certifying that the materials covered by previously submitted affidavits or other representations of compliance with the requirements for specified classifications were received at the jobsite properly labeled or otherwise certified to, and said materials were installed, and in a manner to in no way harm said compliances.

2. FIRE MARSHAL AFFIDAVITS

2.1 The Conditions of the Contract and Division 1 - General Requirements, are a part of this

Section.

2.2 The requirements specified hereinafter refer to compliance with Codes and Regulations of governing authorities referred to in Article 4 of the General Conditions.

2.3 Submit in triplicate, notarized affidavits for the products required as specified in the various technical sections of the specifications. Affidavits shall be submitted to the appropriate field office responsible for the project. Affidavit shall be signed and notarized, and in the following format:

AFFIDAVIT

This is to certify that, (Name of Product) which was or will be furnished to (Company making Application of Product) for (Job or Project Name and Address) is the same in all respects in content, and specifications for mixing and/or application as the specimen tested by (Name of Laboratory) on their project or test number (Test Number) dated (Date of Test).

Flame Spread _____
Fuel Contributed _____
Smoke Developed _____

END OF SECTION

01070 ABBREVIATIONS & SYMBOLS

01071 LIST OF ABBREVIATIONS

ACI	American Concrete Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
BIM	Building Information Modeling
BOCA	Building Officials and Code Administrators
ICBO	International Conference of Building Officials
LEED	Leadership in Environmental and Energy Design (if applicable)
DOT	Department of Transportation
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
SMACNA	Sheet Metal & A/C Contractors National Association
UBC	Uniform Building Code
OSHA	Occupational Safety and Health Administration

END OF SECTION

01095 REFERENCE STANDARDS AND DEFINITIONS

1.1 RELATED DOCUMENTS

a. General provisions of the Contract, including General and Supplementary Conditions, other Division 1 Specification Sections and Drawings, apply to this Section.

1.2 DEFINITIONS

a. Basic Contract definitions are included in the General Conditions and Special Conditions.

b. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the drawings, other paragraphs or schedules in the specifications, and similar requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled" and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

c. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work.

d. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations."

e. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

f. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

g. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, sub-contractor, or sub-sub-contractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

h. Unless otherwise indicated, the term "experienced" when used with the term "Installer" means having a minimum of 5 previous projects similar in size and scope to this project, being familiar with the precautions required, and having compiled with requirements of the authority having jurisdiction.

i. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter". It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

j. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities,

and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

k. Project Site: The space available to the Trade Contractors for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the drawings and may or may not be identical with the description of the land upon which the Project is to be built.

l. Testing Laboratories: A "testing Laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

a. Specification Format: The Specifications are organized into Divisions and Sections based on either the Construction Specifications Institute's 16-Division format or the MASTERFORMAT sections 020000-480000.

b. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1) Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the full context of the Contract Documents so indicates.

2) Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

3) The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

c. Summary References: The Summary Article of each Specification Section includes references to Work Included, Related Work Specified Elsewhere, Products Furnished but not Installed by this Section, and similar phrases. These listings are provided as a guide to the Contractor to assist the Contractor in locating related information within the Specification. No guarantee regarding the absolute completeness of these references is intended or may be inferred nor shall the presence, or lack thereof, of any reference relieve the Contractor of the final responsibility for proper completion of the

work.

1.4 INDUSTRY STANDARDS

a. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

b. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the latest referenced standard in effect at the time of Bid Opening.

c. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.

d. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

1) Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source and maintain these standards, for reference by the Contractor, and Architect, in a convenient location within the temporary office.

e. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where acronyms or abbreviations are used in the Project Manual, they mean the recognized name of the Trade organization, standards generating organization, authority having jurisdiction, or other entity applicable. Refer to the "Encyclopedia of Associations", published by Gale Research Company, available in most libraries.

1.5 SUBMITTALS

a. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

PART 2 PRODUCTS

Not applicable.

PART 3 EXECUTION

Not applicable.

END OF SECTION

01100 ALTERNATES

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 DEFINITIONS

1.2.1 Voluntary and Mandatory Alternates are defined as alternate products, materials, equipment, installations or systems for the work, which may, at the Owner's option, be selected to either add to or delete from the scope of the project.

1.2.2 Alternates may, or may not, substantially change scope and general character of the work, and must not be confused with "allowances", "unit prices", "change orders", "substitutions", and other similar provisions.

1.3 COORDINATION

1.3.1 Coordinate pertinent related work and modify surrounding work as required to properly integrate the work under each Alternate, and to provide the complete construction required by the plans and specifications. Each Alternate includes all related work required to provide the work described in the individual Alternate.

1.4 DESCRIPTION OF ALTERNATES

1.4.1 Refer to Section 00210 for a description of the basic change added to or deleted from the scope of the project.

1.4.2 The Owner reserves the right to select any Alternate following submission of the bid. If selected subsequent to the award and execution of the Agreement, the Alternate will be affected by Change Order and the sole consideration shall be the price quoted in the bid.

1.4.3 Each contractor should review each alternate and include a "deduct or add" amount on the trade contract proposal form. At the end of each alternate is a summary of the Work Categories affected by the alternate.

1.4.4 RELATED DOCUMENTS

a. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.4.5 DESCRIPTION OF REQUIREMENTS:

a. Definition: An alternate is an amount proposed by Bidders and stated on the Bid Form that will be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either scope of work or in products, materials, equipment, systems or installation methods described in

Contract Documents. Alternate Bid Pricing shall be firm for 90 days from date of award.

b. Coordination: Coordinate related work and modify or adjust adjacent work as required to ensure that work affected by each accepted alternate is complete and fully integrated into the project.

c. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected or deferred for construction at a later date. Include a complete description of negotiated modifications to alternates, if any.

d. Schedule: A "Schedule of Alternates" is included in Section 00210. Specification sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the work described under each alternate.

1) Include as part of each alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

01110 VOLUNTARY ALTERNATES

1.1 Bidding of Voluntary Alternates is encouraged. It shall be understood that Voluntary Alternates cannot be considered as a basis for determining a low bid. Contractor may only be determined low bidder based upon the Contract Documents and specified bid alternates in Section 01100.

END OF SECTION

01150 MEASUREMENT AND PAYMENTS

1.1 DESCRIPTION

This Section describes the means and methods required for payment for work performed as an extra to the Contract.

1.2 CHANGES IN THE WORK

1.2.1 The Owner and Architect reserve the right to make changes in the work without notice to sureties or in any way rendering the Contract void.

1.2.2 Changes in the work will be described in Supplemental Instruction (SI), Construction Change Directive (CCD), Bulletins, Proposal Request, or Field Orders issued by the Architect or Construction Manager in accordance with the General Conditions and the Supplementary Conditions, and with procedures described in this Section.

1.2.3 Unless specified otherwise, Bulletins and Proposal Requests are not authorization to proceed with the changes described, and Supplemental Instructions, Construction Change Directives or Field Orders countersigned by the Owner are authorization to proceed. The Trade Contractor will be authorized to proceed with extra work by an approved quotation or signed Field Order.

1.2.4 No claims for additional compensation will be considered for changes in the work unless authorization to proceed has been given by a signed Construction Change Directive**,** Field Order or a Change Order issued by the Construction Manager.

1.2.5 Promptly submit to the Construction Manager, a written detailed quotation of the additional cost, credit or statement noting no change upon the receipt of each Construction Change Directive, Bulletin or Field Order.

1.2.6 Each quotation is subject to approval of the Construction Manager, Architect and the Owner, after which a Change Order will be issued to modify each Trade Contract.

1.2.7 Regard each Construction Change Directive, Bulletin or Field Order as a complete unit and enumerate in detail as to labor, materials and related item in the quotation. Provide additional information as requested by the Construction Manager, Architect and/or Owner.

1.2.8 Proceed promptly in accordance with, and upon receipt of a Change Order. The Contract Sum will be adjusted in accordance with pricing methods described in the General Conditions or as modified by the Supplementary Conditions and as specified in the contract.

END OF SECTION

01200 PROJECT MEETINGS

01215 PRE-CONSTRUCTION SITE INSPECTION

1.1 Each Trade Contractor shall be held to have visited the site of the proposed work before submitting his proposal and to have familiarized himself with all existing conditions affecting the execution of his work in this project. No allowance or extra consideration on behalf of the Trade Contractor will subsequently be made by reason of failure to observe the site conditions, nor on behalf of any subcontractor for the same reason.

01225 PROGRESS MEETINGS

1.1 At regular intervals, the Construction Manager shall hold meetings at the jobsite with the representatives of the various Trade Contractors engaged on the project, to coordinate the progress of the work. The Construction Manager shall notify all parties required to attend, the time and place of these meetings.

1.2 The Construction Manager shall conduct and keep a written record of all such meetings, and distribute copies of them to the Architect, Owner, and all Trade Contractors interested in the matters covered.

1.3 All Trade Contractors shall furnish to the Construction Manager's Field Representative, all available information concerning the conditions and progress of their work, including manpower used on a daily basis.

END OF SECTION

013000 SUBMITTALS

1. SHOP DRAWINGS, PRODUCT DATA & SAMPLES

1.1 DESCRIPTION OF REQUIREMENTS

A. GENERAL:

a. This Section specifies requirements for submittals including shop drawings, product data, samples and other miscellaneous work related submittals. Shop drawings, product data samples and other work related submittals are required to amplify, expand and coordinate the information contained in the Contract Documents.

b. Shop drawings are technical drawings and data that have been specially prepared for this project, including but not limited to the following items:

- Fabrication and installation drawings.
- Setting diagrams.
- Shopwork manufacturing instructions.
- Templates.
- Patterns.
- Coordination drawings (for use on site).
- Schedules.
- Design mix formulas.
- Contractor's engineering calculations.

c. Standard information prepared without specific reference to a project is not considered to be shop drawings.

d. Product data includes standard printed information on manufactured products that has not been specially prepared for this project, including but not limited to the following items:

- Manufacturer's product specifications & installation instructions.
- Standard color charts.
- Catalog cuts.
- Roughing-in diagram and templates.
- Standard wiring diagrams.
- Printed performance curves.
- Operational range diagrams.
- Mill reports.
- Standard product operating and maintenance manuals.

e. Samples are physical examples of work, including but not limited to the following items:

- Partial sections of manufactured or fabricated work.
- Small cuts or containers of materials.
- Complete units of repetitively used materials.
- Swatches showing color, texture and pattern.

- Color range sets.
- Units of work to be used for independent inspection and testing.

a. Mock-ups are special forms of samples, which are too large or otherwise inconvenient for handling in the manner specified for transmittal or sample submittals.

b. Miscellaneous submittals are work related, non-administrative submittals that do not fit in the three previous categories, including, but not limited to the following:

- Specially prepared and standard printed warranties.
- Maintenance agreements.
- Workmanship bonds.
- Survey data and reports.
- Project photographs.
- Testing and certification reports.
- Record drawings.
- Field measurement data.
- Operating and maintenance manuals.
- Keys and other security protection devices.
- Overrun stock.

1.2 SUBMITTAL PROCEDURES

1.2.1 Coordination: Coordinate the preparation and processing of submittals with the performance of the work. Coordinate each separate submittal with other submittals and related activities such as testing, purchasing, fabrication, delivery and similar activities that require sequential activity.

Coordinate the submittal of different units of interrelated work so that one submittal will not be delayed by the Architect/Engineer's need to review a related submittal.

The Architect/Engineer reserves the right to withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

1.2.2 Listing: Prepare a separate listing showing principal submittals and their initial submittal dates as required for coordination of the work. Organize the listing by the related specification number sequence. Submit the listing within 30 days of the date of commencement of the work.

1.2.3 Coordination of Submittal Times: Prepare and transmit each submittal to the Construction Manager sufficiently in advance of the scheduled performance of related work and other applicable activities.

Transmit different kinds of submittals for the same unit of work so that processing will not be delayed by the Architect/Engineer's need to review submittals concurrently for coordination.

1.2.4 Review Time: Allow sufficient time so that the installation will not be delayed as a result of the time required to properly process submittals, including time for resubmittal, if

necessary.

a. Allow 15 working days for the Architect/Engineer's initial processing of each submittal. Allow a longer time period where processing must be delayed for coordination with subsequent submittals. The Architect/ Engineer will advise the Construction Manager promptly when it is determined that a submittal being processed must be delayed for coordination.

b. Allow 10 working days for reprocessing each submittal.

c. No extension of time will be authorized because of the Trade Contractor's failure to transmit submittals to the Construction Manager sufficiently in advance of the work.

1.2.5 Submittal Transmittal: Transmit each submittal from the Trade Contractor to the Construction Manager, by use of a submittal form. Submittals received from sources other than the Trade Contractor will be returned to the sender "without action".

1.2.6 Submittal Form: The form required to be used for transmittal of submittals will be provided to the Trade Contractor by the Construction Manager.

a. Record relevant information and requests for data on the submittal form. On the form, or on a separate sheet attached to the form, record deviations from the requirements of the Contract Documents, if any, including minor variations and limitations.

1.3 SPECIFIC SUBMITTAL REQUIREMENTS

1.3.1 General: Specific submittal requirements for individual units of work are specified in the applicable specification section. Comply with the requirements specified herein for each type of submittal.

1.4 SHOP DRAWINGS

1.4.1 Shop Drawings: Information required on shop drawings includes, dimensions, identification of specific products and materials which are included in the work compliance with specified standards and notations of coordination requirements with other work. Provide special notation of dimensions that have been established by field measurement. Highlight, encircle or otherwise indicate deviations from the contract documents on the shop drawings.

1.4.2 Coordination Drawings: Provide coordination drawings where required for the integration of the work, including work first shown in detail on shop drawings or product data. Show sequencing and relationship of separate units of work, which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination drawings are considered shop drawings and must be definitive in nature.

1.4.3 Do not distribute shop drawing copies without an appropriate final "Action" marking by the Architect/Engineer to be used in connection with the work.

1.4.4 PREPARATION: Submit newly prepared information, drawn to accurate scale. Indicate the name of the firm that prepared each shop drawing and provide appropriate project identification in the title block.

1.4.5 Do not reproduce contract documents as the basis of shop drawings.

1.4.6 SUBMITTAL:

a. One of the prints returned will be marked up and maintained by the Trade Contractor as a "Record Document".

1.5 PRODUCT DATA

1.5.1 PRODUCT DATA: General information required specifically as product data includes manufacturer's standard printed recommendations for application and use, compliance with recognized standards of trade associations and testing agencies, and the application of their labels and seals (if any), special notation of dimensions which have been verified by way of field measurement, and special coordination requirements for interfacing the material, product or system with other work.

1.5.2 PREPARATION: Collect required product data into a single submittal for each unit of work or system. Mark each copy to show which choices and options are applicable to the project. Where product data has been printed to include information on several similar products, some of which are not required for use on the project, or are not included in this submittal, mark the copies to show clearly that such information is not applicable.

1.5.3 SUBMITTALS: Product data submittal is required for information and record and to determine that the products, materials and systems comply with the provisions of the contract documents.

1.5.4 SUBMITTAL: The Architect/Engineer will retain one copy, the Owner's Representative one copy and will return the others marked with "Action" and corrections as required.

a. Do not submit product data or allow its use on the project, until compliance with the requirements of the contract documents has been confirmed by the Trade Contractor.

1.5.5 FINAL DISTRIBUTION: Furnish copies of product data to trade contractors, suppliers, fabricators, manufacturers, installers, governing authorities and others as required for proper performance of the work.

1.5.6 INSTALLATION COPY: Do not proceed with installation of materials, products and systems until a copy of product data applicable to the installation is in the possession of the installer. Do not permit the use of unmarked copies of product data in connection with the performance of the work.

1.6 SAMPLES

1.7.1 Submit samples for the Architect/Engineer's visual review of general generic kind, color,

pattern, and texture, and for a final check of the coordination of these characteristics with other related elements of the work.

Samples are also submitted for quality control comparison of these characteristics between the final sample submittal and the actual work as it is delivered and installed.

a. Refer to individual sections of these specifications for additional sample requirements.

b. Documentation required specifically for sample submittals includes a generic description of the sample, the sample source, the product name or manufacturer, compliance with governing regulations and recognized standards.

1.7.2 PREPARATION: Where possible provide samples that are physically identical with the proposed material to be incorporated in the work; provide full scale, fully fabricated samples, cured and finished in the manner specified. Where variations in color, pattern, or texture are inherent in the material represented by the sample, submit not less than 4 units, which show the approximate limits of variations. Where samples are specified for the Architect/Engineer's selection of color, texture or pattern, submit a full set of available choices for the material or product.

a. Refer to individual sections of these specifications for samples, which, because of their relatively high cost or other special considerations, are intended to be returned to the Contractor for incorporation in the work. Such samples must be in an undamaged condition at the time of use. On the transmittal form to the Architect/Engineer, indicate such special requests regarding the disposition of sample submittals.

1.7.3 DISTRIBUTION OF SAMPLES: Maintain the final submittal sets of samples, last returned by the Architect/Engineer, at the project site, available for quality control comparisons throughout the course of performing the work. In addition, final submittal sets may be used to obtain final acceptance of the work associated with each set.

Prepare and distribute additional sets of samples to subcontractors, suppliers, fabricators, manufacturers, installers, governing authorities, and others as required for proper performance of the work. Show final distribution on transmittal forms.

a. Mockups and similar samples specified in individual work sections are special types of samples. Comply with sample submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.7 MISCELLANEOUS SUBMITTALS

1.7.1 INSPECTION AND TEST REPORTS: Process inspection and test reports in accordance with Product Data requirements.

1.7.2 WARRANTIES: Refer to Section 01740 for specific general requirements on warranties, product bonds, workmanship bonds and maintenance agreements. In addition to copies desired for the Trade Contractor's use, furnish at least 2 executed copies of such warranties, bonds or agreements. Provide at least 2 additional copies

where required for maintenance manuals.

1.7.3 STANDARDS: Where submittal of a copy of standards is indicated, submit at least 2 copies of standards for the Architect/Engineer's use. Where workmanship, whether at the project site or elsewhere is governed by a standard, furnish additional copies of the standard to fabricators, installers and others involved in the performance of the work.

1.7.4 CLOSEOUT SUBMITTALS: Refer to Section 01700 and to individual sections of these specifications for specific submittal requirements of project closeout information, materials, tools, and similar items.

1.7.5 RECORD DOCUMENTS: Furnish set of original documents as maintained on the project site. Along with original marked up record drawings provide electronic copies of marked up drawings.

1.7.6 OPERATING AND MAINTENANCE DATA: Unless specified otherwise, furnish at least 4 bound copies of operating data and maintenance manuals, and one electronic copy.

1.7.7 MATERIALS AND TOOLS: Refer to individual sections of these specifications for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

1.7.8 GENERAL DISTRIBUTION: Provide additional distribution of submittals to subcontractors, suppliers, fabricators, installers, governing authorities, and others as necessary for the proper performance of the work. Include such additional copies of submittals in the transmittal to the Architect/ Engineer where the submittals are required to receive "Action" marking before final distribution. Record distributions on transmittal forms.

1.8 ARCHITECT/ENGINEER'S ACTION:

1.8.1 GENERAL: The Architect/Engineer will review each submittal, mark with appropriate "Action", and where possible return within 10 working days of receipt. Where the submittal must be held for coordination the Architect/Engineer will so advise the Trade Contractor via the Construction Manager without delay.

1.8.2 ACTION STAMP: The Architect/Engineer will stamp each submittal to be returned with a self explanatory action stamp, appropriately marked to indicate whether the submittal returned is for unrestricted use, final but restricted use (as marked), must be revised and resubmitted (use not permitted) or without action (as explained on the transmittal form). Refer to Section 00210 for action stamp markings.

1.8.3 FINAL UNRESTRICTED RELEASE: Where the submittals are marked as follows, the work may proceed provided it complies with the requirements of the contract documents; acceptance of the work will depend upon that compliance.

1.8.4 MAKE CORRECTIONS NOTED: When the submittals are marked as follows, the work may proceed provided it complies with both the Architect's/ Engineer's notations or corrections on the submittal and with the requirements of the contract documents;

acceptance of the work will depend on that compliance.

1.8.5 REVISE AND RESUBMIT: When the submittals are marked as follows, the work may proceed provided it complies with both the Architect's/Engineer's notations or corrections on the submittal and with the requirements of the contract documents, acceptance of the work will depend on that compliance. Revise the submittal and resubmit for Architect's/Engineer's verification of compliance.

1.8.6 REJECTED: When the submittal is marked as follows, do not proceed with the work including purchasing, fabrication, delivery, or other activity. Revise the submittal or prepare a new submittal in activity. Revise the submittal or prepare a new submittal in accordance with the Architect's/Engineer's notations stating the reasons for returning the submittal; resubmit the submittal without delay. Repeat if necessary to obtain a different action marking. Do not permit submittals with the following marking to be used at the project site, or elsewhere where work is in progress.

END OF SECTION

01310 CONSTRUCTION SCHEDULES

1.1 EXECUTION OF THE WORK

1.2 CONSTRUCTION PLANNING

Within five (5) days after the award of each Trade Contract, all Trade Contractors shall submit the following scheduling information:

1.2.1 A Procurement Status Report, in a format acceptable to the Construction Manager, which shall itemize all material and equipment, submittal and review requirements, fabrication and delivery lead times, and delivery requirements needed to meet the Trade Contractor's schedule as well as the overall project schedule.

1.2.2 Each Trade Contractor shall submit their own detailed schedule, in a format acceptable to the Construction Manager, which incorporates: the procurement information of Article 1.1.1-above, all known interfacing of other trades, the Trade Contractor's anticipated durations, and all other information the Trade Contractor feels is necessary to identify their requirements for the Construction Manager to coordinate with the Construction Manager's direction and scheduling.

1.3 CONSTRUCTION SCHEDULING

1.3.1 A detailed Construction Schedule will be prepared with the Trade Contractor's input immediately after award of bids and submittal of the above information. Section 00200 provides the "preliminary construction schedule" which describes the approximate durations of sequence of the projects. The completion dates provided are firm and must be achieved. It is intended that all bidders agree to accept the final schedule, and acknowledge that other Trade Contractor's work is paced by, or dependent upon, the various activities being able to commence and proceed with associated activities as scheduled. The approved Construction Schedule shall be regarded as a firm contractual commitment by all parties affected therein.

1.3.2 All Trade Contractors and their Trade Subcontractors recognize and shall accept modifications to the schedule which are reasonable, in the opinion of the Construction Manager for the general interest of the project, as a result of allowable time extensions (formally or informally approved) in any contract, and such modifications are inherent to the construction process and shall not qualify as a basis for extra compensation from the Construction Manager or Owner."

1.3.3 If a CPM network schedule is used to coordinate the work of the project, start and finish dates for each work activity will be furnished to the Trade Contractor to schedule his work. Periodically, these dates will be revised to reflect changed project conditions. The Construction Manager will attempt to schedule the start of the work of any Trade Contractor on the date for the activity, and the Trade Contractor agrees to cooperate in following that direction.

1.3.4 If it is apparent that a Trade Contractor is not going to complete his work in the time allotted, said Contractor must notify the Construction Manager within five (5) days after publication of the schedule. Adjustments may be made to accommodate a Trade Contractor, if the above notification is received and it is within the dates established.

Otherwise the schedule shall be deemed accepted by all parties and become the schedule for the Trade Contractor. Each Trade Contractor will be responsible to be familiar with the schedule and how it will effect or modify his operations, including his coordination with the activities of other Trade Contractors.

1.3.5 It is expressly agreed that time is of the essence for the completion of work under his contract, and the Trade Contractor agrees to perform the work within the time and in the manner specified or within the time extensions the Owner may grant; provided, however, that the Trade Contractor may be liable for any damages suffered by the Owner due to failure of the Trade Contractor to perform the specified work within the specified time.

1.3.6 The Trade Contractor, within five (5) days after being notified to commence work, agrees to commence work in the field of such points as the Construction Manager may designate, and to continue diligently to perform the work, and to fully complete all of his work to the satisfaction of the Construction Manager and Owner. The work shall be carried to completion with utmost speed.

1.3.7 If the Trade Contractor delays progress for any reason other than those allowed by the General Conditions, and refuses to adequately man the project or to work overtime, the Construction Manager may accelerate the work of subsequent Trade Contractors and backcharge all costs to the late Trade Contractor. All direction in this regard will be given in writing to the Trade Contractor.

END OF SECTION

01370 SCHEDULE OF VALUES

1.1 REQUIREMENTS: The Christman Company requires that all Pay Applications and related information (Schedule of Values) be processed through its proprietary Trade Contractor Portal. Trade Contractor agrees to comply with the requirements of the portal. This is your only method of submitting a payment application.

1.1.1 There is No Fee associated with using the Portal.

1.1.2 This also includes Compliance related information such as the Sworn Statement, supporting Waivers, and Insurance Certificates.

END OF SECTION

01400 QUALITY CONTROL

01410 TESTING LABORATORY SERVICES

1.1 TESTING LABORATORY SERVICES

1.1.1 GENERAL: All work (materials and installation procedures) as indicated in specifications, shall be tested and inspected by an independent testing and inspection agency, approved by the Architect/Engineer to provide the quality control requirements in accordance with these specifications. Results of these tests and inspections when performed in accordance with these specifications will not be disputed by either party. Failure of the Trade Contractor to provide quality control in accordance with this specification may result in the replacement of the work at the Trade Contractor's expense.

1.1.2 Owner Provided Testing – Refer to Section 00210 and work category descriptions for testing services provided by the Owner, if applicable.

1.2 TRADE CONTRACTOR'S RESPONSIBILITY

1.2.1 Unless identified otherwise, Trade Contractors are responsible for testing and/or balancing as defined in their work categories and/or designated specification sections.

1.3 TESTING & INSPECTION AGENCY RESPONSIBILITIES

1.3.1 Perform all testing and inspection of the work in accordance with these specifications. Furnish qualified personnel and sufficient equipment in a timely manner when required by the Trade Contractor and/or Architect/Engineer to perform all testing and inspection in accordance with these specifications. Provide written reports, electronically and at least one hard copy, in a timely manner of the work tested and inspected. The reports shall include complete material test results and for in place material, a sketch showing the exact location where the test was taken on the project site. The inspection and testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirements of the contract documents, nor to approve or accept any portion of the work.

Work will be checked by representatives of the testing agencies as it progresses, but failure to detect any defective work or product will not in any way prevent later rejection when such defect is discovered, nor will it obligate the Owner to final acceptance. When it appears that the work or product furnished is in non-conformance with the contract documents, the representative of the testing agency will direct the attention of the Architect/Engineer and Trade Contractor to such non- conformance.

1.4 AUTHORITY OF THE ARCHITECT/ENGINEER

1.4.1 The Architect/Engineer may order from time to time additional tests and inspection beyond those required, if in his opinion, the subject work may not be meeting specification. The cost for these tests and inspections shall be born by the Trade Contractor if results indicate that work was NOT within the project specifications. The

Architect/Engineer may terminate the testing and inspection agency. The Trade Contractor shall then furnish to Construction Manager the name of an additional agency for approval. The Architect/Engineer may perform quality control tests and inspections.

END OF SECTION

Indoor Air Quality (IAQ) Management Plan - During Construction

Objective

Protect indoor air quality during construction for the safety of construction workers and for the assurance of a high quality indoor environment after building occupancy.

Plan

- Materials have been specified to minimize indoor air pollutants from material off-gassing. Subcontractors are to make every effort to meet the specified requirements for materials.
- Those materials and construction practices that do not specifically meet the requirements of the specifications, should be of the lowest toxicity available in the industry.
- For those materials and construction practices that introduce air quality concerns, use the following procedures to help prevent buildup of contaminates to the indoor environment.

Definitions

- Absorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, materials containing/wrapped in fabrics, fibrous insulation/materials and other materials containing materials with similar absorptive characteristics.
- Contaminants: Gases (i.e. carbon monoxide, acetylene), paint, sealants and coating vapors, regulated pollutants, airborne mold and mildew, products that emit volatile organic compounds during installation, drying, or curing.
- Particulates: Dust, dirt, smoke, concrete dust, masonry dust, drywall dust, wood dust, silica, fiberglass and other airborne solid matter.

HVAC Protection

- Mechanical systems protection – all ductwork not being worked on should be covered to prevent the infiltration of particulate matter. Care should also be given to protect ductwork from collection of particulate matter during delivery to the site. All mechanical equipment that has openings where particulate matter could enter, should be covered at all times.
- If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction – particularly during demolition.
- Do not store construction or waste materials in the mechanical room.
- Use temporary filtration media during construction to protect HVAC at each return air grille; filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 – 1999. Isolate the return side of the HVAC system from the surrounding environment as much as possible. Return side shall have the heaviest work areas dampered off and all return system openings sealed with plastic. Return side shall be shut down whenever possible during heavy construction and demolition.
- When the system is off, all supply ducts, equipment and openings should be sealed with plastic for further protection.
- Provide continuous ventilation rate of one air change per hour minimum during construction. Provide additional ventilation as may be necessary to protect workers' health and avoid the accumulation of volatile compounds, dust and other harmful airborne contamination.

- Filtration media must have a Minimum Efficiency Reporting Value (MERV) of 8.
- Maintain a list, and cut sheet, of each air filter used during construction and at the end of construction. Include the MERV value, manufacturer name and model number.

Source Control

- Subcontractors to use low emitting products as specified. When limited resources are available, materials should be used that have the low toxicity emissions available.
- Use electrically powered equipment when feasible and switch from diesel to bottled gas for equipment such as generators or fork lifts.
- High levels of contaminant odor generated during removal of contaminated soils - consult Construction Manager and testing consultant upon first discovery of a contaminant odor. Respirators may need to be worn.
- Gaseous vapors generated during temporary heating operations – contractors to utilize explosive gas detectors that detect harmful levels of carbon monoxide, propane, natural gas, and smoke. Use electric or steam heaters for temporary heat when possible.
- Concrete floor sealing, block sealing and waterproofing - utilize fans, open windows, and respirators.
- Other- Allow sufficient time for dissipation of odor after installation of materials with elevated concentrations of VOC's and other moisture related/containing materials (i.e. fluid applied coatings, adhesives).
- Exhaust pollution sources to the outside through an available exhaust system or portable fan vented to the outside. Depending on the nature of the material and the location of the exhaust, special filtration may or may not be necessary.
- If exhausting the pollution sources is not feasible, the use of a portable air cleaner may be effective.

Pathway Interruption

- Erect barriers to contain the construction area. The barriers should be selected based upon the worst case contributor to dust or odor escaping from the site.
- Locate trash dumpsters, recycling centers and pollutions sources at reasonable distances from the site, so as not to affect the air quality of the surrounding areas.
- Depending on the weather conditions, ventilate using 100% outside air to exhaust contaminated air directly to the outside during installation of VOC-emitting materials.
- Depressurize the work area allowing the air pressure differential between construction and clean areas to contain dust and odors.

Housekeeping

- Isolate areas with high particulate concentration using solid physical barriers from floor to ceiling (plastic sheeting or similar).
- Asbestos abatement- A certified abatement firm and testing consultant will be hired to handle these situations. No trades are to be present in areas while abatement activities are taking place. Areas being abated shall be separated from trades/Owner occupants by a solid physical barrier.

- Control dust and particulate concentration with wetting agents or sweeping compounds.
- If vacuum cleaners are being used for cleaning activities, use high efficiency particulate air filters in them.
- Remove spills of high VOC-emitting materials immediately.
- Use low-toxic cleaning supplies for surfaces, equipment and worker's personal use.
- Do not allow water to accumulate in the building envelope or anywhere on-site. Take care to remove the accumulated water as soon as possible and disinfect the area if necessary.
- Do not install any building materials that have become wet. If building materials do become wet then dry the materials out completely before they are covered up. Failure to do this will result in harmful mold growth which will be very expensive to remediate after the fact.
- When performing sanding operations for gypsum board assemblies, provide the following protection:

    1. Isolate the space
    2. Provide plastic sheet separation during sanding
    3. Close and seal all air system devices and ductwork
    4. Sequence construction to avoid contamination of other spaces with gypsum dust
    5. Provide worker protection

Scheduling

- Consult manufacturers for appropriate dry out times of materials prior to arrival on site. Factory aging of materials with strong odor emissions should be considered prior to delivery of materials on-site.
- Absorptive materials should be sequenced to arrive on-site when moisture and humidity levels are at acceptable levels based upon manufacturer's written/acceptable requirements.
- Products that do not meet the specified requirements, due to limited availability of materials, should be stored in dry, well ventilated areas for odor dissipation (off-gassing/conditioning).
- If absorbent materials must be stored in high humidity on site, protect absorbent materials with an impermeable moisture barrier, preferably a barrier containing recycled content.
- Upon completion of construction, replace all filtration media immediately prior to occupancy.
- After construction ends consideration should be given for conducting a baseline indoor air quality testing procedure for the affected space in the building.

Building Flush Out

- The Construction Manager, with the help of the Mechanical and Controls Contractors, will conduct a building flush out with new filtration media at 100% outside air after construction ends and prior to testing. The building flush out shall comply with the latest LEED requirements for the *Construction IAQ Management Plan – Before Occupancy*

Management & Enforcement of Plan

Construction Manager:

Superintendent shall give a copy of this plan to all subcontractors and shall reinforce the requirements of this plan on a daily basis and reserves the right to modify or change the plan at his or her discretion

based on the current safety situation of the site. A testing consultant will be hired to monitor and report air contaminants and ventilation effectiveness at the discretion of the Superintendent. Project Engineer will support Superintendent in duct protection inspections throughout building.

Photo Documentation:
The Project Superintendent or Project Engineer shall document implementation of the IAQ Plan by taking at least 6 photos on at least 3 different occasions throughout the project. These photos should show each of the IAQ strategies described in this plan.

Architect:
Review compliance with plan during weekly site visits.

Owner:
Reserves the right at any time to verify compliance and request a team meeting to review project safety goals at his/her discretion.

Resources:
These guidelines were developed through referencing the SMACNA IAQ Guidelines for Occupied Buildings under Construction and the USGBC LEED-NC for New Construction Reference Guide.

- www.smacna.org
- www.usgbc.org

01500 TEMPORARY FACILITIES

1.1 DESCRIPTION OF REQUIREMENTS

1.1.1 This section specifies requirements for temporary services and facilities, including such items as temporary utility services, temporary construction and support facilities, and project security and protection. Refer to Section 00210 for additional requirements.

1.1.2 USE CHARGES: No cost or usage charges for temporary services or facilities are chargeable to the Owner or Architect/Engineer. The Construction Manager is responsible for these charges where indicated. In all other cases the Trade Contractor requiring same is responsible for the charges incurred. Cost or use charges for temporary services or facilities will not be accepted as a basis of claims for a change order.

1.2 PROTECTION OF EXISTING FACILITIES

1.2.1 Each Trade Contractor shall provide and maintain proper shoring and bracing for existing underground utilities, sewers, and building foundations encountered during his excavation work, to protect them from collapse or other type of damage until such time as they are to be removed, incorporated into the new work, or can be properly backfilled upon completion of new work.

1.2.2 Each Trade Contractor shall provide and maintain proper shoring and bracing for existing structures and finishes encountered during the execution of his work to protect from collapse or other type of damage until such time as they are to be removed, incorporated into the new work, or can be properly backfilled upon completion of new work.

1.2.3 Each Trade Contractor shall provide and maintain temporary protection for new and existing work during the execution of his work to protect from dirt and damage. Any damage to new and/or existing work resulting from the lack of or inadequate temporary protection shall be this contractor's responsibility to restore.

01510 TEMPORARY UTILITIES

1.1 TEMPORARY ELECTRICAL POWER & LIGHTING

Unless identified otherwise, the following provisions shall apply:

1.1.1 The temporary electrical power and lighting will be installed and maintained by the Electrical Trade Contractor (WC 28). Refer to Section 00210 to verify if the Owner shall pay for all power consumed for the temporary electrical service.

1.1.2 All Trade Contractors shall obtain the power for their temporary electric requirements from the existing power source available on the site. All necessary lugs, transformers, disconnect switches, fuses, cable, posts, ground fault interrupters, etc., required for connection to the power source and distribution, including wires, cable, supports, etc., shall be provided by Trade Contractor, all as coordinated and approved by the Construction Manager. The Owner shall pay for all reasonable amounts of power consumed for the temporary electrical service. Electric heaters will not be allowed for heating temporary trailers and offices.

1.1.3 Any electrical requirements for power or lighting beyond those listed in this paragraph shall be the responsibility of the Trade Contractor requiring them.

1.1.4 Overtime work requiring standby electricians shall be at the expense of the Trade Contractor requiring same. Installation of temporary electrical power and lighting shall be as scheduled by the Construction Manager.

1.1.5 Electric welder machines will not be allowed to be used without the express permission and approval of the Construction Manager and Owner. The Trade Contractor would have to pay for all equipment and materials required to provide the distribution and power supply if permission were granted to use electric welders, all as coordinated and approved by the Construction Manager.

1.1.6 All temporary electrical installations shall be in compliance with the latest National Electrical Code or OSHA, whichever is more stringent.

1.2 TEMPORARY HEAT

1.2.1 Unless identified otherwise, all equipment and labor for temporary heat after building enclosure shall be furnished by the Construction Manager. Refer to Section 00210 to verify if energy will be supplied by the Owner when the heating equipment is connected to the existing power system.

1.3 COLD WEATHER PROTECTION

1.3.1 Unless identified otherwise, each Trade Contractor shall provide the temporary heat and protection necessary to allow his work to continue during cold weather. The building shall be considered to be enclosed when the exterior walls, roofing and temporary closures to all wall and roof openings are in place.

1.4 TEMPORARY TELEPHONE SERVICE

1.4.1 Each Trade Contractor shall provide temporary job site telephone service as required at his own expense.

1.4.2 Telephone numbers for summoning aid, such as the Police Department, the Fire Department, physicians, ambulances, and rescue squads from outside sources shall be conspicuously posted by the Construction Manager at the site of the work.

1.5 TEMPORARY POTABLE WATER SUPPLY

1.5.1 Unless identified otherwise, the Mechanical Trade Contractor (WC 27) shall furnish, install, maintain, and remove if necessary, a temporary water supply system as required. Refer to Section 00210 to verify if Owner shall pay for water usage fees when connected to the Owner's existing system.

1.6 TEMPORARY TOILET FACILITIES

1.6.1 The Construction Manager shall provide and maintain adequate toilet facilities in a clean and sanitary condition for the use of all Trade Contractors. The use of chemical toilet facilities will be permitted.

1.7 FIRST AID

1.7.1 The Trade Contractor shall provide a completely equipped first-aid kit, which shall be readily accessible at all times and shall be provided and maintained at the site of the work in a clean and orderly condition. The required number of employees who have been properly instructed shall be designated to be in charge of first aid work. At least one such employee shall be available at all times that the work is in progress.

1.8 TEMPORARY FIRE PROTECTION

1.8.1 Each Trade Contractor shall be responsible for temporary fire protection related to his own work.

1.8.2 Unless identified otherwise, The General Trades Contractor (WC 20) shall furnish fire extinguishers in accordance with OSHA, as required for the building. Each Trade Contractor shall furnish fire extinguishers in accordance with OSHA requirements when his work required additional extinguishers.

01520 CONSTRUCTION AIDS

1.1 HOISTING & SCAFFOLDING

1.1.1 All hoisting required in the performance of each Trade Contractor will be provided by that Contractor. If a crane is 125 tons or greater, or is a tower crane, only certified operators are allowed. Trade Contractor is responsible for providing required documentation of certification of operators PRIOR to start of work.

1.1.2 Each Trade Contractor shall provide his own scaffolding, which shall be in accordance with all OSHA safety requirements.

01530 BARRIERS

1.1 TEMPORARY SITE FENCE

1.1.1 The temporary site fencing will be provided by the Construction Manager unless otherwise specifically noted.

1.2 TEMPORARY BARRICADES, TRAFFIC CONTROL & TRAFFIC LIGHTS

1.2.1 Each Trade Contractor is responsible for the maintenance and replacement (when removed) of all temporary barricades, traffic control, and traffic lights. In addition, each Trade Contractor shall be responsible for installation of temporary barricades in accordance with MIOSHA requirements at openings created by that trade contractor.

01540 SECURITY

1.1 WATCHMAN

1.1.1 Unless identified otherwise, the services of a watchman will not be provided by either the Owner or the Construction Manager. Each Trade Contractor shall be responsible for, and make good any loss not covered by the Builder's Risk Insurance and shall be

responsible for the associated deductible costs.

01550 ACCESS ROADS & PARKING AREAS

1.1 CONSTRUCTION PARKING

1.1.1 Refer to Section 00210 for parking requirements.

01560 SPECIAL CONTROLS

1.1 WORK INCLUDED: The work covered by this Section of the Specifications pertains to Special Controls.

1.1.1 LIMITING EXPOSURES OF WORK: Each Trade Contractor shall supervise performance of the work in such a manner and by such means which will ensure that none of the work, whether completed or in progress, will be subjected to harmful, dangerous, damaging or otherwise deleterious exposure during the construction period. Such exposures include, where applicable, but not by way of limitation the following:

- Excessive static or dynamic loading.
- Excessive internal or external pressures.
- Excessively high or low temperatures.
- Thermal shock.
- Excessively high or low humidity.
- Air contamination or pollution.
- Water or ice.
- Solvents.
- Chemicals.
- Light.
- Puncture.
- Abrasion.
- Heavy traffic.
- Soiling.
- Bacteria.
- Insect infestation.
- Combustion.
- Electrical current.
- High speed operation, improper lubrication, unusual wear or other misuse.
- Incompatible interface.
- Destructive testing.
- Misalignment.
- Excessive weathering.
- Unprotected storage.
- Improper shipping or handling.
- Theft and Vandalism.

1.2 SPECIAL CONTROLS DESCRIPTIONS

1.2.1 SPECIFICATIONS BY REFERENCE: Where reference is made in the specifications to standards of any technical society, association, governmental agency, etc., said specifications or standards shall apply and be binding as though fully repeated therein

and are to be considered as a part of these specifications.

1.2.2 RELATED WORK: The contractor shall conduct his work in a manner to prevent air, water, and noise pollution by establishing adequate controls during the construction operations. All controls shall be in accordance with the applicable laws of the State of Michigan.

A. AIR POLLUTION: The open burning of combustible wastes from clearing and grubbing operations and of waste construction materials will not be permitted. The Contractor shall dispose of all such wastes at sanitary landfill(s) licensed by the Michigan Department of Natural Resources.

1) Dust Control: The contractor shall maintain all traveled areas in a safe, dust-free condition at all times. To accomplish this, the Contractor shall remove any tracked materials such as mud, dirt, etc. from construction and haul roads, furnish and apply chloride treatment to temporary roads, furnish and install temporary road patches or surfaces, or any approved methods or systems.

B. WATER POLLUTION: The contractor will be required to perform all construction operations in a manner that will conform to the requirements of Act 347, Soil Erosion and Sedimentation Control Act. Methods to be used are indicated herein (Items No. 1 thru No. 46) and referenced with numbers and symbols to the plans when special details are designated. The contractor shall also be required to perform all work in conformance with the requirements of Act 346, Inland Lakes and Streams. The permits for the construction will be obtained by the Owner, unless otherwise noted in the work category description.

C. NOISE POLLUTION: The contractor shall exercise judgment in the conduct of operations, which by nature result in excessive noise. All such operations shall be coordinated with the Construction Manager and Owner to avoid disruption to Owner operations.

D. CONSTRUCTION DEBRIS: All construction debris shall be removed from the construction site(s) at regular intervals and disposed of at sanitary landfill(s) licensed by State department having authority.

E. HOUSEKEEPING: The project work areas shall be maintained in a neat and clean condition and all debris and waste materials shall be removed from work areas on a daily basis.

F. PERMANENT HVAC SYSTEM: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures.

1.2.3 VEHICULAR AND PEDESTRIAN TRAFFIC CONTROL: The contractor shall be responsible for providing, installing, and maintaining vehicular and pedestrian traffic control signs, lights, and barricades in conjunction with construction operations where applicable. Vehicular traffic control measures shall be in accordance with the Michigan Manual of Uniform Traffic Control Devices.

A. STREET CLOSING: No street or roadway may be closed to traffic without prior written permission of the governing body having jurisdiction over the street or roadway.

B. EXISTING TRAFFIC CONTROL SIGNS: Existing traffic control signs which conflict with construction operations may be temporarily removed. The contractor shall provide traffic control for the duration of the sign displacement and signs shall be replaced in the proper location immediately after construction operations adjacent to the sign locations are completed.

01590 FIELD OFFICES

1.1 The Construction Manager shall maintain a temporary field office at the site, equipped with telephone, plan desk and plan files, properly heated and illuminated for his, the Architect's, and the Owner's exclusive use. Each Trade Contractor shall provide his own office as necessary. Temporary offices shall be arranged to avoid interfering with construction, and location shall be approved by the Construction Manager.

01595 SMOKING POLICY

1.1 Refer to Section 00210 for Smoking Policy. Failure to comply with this policy may result in the loss of smoking privileges for all construction personnel on the project, and/or dismissal from the site. There will be no smoking in the Construction Manager’s field office.

END OF SECTION

01600 MATERIAL AND EQUIPMENT

01610 MOVING MATERIALS

1.1 If at any time it becomes necessary to move materials temporarily located on site, which is to enter into their final construction, the Trade Contractor furnishing the materials shall, when so directed by the Construction Manager, move them to another location at his own expense.

01620 STORAGE & PROTECTION

1.1 GENERAL

1.1.1 Each Trade Contractor shall use the area designated by the Construction Manager for storage of materials, etc., but shall confine this area to a minimum within Contract limits as shown on the plans. Storage beyond this area will not be permitted. Roof areas shall NOT be used for the storage of windows, removals, debris or any other construction items. Storage on the site is very limited and Trade Contractors shall provide for the bulk of materials remote from the site. Refer to Section 00210 for project specific requirements.

1.1.2 Each Trade Contractor shall provide suitable and sufficiently enclosed and covered spaces, with raised flooring, to protect materials and equipment from damage by weather or construction work.

01625 SALVAGING OF MATERIALS

1.1 GENERAL

1.1.1 If applicable, materials or equipment shown on drawing or specified herein to be salvaged but not reused, shall become the property of the Owner and each Trade Contractor shall deliver said items to location designated by the Construction Manager. All items not specified to be salvaged for reuse or delivered to the Owner, will be removed from the project site and disposed of legally.

01631 PRODUCTS AND SUBSTITUTIONS

1.1 SUMMARY

Specified Herein: General Requirements for Substitutions and Product Acceptance.

1.2 SUBSTITUTION SUBMITTALS

1.2.1 The following submittals shall be required for materials, assemblies, and component parts of assemblies where scheduled in the "Submittals" Section of Division 1, specified in the Trade Sections or required by the Construction Manager or the Architect as a condition precedent to acceptance of a proposal material, a statement of:

a. Product Certification
b. Manufacturer's review of documents and conditions of use.
c. Approval of proposed Applicator or Installer.
d. Proposal for on-site instruction.
e. Manufacturer's supervision of inspection.

1.2.2 Submittals shall be in same form as specified for Request for Acceptance of Materials described herein and, wherever practical should accompany such request.

1.2.3 Submit description of the complete system for each assembly listing all proposed components and acknowledging adjacent materials which are in contact with material or function as a part of the system.

1.2.4 Where one or more of these services are specified, they are considered to be an integral part of the new system. A proposal to delete any specified service will be considered as a reduction in Scope, subject to general conditions for changes in the work.

1.3 MODIFICATIONS

1.3.1 Letter of certification, or request for acceptance, shall indicate all modifications and clarifications to the Contract Documents, including additional instructions for installation or use, which are, in the opinion of the Manufacturer, necessary for proper performance.

1.3.2 If any of the services specified under this Section are not scheduled as a requirement but are normally recommended by the Manufacturer, notify the Construction Manager and the Architect of such recommendation.

1.3.3 Modifications and clarifications to the Contract Documents, which in the opinion of the Architect do not affect the finished quality of appearance of the Work, will be accepted, subject to the following conditions:

a. Conform to the functional intent of system design.
b. Accepted by all contracting parties, including Subcontractor and Manufacturer.
c. Include all costs in the original bid price for adjustments to the scope of the Work including the work of other trades.

1.3.4 Modification which affect the scope of the work, or the work of other trades, and for any reason can not be settled prior to bidding, will be considered under the terms of the General Conditions as Changes in the Work.

1.4 PROTECTION CERTIFICATION

1.4.1 Product certification is a statement by the manufacturer that to the best of its knowledge, the material has not failed to perform when previously used for similar purposes and under similar conditions of use.

1.4.2 Obtain and submit statements from manufacturers and fabricators of materials,

assemblies and component parts of assemblies that the product as delivered conforms to their published data.

1.4.3 Obtain manufacturer's approval for all variations from published recommendations for installation, operation and conditions of use.

1.4.4 It shall be the duty of the supplier of any material on this Work to submit evidence, upon request, that his material is in compliance with the applicable codes, ordinances and standards referenced therein, in the method in which the material is used in this project.

1.5 GENERAL REQUIREMENTS FOR SUBSTITUTIONS

1.5.1 The Contract Documents indicate and call for certain articles, devices, products, fixtures, materials and work by named manufacturers. The Contract shall be based on materials and work manufactured and supplied by those named.

1.5.2 Definitions:

a. Specified Manufacturers or Materials: Those named in the Contract Documents.
b. Substitutions: Manufacturers or materials, which are not named in the Contract Documents.

1.5.3 Trade Contractor's Responsibility: Manufacturers and trade names are specified to establish a standard. The fact that a product is named does not constitute a guarantee by the Architect that the named Manufacturers have agreed to provide or to modify their product in order to meet all requirements of the Contract Documents. It is the responsibility of the Trade Contractor to obtain assurances from its suppliers that the product it proposes to use will meet all requirements of the Contract Documents. The fact that a material or Manufacturer is a substitution shall not act to either increase or decrease the Trade Contractor's responsibility for performance.

1.5.4 Substitutions During Bidding:

a. Substitutions shall be included in the proposal under the following conditions only and shall follow all requirements of "Acceptance of Substitutions". Paragraph 1.5.6.
b. When the Trade Contractor knows of another product of equal or better quality and performance, which is more readily available.
c. When the trade contractor has had unsatisfactory experience with one or more of the specified products or has reason to believe that the specified manufacturer will not provide the necessary guarantees or assume responsibility for performance.

1.5.5 Substitutions After Contract:

a. Substitutions proposed after execution of the Contract will, if approved by the Architect, be handled in accordance with Article 12 "Changes in the Work" as modified and supplemented herein. A **Request for Change** is sufficient authorization for the Trade Contractor's issuance of a purchase order.

b. A change of Manufacturer or product previously approved will be considered and handled as a Change in the Work.

c. Increases in the cost of materials or Work resulting from the failure of the Trade Contractor to issue a purchase order within the time limits stated in the specified manufacturer's original proposal shall be the sole responsibility of the Trade Contractor and shall not be grounds for a substitution or an increase in the Contract Sum.

1.5.6 Acceptance of Substitutions:

a. Substitutions will be considered for any manufacturer except where only one manufacturer is listed.

b. In all cases where substitutions are proposed by the trade contractor, it shall be the sole responsibility of the trade contractor to provide adequate data and samples as required by the Architect to evaluate the substitution.

c. Request for acceptance of substitution shall be presented not less than seven (7) days in advance of the date on which a decision by the Architect is required and shall:

1) Include all information required by this Specification.
2) State the reason for the substitution.
3) Include accurate cost data if the substitute material involves a change in the Contract Sum, or if so requested by the Architect.
4) Provide or make arrangements for the Manufacturer to provide complete data describing the proposed substitution, including samples and itemized comparison with the specified materials, and work, if requested by the Architect.

d. The Architect shall not be obliged to justify his reason for rejecting a proposed substitution.

e. In the event that a substitution is accepted conditionally on the Contractor's agreement to assume full responsibility for equality and performance, the Contract shall provide a full value warranty and agree to make good all damages resulting from the failure of the substitute product.

1.6 ACCEPTANCE OF MATERIALS AND MANUFACTURERS

1.6.1 Standard Materials:

a. Architect's acceptance applies to the Manufacturer only and shall not act to permit any deviation from other requirements of the Specifications.

b. Acceptance will be based on the Manufacturer's specifications at time of issuance of Bidding Documents. Deviations from such specifications shall be considered as a substitution.

c. Requests for acceptance shall be in tabular form stating Specification paragraph and material selected, except as otherwise provided.

d. Shop Drawings shall not indicate any material for which acceptance has not been received, unless accompanied by a separate request for approval. In no case shall Architect's review and return of Shop Drawings constitute and acceptance of either specified or substitute manufacturers or materials.

1.6.2 Special Materials

a. Special materials are materials, which are specified as requiring supervision or technical services by the manufacturer for proper installation.

b. Request for acceptance of special materials shall include a letter from the manufacturer which letter shall contain all information required hereinafter.

1.6.3 Materials Involving Supplementary Warranty or Maintenance Contract:

a. These materials shall be submitted as a request for acceptance over the signature of a qualified technical representative in the direct employment of the manufacturer or such other person as the manufacturer may authorize in writing. Request for acceptance shall contain the following information:

1) Name of project.
2) Name of Contractor, Subcontractor or other party to whom material is furnished.
3) Reference to Specification Section and Article where material is specified and other Contract Documents necessary for identification.
4) Statement of acceptance of documents, conditions, and performance requirements.
   i. Statement that documents as issued are in accordance with manufacturer's recommendations for use of specified materials, or
   ii. Recommended modification of detail, use, application or for substitution of different product by same manufacturer as being more suitable for the performance requirements of the warranty.
5) Statement that detailed installation instructions will be provided.
6) Extent of job site technical services, consultants or instructors proposed, if any.
7) Statement that warranty will be provided.
8) Special provisions required to keep warranty in force.

b. Requests for acceptance may be in the form of a letter including the above items and addressed to the subcontractor responsible for installation of the material, or may be according to a sample form of Material Proposal, provided by the Architect.

c. Upon receipt of the manufacturer's proposal, the subcontractor shall add his own statement agreeing to comply with the manufacturer's requirements and warranting his own workmanship.

d. The contractor shall submit letter of endorsement and copies of all documents, including letters of comment, to the Architect for approval. In the event that the request for approval recommends a change in the work, modification of

detail, or substitution of material, the contractor shall indicate his concurrence with the change as being within the scope of the contract or indicate the change in the Contract Sum for making such change, or state his objections to the change.

1.7 AIR POLLUTION CONTROL

1.7.1 Request for approval of equipment, which may generate air pollutants, shall be accompanied by certification of compliance with approvals from all State and Local Air Pollution Control Authorities having jurisdiction.

1.7.2 Request shall state that manufacturer has provided all information and complied with all requirements of the above agencies including requirements for in place monitoring and measurements.

1.8 INSPECTION AND TESTING

1.8.1 In accordance with Sections of this Division applying to Laboratory Tests and Inspections, the Owner has the option to employ independent inspectors for certain portions of the Work and to have materials tested by an Independent Testing Laboratory.

1.8.2 In addition to necessary samples of materials, manufacturer shall provide information and data required by the laboratories and inspectors for the proper performance of their work.

1.8.3 Where certification by Independent Testing Laboratory is required to demonstrate compliance with a specified standard (ASTM, ANSI or similar), Laboratory Reports shall be dated not more than two years prior to submittal and shall refer to the issue of said standard current as of the issue date of the Contract Documents. Later issue or similar standards superseding the standards will be accepted subject approval by the Architect.

END OF SECTION

1700 PROJECT CLOSEOUT

1.1 DESCRIPTION OF REQUIREMENTS

1.1.1 DEFINITIONS: Project closeout is the term used to describe certain collective project requirements, indicating completion of the Work that are to be fulfilled near the end of the Contract time in preparations for final acceptance and occupancy of the Work by the Owner, as well as final payment to each Trade Contractor and the normal termination of the Contract.

a. Specific requirements for individual units of work are included in the appropriate sections in Divisions 2 through 42.

1.2 PREREQUISITES FOR SUBSTANTIAL COMPLETION

1.2.1 GENERAL: Complete the following before requesting the Construction Manager to coordinate inspections for certification of substantial completion, either for the entire Work or for portions of the Work. List known exceptions in the request.

a. In the progress payment request that coincides with, the date substantial completion is claimed, show either 100% completion for the portion of the Work claimed as "substantially complete", or list incomplete items, the value of incomplete work, and reasons for the Work being incomplete.
b. Include supporting documentation for completion as indicated in these contract documents.
c. Advise Construction Manager of pending insurance change-over requirements.
d. Submit special warranties, workmanship/maintenance bonds, maintenance agreements, final certifications, and similar documents.
e. Obtain and submit releases enabling the Owner's full, unrestricted use of the Work and access to services and utilities. Where required, include occupancy permits, operating certificates and similar releases.
f. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.
g. Deliver tools, spare parts, extra stocks of material and similar physical items to Construction Manager.
h. Make the final change-over of locks and transmit keys to the Construction Manager. Advise the Construction Manager's personnel of the change over in security provisions.
i. Complete start up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities and services from the project site, along with construction tools and facilities, mockups, and similar elements.
j. Complete final cleaning up requirements, including touch-up painting of marred surfaces.
k. Touch-up and otherwise repair and restore marred exposed finishes.
l. Submit a statement showing an accounting of change-over requirements.

1.2.2 INSPECTION PROCEDURES: Upon receipt of the Trade Contractor's request for inspection, the Architect/Engineer will either proceed with inspection or advise the Construction Manager of unfilled prerequisites.

a. Following the initial inspection, the Architect/Engineer will either prepare the certificate of substantial completion, or will advise the Construction Manager of work which must be performed before the certificate will be issued. The Architect/Engineer will repeat the inspection when requested and when assured

that the Work has been substantially completed.

b. Results of the completed inspection will form the initial "punchlist" for final acceptance.

1.3 PREREQUISITES FOR FINAL ACCEPTANCE

1.3.1 GENERAL: Complete the following before requesting the Architect / Engineer's final inspection for certification of final acceptance, and final payment as required by the General Conditions. List known exceptions, if any, in the request.

a. Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
b. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
c. Submit a certified copy of the Architect/Engineer's final punchlist of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and has been endorsed and dated by the Architect/Engineer.
d. Submit consent of surety.
e. Submit a final liquidated damages settlement statement, acceptable to the Owner where applicable.
f. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.3.2 REINSPECTION PROCEDURE: The Architect/Engineer will reinspect the Work upon receipt of the Construction Manager's notice that the work, including punchlist items resulting from earlier inspections, has been completed, except for these items whose completion has been delayed because of circumstances that are acceptable to the Architect/Engineer.

a. Upon completion of reinspection, the Architect/Engineer will either prepare a certificate of final acceptance, or will advise the Construction Manager of work that is incomplete or of obligations that have not been fulfilled, but are required for final acceptance.
b. If necessary, the reinspection procedure will be repeated.

1.4 RECORD DOCUMENT SUBMITTALS

1.4.1 GENERAL: Specific requirements for record documents are indicated in the individual sections of these specifications. Other requirements are indicated in the General Conditions. General submittal requirements are indicated in the various "submittals" sections.

a. Do not use record documents for construction purposes; protect from deterioration and loss provide access to record documents for the Architect/Engineer's reference during normal working hours.

1.4.2 Record Drawings: Maintain a record set contract drawings and shop drawings in a clean, undamaged condition. Mark up the set of record documents to show the actual installation where the installed work varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing the actual "field" condition fully and accurately; however, where shop drawings are used for mark up, record a cross reference at the corresponding location on the working drawings. Give particular attention to concealed work that would be difficult to measure and record at a later

date.

a. Mark record sets with red erasable pencil and, where feasible, use other colors to distinguish between variations in separate categories of work.
b. Mark up new information, which is known to be important to the Owner, but for some reason was not shown on either contract drawings or shop drawings.
c. Note related change order numbers where applicable.
d. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
e. At the completion of the Trade Contractor's work, submit record sets of drawings to the Construction Manager showing all record drawing conditions.

1.4.3 RECORD SPECIFICATIONS: Maintain one complete copy of the Project Manual, including specifications addenda, bulletins, and one copy of other written constriction documents such as change orders and similar modifications issued in printed form during construction. Mark these documents to show substantial variations in the actual work performed in comparison with the text of the specifications and modifications as issued. Give particular attention to substitutions, selection of options and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable.

a. Upon completion of the Work, submit record specifications to the Construction Manager for the Owner's records.

1.4.4 RECORD PRODUCT DATA: Maintain one copy of each product data submittal. Mark these documents to show significant variations in the actual Work performed in comparison with the submitted information. Give particular attention to concealed products and portions of the Work, which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and markup of record drawings and specifications.

a. Upon completion of mark up, submit complete sets of record product data to the Construction Manager for the Owner's records.

1.4.5 MISCELLANEOUS RECORD SUBMITTALS: Refer to other sections of the specifications for requirements of miscellaneous record keeping and submittals in connection with the actual performance of the Work. Immediately prior to the date or dates of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to Construction Manager for the Owner's records.

1.4.6 MISCELLANEOUS MANUALS; Organize operating and maintenance date into suitable sets of manageable size. Bind data into individual binders properly identified and indexed. Unless identified otherwise, bind each set of data in a heavy duty 3 ring vinyl covered binder, with pocket folders for folded sheet information. Mark the appropriate identification on both front and spine of each binder. 3-ring vinyl covered binder, with pocket folders for folded sheet information. Mark the appropriate identification on both front and spine of each binder.

a. Include the following types of information in operation and maintenance manuals:
   - Emergency instructions.
   - Spare parts listing.
   - Copies of warranties.

- Wiring diagrams.
- Recommended "turn around" cycles.
- Inspection procedures.
- Shop drawings and product data.

2.1 EXECUTION

2.2 CLOSEOUT PROCEDURES

2.2.1 GENERAL OPERATING AND MAINTENANCE INSTRUCTIONS: Arrange for each installer of operating equipment and other work that requires regular or continuing maintenance, to meet at the site with the Owner's personnel to provide necessary basic instruction in the proper operation and maintenance of the entire Work. Where installers are not experienced in the required procedures, include instruction by the manufacturer's representatives.

a. As part of this instruction provide a detailed review of the following items:
- Maintenance manuals.
- Record documents.
- Spare parts and materials.
- Tools.
- Lubricants.
- Fuels.
- Identification systems.
- Control sequences.
- Hazards.
- Cleaning.
- Warranties, bonds, maintenance agreements and similar continuing commitments.

b. As part of this instruction for operating equipment demonstrate the following procedures:
- Start-up.
- Shut down.
- Noise and vibration adjustments.

2.3 FINAL CLEANING

2.3.1 GENERAL: Special cleaning requirements for specific units of Work are included in the appropriate sections of the specifications. General Cleaning during the regular progress of the Work is required by the General Conditions and Subcontract Agreements.

2.3.2 CLEANING: Provide final cleaning of the Work at the time indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of work to the condition expected from a normal, commercial building cleaning and maintenance program. Comply with the manufacturer's instructions for operations.

Complete the following cleaning operations before requesting the Architect /Engineer's inspection for certification of substantial completion:

a. Remove labels which are not required as permanent labels.
b. Clean transparent materials, including mirrors and glass in doors and windows, to a polished condition. Remove substances, which are noticeable as vision obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
c. Clean exposed exterior and interior hard surfaced finishes to a dust free

condition, free of dust, stains, films and similar noticeable distracting substances. Leave concrete floors broom clean. Vacuum carpeted surfaces.

d. Wipe surfaces of mechanical and electrical equipment clean. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

e. Clean the project site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas to a broom clean condition; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even textured surface.

2.3.3 REMOVAL OF PROTECTION: Remove temporary protection devices and facilities, which were installed during the course of the work to protect previously, completed work during remainder of the construction period.

2.3.4 COMPLIANCE: Comply with safety standards and governing regulations for cleaning operation. Do not burn waste materials at site. Do not bury debris or excess materials on Owner's property. Do not discharge volatile or other harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

a. Where extra materials of value remaining after completion of associated work have become Owner's property, dispose of these materials to the Owner's best advantage as directed.

END OF SECTION

01740 WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Specified Herein: Warranties and continuing services required to be provided by manufacturers of materials and systems where required for proper performance.

1.1.2 The word "Guarantee" when appearing in any Contract Document or construction correspondence shall be defined as warranty in accordance with Article 3.5 of the General Conditions.

1.2 SUBMITTALS

1.2.1 Submit warranties in accordance with Article 3.5 of the General Conditions as modified by Supplementary Conditions and additional requirements specified under the individual Trade Sections.

1.2.2 Required types of warranties and additional services are scheduled and listed in the Trade Sections.

1.2.3 In all cases where "Special Warranties" or "Service Contracts" are required, the request for approval of materials will be accepted by the Owner and the Architect on the understanding that manufacturer agrees to provide the specified warranty or other service unless stated otherwise in the request.

1.2.4 The Owner will not be bound to accept any limitations or variations from the specified warranty, which were not filed with the request for acceptance and accepted prior to purchase of materials.

1.2.5 Warranties shall be submitted prior to request for payment for 100% completion in each case, shall acknowledge the responsibilities defined under Supplementary Conditions and shall include:

a. Manufacturer's warranty that all materials comply with its published standards, comply with the requirements of the Specifications and where specified, are adequate for the proposed use.
b. Subcontractor's warranty that all workmanship complies with the requirements of the Specifications and of the manufacturer.
c. Contractor's warranty covering the entire work and accepting responsibility for all limitations imposed by the manufacturer or subcontractor except where such limitations have been previously accepted by the Architect.
d. Certification and verification of previously submitted information including statement of all limitations, required maintenance and similar conditions of the warranty.

1.3 STANDARD WARRANTIES

1.3.1 A standard warranty is a warranty whose terms are essentially the same as normally

offered by the manufacturer of standard with the industry.

1.3.2 General Conditions require that standard warranties apply as a minimum requirement notwithstanding the fact that submittal of a copy of the warranty is not required.

1.3.3 Unless otherwise specified, a standard warranty shall be for a period on one (1) year from Date of Substantial Completion.

1.3.4 Contractor shall obtain and furnish to the Owner from each manufacturer of materials or equipment incorporated into the Work a warranty at least as favorable to Owner as that customarily given by such manufacturer to others. Contractor shall inform itself as to any conditions precedent to the effectiveness of each manufacturer's warranty and comply with all such conditions (or obtain waivers thereof from the manufacturer) so that such warranty shall be fully effective. If any event occurs which might invalidate any manufacturer's warranty, contractor shall promptly notify the Owner and the Architect.

1.3.5 All warranty periods shall commence on the Date of Substantial Completion except that, if it is discovered after said date that certain work or materials were not in fact in conformance with the requirements of the Contract Documents, the applicable warranty period shall re-commence from the completion of the repair or replacement of such Work to make it so conform.

1.3.6 The fact that a manufacturer's warranty differs in its terms from those of the contractor or any subcontractor, the acceptance by the Owner of any warranty of a manufacturer or subcontractor, or the fact that the Owner has claimed initially on such warranty, shall not in any way release contractor from his warranty obligations under the contract.

1.4 SPECIAL WARRANTIES

1.4.1 A special warranty is one whose terms, in addition to the standard coverage offered by the manufacturer, contain other special provisions, including:

a. Acknowledgment of specified list of items, which shall be specifically noted as being covered by the warranty.
b. Acknowledgment of specific conditions for use or exposure.
c. Extension of warranty to waive standard exceptions or to extend limits including time.
d. Requirements for specific performance by other trades including method of separation and protection from, or assurance of compatibility with, adjacent materials.
e. Assemblies and systems, which may include products of other manufacturers.
f. Conditions where certain performance criteria are specified and must be either acknowledged or actual limits are required to be determined by performance testing subject to Owner's review and acceptance.
g. Conditions where manufacturer's continuing involvement such as maintenance or advisory service is required.

1.4.2 Maintenance Service During Warranty Period:

a. Reference to routine maintenance required to be performed by the Owner

during the warranty period shall be listed in the original submittal of proposed warranty.

b. All other administration and maintenance service required during the warranty period, including installation of items repaired or replaced under the terms of the warranty shall be included in the original Contract.

1.5 SERVICE CONTRACTS

1.5.1 Required types of Service Contract Proposals are scheduled under Schedule or Required Submittals and are listed in the Trade Sections.

1.5.2 Where specified, the subcontractor or manufacturer originally supplying services and skills required for proper maintenance and agreeing to maintain availability of replacement parts and materials.

1.5.3 The Service Contract is in addition to, and independent of, the Warranty and shall not act to either extend the Warranty or to reduce the contractor's responsibilities thereunder.

1.5.4 Unless otherwise specified or agreed, Service Contracts shall be written for a period of five (5) years starting with the termination of similar services included under the warranty and shall include cancellation privilege annually when exercised at least 60 days prior to anniversary date.

1.5.5 The contractor shall:

a. Prior to submittal of manufacturer of subcontractor for approval, verify that specified service is available and will be offered.
b. Secure from the manufacturer of subcontractor a bona fide proposal to perform the specified services.
c. When so directed, assist the Architect in obtaining proposals for the performance of the specified services by other competent parties.

1.6 ADVISORY AND INSPECTION SERVICE

1.6.1 Advisory and Inspection Service consists of:

a. Periodic inspection on a regular scheduled basis. Include schedule of proposed inspections of the agreement.

b. All necessary information, including special training, where required to adequately instruct Owner's maintenance personnel in preventive maintenance repairs and treatments. If such maintenance work is recommended:

1) Obtain or submit price quotations for recommended work.

2) When so instructed by the Owner, make all necessary arrangements for the performance of the Work.

1.6.2 Parts and Materials Agreement:

a. Where standard commercially available parts of materials are suitable for maintenance or repair, inform Owner concerning trade name or description and location where they may be obtained.

b. Where parts or materials are not readily available maintain replacement stocks at a location as required to prevent undue delay in repairs or loss of use of equipment pending delivery.

1.7 MAINTENANCE SERVICE

1.7.1 A Maintenance Service Contract is an agreement that in addition to Advisory and Inspection Service, the Manufacturer will provide, or otherwise make available through his agent, a regular maintenance service program scheduled during normal working hours.

1.7.2 Proposals shall schedule proposed times for servicing and list the services to be performed.

1.7.3 Maintenance service of equipment shall be performed solely by the original Equipment Contractor and shall not be assigned or transferred to any agent or subcontractor without the approval of the Owner.

1.7.4 Repairs:

a. Permanent repairs shall be started within seven (7) days after notification by the Owner.

b. In the event that emergency and permanent repairs are not started within the specified time limits, or if the work is stopped without the Owner's consent, the Owner shall have the same options to have repairs performed by others as specified under Warranties without invalidating this agreement.

1.7.5 Equipment maintenance shall include systematic examinations, and adjustments and lubrication of all equipment. The Equipment Maintenance Contractor shall repair and replace electrical and mechanical parts whenever required using only genuine standard parts recommended or produced by the manufacturer of the equipment.

1.7.6 Addition work when so directed by the Owner shall be included under the work of the Maintenance Contract and the Contractor shall be reimbursed at the current prevailing rate for the cost of materials, labor and services. Such additional work shall include:

a. Repairs or replacement required as a result of negligence, abuse, or other actions contrary to the Equipment Contractor's operating instructions.
b. Improvement or additional equipment required by the Owner, Insurance Companies, or Governmental Authorities.
c. Except for emergency service, the additional cost for overtime work based on the difference between regular and overtime labor when the Owner requests

that such work be performed outside of regular working and so authorized in writing.

1.7.7 Additional requirements for specific maintenance contracts are specified in the various Trade Sections.

1.8 EMERGENCY CALL-BACK SERVICE

1.8.1 Emergency Call-Back Service is an agreement to provide rescue and repair service on an emergency basis where required for the protection of life and property.

1.8.2 Owner's agreement to permit manufacturers to assign agreement to an agent does not relieve manufacturer of responsibility to verify that service remains available for the specified time.

1.8.3 Agreement shall remain in effect for the lifetime of all Warranties, Service Contracts and for such longer time as may be specified or agreed.

1.8.4 Service shall be available on a 24 hour, 7-day basis and shall be performed within the following time limit after notification of emergency unless otherwise specified. Maintain emergency telephone number on file with the Owner for nights and weekends.

1.9 CERTIFICATION

1.9.1 Product Certification: See Division 1, Section titled "Material and Equipment".

1.9.2 Workmanship Certification is a statement by the applicator or installer that all materials and workmanship in connection with the system have been furnished and installed in complete conformance with Contract Documents, and with the manufacturer's specifications and requirements for the particular type of use specified.

1.9.3 A product certification where specified as a requirement shall be in a form similar to the following:

> "We, the (Manufacturing Company), certify that the complete system as detailed and specified can be installed and will perform in accordance with the requirements of the specifications and the ASTM Standards referenced therein for the guarantee period of one year or such longer period as may be negotiated between the Owner and the (Manufacturing Company).
>
> Upon completion of the Project we will inspect the work and certify to the Owner that the system as installed is in accordance with the Manufacturer's requirements or indicated in writing what remedial action is necessary in order that it does so conform."

END OF SECTION

017419 CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. 017419-1 TCC Waste Management Plan

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

2. Salvaging non-hazardous demolition and construction waste.
2. Recycling non-hazardous demolition and construction waste.
2. Disposing of non-hazardous demolition and construction waste.

B. Related Sections include the following:

2. Division 1 Section "Summary of Multiple Contracts" for coordination of responsibilities for waste management.

2. Division 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.

2. Division 02 Section "Structure Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements[, and for disposition of hazardous waste].

2. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

2. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.

2. Division 04 Section "Stone Masonry" for disposal requirements for excess stone and stone waste.

2. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials

B. Salvage/Recycle Goals: Owner's goal is to salvage and recycle as much non-hazardous demolition and construction waste as possible including the following materials:

2. Demolition Waste:

a. Asphaltic concrete paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.

n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panel boards.
oo. Transformers.

2. Construction Waste:
   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Carpet and pad.
   i. Gypsum board.
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.

5) Polystyrene packaging.
6) Wood crates.
7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Comply with Section 017419.1 Waste Management Project Specific Plan or submit an equally comprehensive Waste Management Plan.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include the following information:

2. Material category.
2. Generation point of waste.
2. Total quantity of waste in tons.
2. Quantity of waste salvaged, actual in tons.
2. Quantity of waste recycled, actual in tons.
2. Total quantity of waste recovered (salvaged plus recycled) in tons.
2. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Qualification Data: For Waste Management Coordinator and refrigerant recovery technician.

G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

2. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
2. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
2. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Comply with Section 017419.1 Waste Management Project Specific Plan in the following section, or submit an equally comprehensive Waste Management Plan.

B. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

2. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
2. Total cost of disposal (with no waste management).
2. Revenue from salvaged materials.
2. Revenue from recycled materials.
2. Savings in hauling and tipping fees by donating materials.
2. Savings in hauling and tipping fees that are avoided.
2. Handling and transportation costs. Include cost of collection containers for each type of waste.
2. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

1.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Construction Manager. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

2. Comply with Division 1 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

2. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

2. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

1.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

2. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
2. Store items in a secure area until installation.
2. Protect items from damage during transport and storage.
2. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

2. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.
2. Store items in a secure area until delivery to Owner.
2. Transport items to Owner's storage area designated by Owner.
2. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

1.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:

See Section 017419.1 Waste Management Project Specific Plan

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.

D. D. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

E. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

2. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
2. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
2. Store components off the ground and protect from the weather.
2. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

1.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2-inch size.

2. Crush asphaltic concrete paving and screen to comply with requirements in Division 2 Section "Earthwork" for use as general fill.

B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

2. Pulverize concrete to maximum 1-1/2-inch size.
2. Crush concrete and screen to comply with requirements in Division 2 Section "Earthwork" for use as satisfactory soil for fill or sub-base.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

2. Pulverize masonry to maximum 1-inch size.

a. Crush masonry and screen to comply with requirements in Division 31 Section "Earthwork" for use as general fill.
b. Crush masonry and screen to comply with requirements in Division 32 Section "Exterior Plants" for use as mineral mulch.

2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

2. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

2. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

2. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

L. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

M. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

K. Conduit: Reduce conduit to straight lengths and store by type and size.

1.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

2. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
2. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
2. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

2. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

a. Comply with requirements in Division 32 Section "Exterior Plants." for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.

2. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

   a. Comply with requirements in Division 32 Section "Exterior Plants." for use of clean ground gypsum board as inorganic soil amendment.

1.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

   2. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 018119 – INDOOR AIR REQUIREMENTS

PART 1 – GENERAL

1.2. SECTION INCLUDES
A. Overview of indoor air quality requirements and procedures, including product/material selection.

1.3. DEFINITIONS
A. Volatile Organic Compounds (VOCs): Organic chemicals that produce vapors readily at room temperature and normal atmospheric pressure (e.g. gasoline, solvents, etc.). VOCs react with sunlight and nitrogen to form ground-level ozone, a chemical that has detrimental effect on human health, agricultural crops, forests, soil, groundwater and ecosystems.
B. Carpet and Rug Institute (CRI) Green Label: a program established by the national trade association representing the carpet and rug industry to identify carpet products that have been tested by an independent laboratory and have met the criteria for low VOC emissions.

1.4. REFERENCES
A. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). IAQ
   a. Guidelines for Occupied Buildings Under Construction. Second Edition, 2007.
B. ASHRAE. ANSI/ASHRAE 52.2-1999: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
C. EPA. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air.
D. State of California. South Coast Air Quality Management District (SCAQMD) Rule 1168. January 2005 (as amended).
E. State of California. South Coast Air Quality Management District (SCAQMD) Rule 1113. January 2004 (as amended).
F. Green Seal. Paints (GS-11). January 1997. May 1993.
G. Green Seal. Anti-Corrosive Paints (GC-03). January 1997.
H. U.S. Green Building Council. "Indoor Environmental Quality Credit 3: Construction IAQ
   a. Management Plan and Credit 4: Low-Emitting Materials" Leadership in Energy and Design
   b. Environmental Design Reference Guide for Green Building Design and Construction, 2009 Edition. USGBC. "Materials & Resources Credit 2: Construction Waste Management". Leadership in Energy and Environmental Design Reference Guide for Green Building Design and Construction, 2009 Edition.
I. California Department of Health Services Standard Practice for the Treating of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

1.5. OBJECTIVES
A. Meet or exceed the recommended Design Approaches of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition, 2007, Chapter 3.
B. Protect construction workers and future building occupants from indoor air quality problems resulting from construction activities and building materials.
C. Reduce the production and circulation of pollutants during construction.
D. Protect equipment and absorptive materials stored and installed on-site from moisture, dust and dirt accumulation during construction.

E. Prepare the building for occupancy following construction and prior to occupancy.

1.6. DESCRIPTION OF WORK

A. The site superintendent (or other person designated by the Contractor) shall be responsible for all aspects of LEED coordination during construction related to indoor air quality management.

B. Reference 018119-1 TCC Indoor Air Quality Management Plan – During Construction for the required Best Management Practices for Contractors and Sub-Contractors.

1.7. LEED START-UP MEETING

A. Prior to mobilization on-site, the Contractor shall hold a start-up meeting with the Architect to review indoor air quality management requirements. This meeting shall include a review of:

1. Indoor air quality management objectives.
2. Indoor air quality management requirements and procedures.
3. Indoor air quality management documentation and submittals.

1.8. LEED COORDINATION MEETING

A. Prior to start of construction, the Contractor (in conjunction with the Architect) shall hold a coordination meeting with the construction team to explain the indoor air quality management requirements to the Sub-Contractors. This meeting shall include a review of:

1. Indoor air quality management objectives.
2. Indoor air quality management requirements and procedures.
3. Indoor air quality management documentation and submittals.

1.9. SUBMITTALS

A. Product VOC Identification

1. Collect supporting documentation (MSDSs, product data sheets, letter from manufacturers, etc.) to document VOC emission rates for all adhesives, sealants, paints and coatings that are applied onsite and fall within the building weather barrier.
2. Submit completed supporting product literature to the Contractor and Or Architect for review at least 14 days prior to ordering.

B. Low Emitting Flooring Systems

1. Collect supporting documentation (letters from manufacturers, product literature, etc.) for all carpet and hard surface flooring products used in the building.
2. Submit completed supporting product literature to the Contractor and Or Architect for review at least 14 days prior to ordering..

C. IAQ Management Inspection Log

1. Contractor / Subcontractor shall keep a completed log. The log shall commence when the building is enclosed and carry through to building turnover.

D. Photo Documentation Checklist

1. Photographs shall be provided as specified in the checklist.
2. Photographs will be taken on **six** different occasions during construction to prove continuous compliance.

2. PART 2 - PRODUCTS

2.1. GENERAL

A. The VOC content limits listed in this section may be amended from time to time by their governing bodies. In the event that the VOC limits listed below are higher than the VOC limits in effect at the date of application for building permit, the VOC limits in effect at the date of application for building permit shall be used.

B. Reference SECTION 016119 LEED PRODUCT REQUIREMENTS for product Indoor Air

Quality / Emission requirements and acceptable levels.

3. PART 3 - EXECUTION
   3.1. POLUTANT SOURCE IDENTIFICATION
      A. Identify potential sources of indoor air pollutants on the construction site.
      B. Any construction activity or material that produces odor and/or dust is considered a source of air pollutants. Pollutant sources include, but are not limited to:
      C. Materials that produce detectable odor:

Paints	Coatings	Grouts
Stains	Adhesives	Epoxy Flooring
Sealants	Caulking	Solvents
Pesticides	Fuels	Cleaning Products

      D. Materials that create dust:

Concrete Products	Drywall	Wood Products
Acoustical Ceiling Tile	Insulation	Ceramic Tile

      E. Equipment that emit products of combustion or create odor and/or dust:

Generators	Compressors	Cutting Tools / Saws
Touché / Welders	Vehicles	Portable Heaters

      F. Construction activities that disrupt pollutants:

Demolition	Repair	Renovation

      G. Other

Demolition	Repair	Renovation

   3.2. MINIMIZE POLLUTANTS
      A. Reference 018119-1 TCC Indoor Air Quality Management Plan – During Construction
      B. Additional measures include but are not limited for the minimization of pollutants generated inside the building from the sources identified under article 3.1:
         1. Smoking shall be prohibited inside the building at all times during construction and within 25 feet of building entrances once enclosed.
         2. Fuelling up equipment outside the building.
         3. Storing gasoline or solvents outside the building.
         4. Restricting outdoor vehicular/equipment traffic and operation where emissions can enter the building.
         5. Reducing on-site emissions by using equipment that burns propane/natural gas or is powered by electricity.
         6. Exhausting pollutant sources directly outside using temporary or permanent ventilation equipment. Where exhaust is not feasible, locally re-circulate air through a portable air cleaner.
         7. Collecting and bagging sawdust from woodworking tools.
         8. Covering and/or sealing all indoor sources of odor and dust.
         9. Using painting techniques that minimize odor (e.g roller instead of spraying).
         10. Using cleaning practices that minimize dust (e.g. vacuum instead of sweeping).
         11. Using cleaning products that minimize pollution, fumes, VOC's, etc.
         12. Prohibiting the burning of garbage.
   3.3. HOUSEKEEPING MEASURES
      A. Prevent the accumulation of moisture, dust and dirt in the building from the sources identified under article 3.1 using the following measures:

1. Frequently cleaning interior surfaces to minimize dust and dirt accumulation.
    a) Note: Localized cleaning should occur immediately after a construction activity is completed and/or at the end of each day. A full building clean-up must be performed at least once a week.

B. Promptly clean all spills (fuels, lubricants, paints, adhesives, etc.).

C. Clean or remove excess products.

1. All Pollutant Containment, Housekeeping and HVAC protection measures will be reviewed by the Contractor and / or Architect during site visits.
    a) All deficiencies identified by the Contractor and / or Architect must be remedied and documented in the IAQ Management Inspection Log within 48 hours of notification.
    b) The Contractor shall clean or replace any equipment or materials that is incorrectly stored or improperly protected at no extra cost to the contract.

3.4. REMOVAL OF PROTECTION MEASURES

A. All products/materials installed as a part of indoor air quality management measures shall be removed prior to building turnover. Any remedial work required as a result of removing the measures is the responsibility of the Contractor.

END OF SECTION 018119

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 4 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

B. Related Sections:

2. Division 01 Section "Facilities Exterior Enclosure Commissioning" for commissioning process activities for building exterior enclosure, roof, and foundation systems, assemblies, equipment, and components.
2. Division 01 Section "Interiors Commissioning" for commissioning process activities for building interiors construction, stairways, and finish systems and assemblies.
2. Division 14 Section "Commissioning of Conveying Equipment" for commissioning process activities for conveying systems, assemblies, equipment, and components.
2. Division 21 Section "Commissioning of Fire Suppression" for commissioning process activities for fire-suppression systems, assemblies, equipment, and components.
2. Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.
2. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
2. Division 25 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
2. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.
2. Division 27 Section "Commissioning of Communications" for commissioning process activities for communications systems, assemblies, equipment, and components.
2. Division 28 Section "Commissioning of Electronic Safety and Security" for commissioning process activities for electronic safety and security systems, assemblies, equipment, and components.

1.3 DEFINITIONS

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

2. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
2. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and each Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 EACH CONTRACTOR'S RESPONSIBILITIES

A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

2. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
2. Attend commissioning team meetings held on a monthly basis.
2. Integrate and coordinate commissioning process activities with construction schedule.
2. Review and accept construction checklists provided by the CxA.
2. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
2. Review and accept commissioning process test procedures provided by the Commissioning Authority.
2. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Prepare and maintain the Issues Log.

G. Prepare and maintain completed construction checklist log.

H. Witness systems, assemblies, equipment, and component startup.

I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 5 - PRODUCTS (Not Used)

PART 6 - EXECUTION (Not Used)

END OF SECTION 019113

Project Manual

100% Construction Documents

Lansing School District SB-1785
Mt. Hope
Ingham County, Michigan

C2AE Project #22-0116

June 2023

c2ae
architecture • engineering

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329200 Turf and Grasses
329300 Plants

DIVISION 33 - UTILITIES

330500 Common Work Results For Utilities
331415 Site Water Distribution Piping
334200 Stormwater Conveyance
334600 Subdrainage

APPENDIX

Geotechnical Report, prepared by Driesenga & Associates, Inc., dated September 16, 2022

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form provided in Project Manual.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.
      f. Certificates and qualification data, where applicable or requested.
      g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
      h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.

i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Substitution request is fully documented and properly submitted.
      c. Requested substitution will not adversely affect Contractor's construction schedule.
      d. Requested substitution has received necessary approvals of authorities having jurisdiction.
      e. Requested substitution is compatible with other portions of the Work.
      f. Requested substitution has been coordinated with other portions of the Work.
      g. Requested substitution provides specified warranty.
      h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)
END OF SECTION 012500

REQUEST FOR SUBSTITUTION

TO:_____ **DATE:**_____

PROJECT: _____

SECTION **PARAGRAPH** **SPECIFIED ITEM**

_____ _____ _____

PROPOSED SUBSTITUTION: _____ **MODEL:** _____

MANUFACTURER: _____ **PHONE:** (____)_____

Include product description, specifications, drawings, photographs, performance and test data adequate for evaluation. Clearly identify applicable portions of the data. Also include description of changes to contract documents that would be required as a result of the substitution.

The undersigned states that the following line items, unless modified on attachments, are correct:

A. I have read and fully understand the conditions for substitutions outlined in this specification section.

B. The proposed substitution does not affect dimensions shown on drawings.

C. The undersigned will reimburse architect for any building design changes required due to the substitution, including engineering, detailing, and services associated with re-approval by authorities.

D. I will coordinate installation and make both known and unforeseen changes to other work required for substitution at no additional cost to the owner.

E. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.

F. Maintenance and service parts will be locally available for the proposed substitution.

G. The undersigned further states that the function, appearance, and quality of the proposed substitutions are equivalent or superior to the specified item.

SUBMITTED BY: _____

SIGNATURE _____

FIRM _____

ADDRESS _____

_____

TELEPHONE (____)_____

FAX (____)_____

FOR USE BY C2AE

ACCEPTED **ACCEPTED AS NOTED**

NOT ACCEPTED **RECEIVED TOO LATE**

BY _____

DATE _____

REMARKS_____

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination drawings.
   2. Digital project management procedures.

B. Related Requirements:
   1. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

1.3 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
   2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
   4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   6. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format:
      a. Same digital data software program, version, and operating system as original Drawings.
      b. DWG, Version Autocad 2022, operating in Microsoft Windows operating system.
   2. File Submittal Format: Submit or post coordination drawing files using PDF format.

1.4 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings may be provided by Architect for Contractor's use during construction.
   1. A fee for the CAD drawings will be charged to the contractor.
   2. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
   3. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
   4. Digital Drawing Software Program: Contract Drawings are available in AutoCAD 2022.

5. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
    a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

DISCLAIMER FOR USE OF ELECTRONIC DOCUMENT FILES

1. At your request, we will provide electronic files for your convenience and use in the preparation of shop drawings related to the Lansing School District SB-1785, Mt. Hope Elementary Renovations, subject to the following terms and conditions: Our electronic files are compatible with AutoCAD 2022. We make no representation as to the compatibility of these files with your hardware or software beyond the specified release of the referenced software.

2. Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents, or subconsultants that may arise out of or in connections with your use of the electronic files.

3. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files.

4. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm, and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.

5. Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display.

6. We will furnish you the following drawing sheets: _____

7. A service fee of $200 (two hundred dollars) per sheet shall be remitted to us prior to delivery of the electronic files.

8. Under no circumstances shall deliver of the electronic files for use by you be deemed a sale by us, and we make no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files.

_____ _____
Consultant Name and Firm Contractor Name and Firm

Address _____

City, State, Zip _____

Phone _____

Email _____

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Integrated exterior mockups.
   2. Room mockups.

B. Related Requirements:
   1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.
   2. Section 019119.43 "Exterior Enclosure Commissioning" for testing building enclosure systems and assemblies as part of the exterior enclosure commissioning process.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements and part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

B. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Construction Manager, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior and room mockups.
   2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
   3. Review locations and extent of mockups.
   4. Review testing procedures to be performed on mockups.
   5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Room Mockup Coordination Drawings: Classroom, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. HVAC
   2. Lighting
   3. Fire protection
   4. Low Voltage

1.6 QUALITY ASSURANCE

A. Build mockups to do the following:
   1. Verify selections made under Sample submittals.
   2. Demonstrate aesthetic effects.
   3. Demonstrate the qualities of products and workmanship.
   4. Demonstrate acceptable coordination between components and systems.
   5. Perform preconstruction testing, such as window air- and water-leakage testing.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
   1. Build mockups of size indicated.
   2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:
   1. Notify Architect and Construction Manager seven days in advance of the dates and times when mockups will be constructed.
   2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's and Construction Manager's approval of mockups before starting fabrication or construction of corresponding Work.
   1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. The Work of integrated exterior mockups includes, but is not limited to, the following:
   1. Masonry veneer.
   2. Cold-formed metal framing and sheathing.
   3. Air and weather barriers.
   4. Thermal insulation.
   5. Through-wall flashing.
   6. Flashing and sheet metal trim.
   7. Joint sealants.
   8. Metal wall panels.
   9. Aluminum-framed entrances and storefront.
   10. Glazed curtain walls.
   11. Aluminum windows.
   12. Glazing.

F. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

G. Retain approved mockups constructed in place. Incorporate fully into the Work.

2.2 ROOM MOCKUPS

A. Build room mockups to evaluate constructability, demonstrate the coordination of trades and sequencing of Work, and to demonstrate aesthetic requirements. Include each visible finish, component, and equipment item within room mockups; include operable lighting.

B. Provide room mockups of the following rooms:
   1. Classroom.

C. The Work of room mockups includes, but is not limited to, the following:
   1. Metal framing including unistrut
   2. Gypsum board.
   3. Wiring devices including those related to low voltage
   4. Lighting.

PART 3 - EXECUTION

3.1 EVALUATION OF INTEGRATED EXTERIOR MOCKUPS

A. Integrated Exterior Mockup Testing Services: Perform the following tests in the following order:
   1. Water-Spray Test: Before installation of interior finishes has begun, test areas designated by Architect in accordance with AAMA 501.2 for evidence of water penetration.
   2. Water Penetration: Test in accordance with ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and verify no evidence of water penetration.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.
   1. Liquid applied air barrier
   2. SPF insulation
   3. Cavity wall drainage systems
   4. Storefront/Curtainwall systems

C. Prepare test and inspection reports.

END OF SECTION 014339

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for temporary controls, utilities, support facilities, temporary site fencing, and, if applicable, temporary erosion and sedimentation controls if not specified in Section 311000 "Site Clearing".
   2. Section 311000 "Site Clearing" for removing existing trees and shrubs and for temporary erosion- and sedimentation-control measures if not specified in Section 015000 "Temporary Facilities and Controls".

1.2 DEFINITIONS

A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.

B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
      a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
      b. Arborist's responsibilities.
      c. Quality-control program.
      d. Coordination of Work and equipment movement with the locations of protection zones.
      e. Trenching by hand or with air spade within protection zones.
      f. Field quality control.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction

B. Shop Drawings:
   1. Include plans, elevations, and sections showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between equipment-movement routes and material storage locations with protection zones.
   2. Detail fabrication and assembly of protection-zone fencing and signage.
   3. Indicate extent of utility boring and trenching by hand or with air spade within protection zones.

C. Samples: For each type of the following:
   1. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
   2. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

D. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
   1. Species and size of tree.
   2. Location on site plan. Include unique identifier for each.
   3. Reason for pruning.
   4. Description of pruning to be performed.
   5. Description of maintenance following pruning.

E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

F. Mitigation Requirements: As required by jurisdiction or as developed by arborist, for mitigation of damage to trees and other plantings. Include the following:
   1. Local ordinances governing tree mitigation.
   2. Standards established under the approved tree mitigation report developed by the arborist.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction in accordance with recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
   1. Use sufficiently detailed photographs or video recordings.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA

B. Tree-Service Firm Qualifications: An experienced tree-service firm that has successfully completed temporary tree- and plant-protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection-zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Moving or parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

D. Take precautions to protect plants from airborne contaminants, such as paint or fireproofing overspray.
   1. Warranty Period from date of Substantial Completion shall be 24 months.
   2. Include the following remedial actions as a minimum:
      a. Immediately remove dead trees and replace unless required to plant in the succeeding planting season.

b. Replace trees that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each tree is required except for losses or replacements due to failure to comply with requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil from location indicated on Drawings of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: Double Shredded Hardwood Size Range: 3 inches maximum, 1/2 inch minimum.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Owner's Representative.
1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 72 inches apart.
   a. Height: 48 inches
   b. Color: High-visibility orange, nonfading.
2. Gates: Double- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size and Text: As indicated on Drawings.
2. Lettering: 3-inch- black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, to remain. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 TREE PROTECTION

A. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
   1. Apply 4-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 3 inches of tree trunks.

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Owner’s Representative.
   2. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
   3. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Owner's Representative. Install one sign spaced approximately every 35 ft. on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Maintain hydration of plants to assure plant survival.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Owner's Representative and remove when construction operations are complete and equipment has been removed from the site.
   1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
   2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.5 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

3.6 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
   1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
   2. Cut Ends: Do not paint cut root ends.
   3. Temporarily support and protect roots from damage until they are permanently covered with soil.
   4. Cover exposed roots with burlap and water regularly.
   5. Backfill as soon as possible in accordance with requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge Insert requirement of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.7 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
   1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
   2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
   3. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1

B. Unless otherwise directed by arborist and acceptable to Architect or Landscape Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site

3.8 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
   1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.9 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.10 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect or Landscape Architect.
   1. Submit details of proposed pruning and repairs.
   2. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with arborist's written instructions.
   3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect or Landscape Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect or Landscape Architect determines are incapable of restoring to normal growth pattern.
   1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
   2. Large Trees: Provide two new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
      a. Species: As selected by Architect or Landscape Architect.
   3. Plant and maintain new trees as specified in Section 329300 "Plants."

END OF SECTION 015639

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:
1. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
2. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
3. Section 210800 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.
4. Section 220800 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.
5. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
6. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.
7. Section 270800 "Commissioning of Communications" for technical commissioning requirements for communications systems.
8. Section 280800 "Commissioning of Electronic Safety and Security" for technical commissioning requirements for electronic safety and security systems.

1.2 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

B. Basis-of-Design Document: A document prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority: An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.

E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.

F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
   1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:
      a. Completion of tests and acceptance of test results.
      b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
      c. Completion and acceptance of submittals and reports.

G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Architect or Commissioning Authority.

H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.3 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:
   1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
   2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
   3. Contractor personnel and subcontractors participating in each test.
   4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. List test instrumentation, equipment, and monitoring devices. Include the following information:
   1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
   2. Brief description of intended use.
   3. Calibration record showing the following:
      a. Calibration agency, including name and contact information.
      b. Last date of calibration.
      c. Range of values for which calibration is valid.
      d. Certification of accuracy.
      e. Certification for calibration equipment traceable to NIST.
      f. Due date of the next calibration.

F. Test Reports:
   1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
   2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
   3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
   4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
   5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
   6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

G. Construction Checklists:
   1. Material checks.
   2. Installation checks.
   3. Startup procedures, where required.

1.4 CLOSEOUT SUBMITTALS

A. Commissioning Report:
   1. At Construction-Phase Commissioning Completion, include the following:
      a. Pre-startup reports.
      b. Approved test procedures
      c. Test data forms, completed and signed.
      d. Progress reports.
      e. Commissioning issue report log.
      f. Commissioning issue reports showing resolution of issues.
      g. Correspondence or other documents related to resolution of issues.
      h. Other reports required by commissioning process.
      i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
      j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:
   1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
   2. Calibrated and certified.
      a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
      b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
   3. Maintain test equipment and instrumentation.
   4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.
   1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
   2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:
   1. Bind report in three-ring binders.
   2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
   3. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:
   1. Include a table of contents and an index to each test.
   2. Include major tabs for each Specification Section.
   3. Include minor tabs for each test.
   4. Within each minor tab, include the following:
      a. Test specification.
      b. Pre-startup reports.
      c. Approved test procedures.
      d. Test data forms, completed and signed.
      e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.
   1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
   2. Included optional features.
   3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
   4. Installation Checks:
      a. Location according to Drawings and approved Shop Drawings.
      b. Configuration.
      c. Compliance with manufacturers' written installation instructions.
      d. Attachment to structure.
      e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
      f. Utility connections are of the correct characteristics, as applicable.
      g. Correct labeling and identification.
      h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:
   1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
   2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
   3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
   4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
   5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after datse of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
   1. Identify deferred construction checklists by number and title.
   2. Provide a target schedule for completion of deferred construction checklists.
   3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
   1. Identify delayed construction checklist by construction checklist number and title.
   2. Provide a target schedule for completion of delayed construction checklists.
   3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
   1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.
      a. General Inspection: Level III.
      b. Special Inspection: Level S-1.
      c. Acceptance Quality Limit (AQL) of 1.5.
   2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
   3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
   4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
   1. Operating the equipment and systems they install during tests.
   2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 CONTRACTOR'S RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:
   1. Coordinate with subcontractors on their commissioning responsibilities and activities.
   2. Obtain, assemble, and submit commissioning documentation.
   3. Attend periodic on-site commissioning meetings.
   4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
   5. Review and comment on preliminary test procedures and data forms.
   6. Report inconsistencies and issues in system operations.
   7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
   8. Direct and coordinate test demonstrations.
   9. Coordinate witnessing of test demonstrations by Owner's witness.
   10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
   11. Prepare and submit specified commissioning reports.
   12. Track commissioning issues until resolution and retesting is successfully completed.
   13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
   14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:
   1. Complete construction checklists as Work is completed.
   2. Distribute construction checklists to installing contractors before they start work.
   3. Installers:
      a. Verify installation using approved construction checklists as Work proceeds.
      b. Complete and sign construction checklists weekly for work performed during the preceding week.
   4. Provide Commissioning Authority access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:
   1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
   2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
   3. Completed test data forms are the official records of the test results.
   4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
   5. Review preliminary test procedures and test data forms, and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:
      a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
      b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
   6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
   7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:
   1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
   2. Perform and complete each step of the approved test procedures in the order listed.
   3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
   4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
   5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:
   1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
   2. Notify Owner's witness at least three days in advance of each test demonstration.
   3. Perform and complete each step of the approved test procedures in the order listed.
   4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
   5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
   6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
      a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.
   7. False load test requirements are specified in related sections.
      a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:
   1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:
      a. Identify deferred tests by number and title.
      b. Provide a target schedule for completion of deferred tests.
   2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
   3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Delayed Tests:
   1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:
      a. Identify delayed tests by test number and title.
      b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
   2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
   3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Commissioning Compliance Issues:
   1. Test results that are not within the range of acceptable results are commissioning compliance issues.
   2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
   3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.

4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
   a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
   b. Submit commissioning compliance issue report form within 24 hours of the test.
   c. Determine the cause of the failure.
   d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
   a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
   b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
   c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
   d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
6. Diagnose and correct failed test demonstrations as follows:
   a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
   b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
   c. Record the results of each step of the diagnostic procedure.
   d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
   e. Determine and record corrective measures.
   f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
7. Retest:
   a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
   b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.
   a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
   1. Construction Checklists:
      a. Material checks.
      b. Installation checks.
      c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
      d. Performance Tests:
         1) Static tests, as appropriate.
         2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
         3) Equipment and assembly performance tests.
         4) System performance tests.
         5) Intersystem performance tests.
   2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.7 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."
   1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
   2. Schedule the start date and duration for the following commissioning activities:
      a. Submittals.
      b. Preliminary operation and maintenance manual submittals.
      c. Installation checks.
      d. Startup, where required.
      e. Performance tests.
      f. Performance test demonstrations.
      g. Commissioning tests.
      h. Commissioning test demonstrations.
   3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
   4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:
   1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
   2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
   3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:
   1. Coordinate Owner's witness participation via Architect.
   2. Notify Architect of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.8 COMMISSIONING REPORTS

A. Test Reports:
   1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
      a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
      b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.

c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:
   a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
   b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
   c. Signatures of individuals performing and witnessing tests.
   d. Data trend logs accumulated overnight from the previous day of testing.
3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:
   a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
   b. Action distribution list.
   c. Report date.
   d. Test number and description.
   e. Equipment identification and location.
   f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
   g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
   h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
   i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
   j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
   k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:
   a. Completed data forms.
   b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
   c. Activities scheduled but not conducted per schedule.
   d. Commissioning compliance issue report log.
   e. Schedule changes for remaining Commissioning-Process Work, if any.
5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
   a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
   b. Attach to the data form printed trend log data collected during the test or test demonstration.
   c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.
6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."
   a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.9 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected site elements.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.4 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   5. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.6 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Form-facing material for cast-in-place concrete.
   2. Shoring, bracing, and anchoring.

B. Related Requirements:
   1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
   1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
   2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
   a. Plywood, metal, or other approved panel materials.
   b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
   1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces without spiral or vertical seams not exceeding specified formwork surface class.
   1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.3 RELATED MATERIALS

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
   2. Form release agent for form liners shall be acceptable to form liner manufacturer.

C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:
   1. Surface Finish-1.0: ACI 117 Class D, 1 inch.

2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.
1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Do not chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
   a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
   1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
   2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
   3. Clean embedded items immediately prior to concrete placement.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
   2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.

2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel reinforcement bars.
   2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Each type of steel reinforcement.

B. Shop Drawings: Comply with ACI SP-066:
   1. Include placing drawings that detail fabrication, bending, and placement.
   2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
   1. Location of construction joints is subject to approval of Architect.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:
   1. Steel Reinforcement.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
   1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
   1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
      a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
   1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:
   1. Do not cut or puncture vapor retarder.
   2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.
   1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.
   1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
   2. Stagger splices in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.
   1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
      a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
   2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
   3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
   4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement.
   2. Continue reinforcement across construction joints unless otherwise indicated.
   3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
   2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
   3. Section 033543 "Polished Concrete Finishing" for concrete floors scheduled to receive a polished concrete finish.
   4. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
   5. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete Subcontractor.
      e. Special concrete finish Subcontractor.
   2. Review the following:
      a. Special inspection and testing and inspecting agency procedures for field quality control.
      b. Construction joints, control joints, isolation joints, and joint-filler strips.
      c. Semirigid joint fillers.
      d. Vapor-retarder installation.
      e. Anchor rod and anchorage device installation tolerances.
      f. Cold and hot weather concreting procedures.
      g. Concrete finishes and finishing.
      h. Curing procedures.

i. Forms and form-removal limitations.
j. Shoring and reshoring procedures.
k. Methods for achieving specified floor and slab flatness and levelness.
l. Floor and slab flatness and levelness measurements.
m. Concrete repair procedures.
n. Concrete protection.
o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
p. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.
1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement
7. Aggregates.
8. Admixtures:
   a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
9. Vapor retarders.
10. Floor and slab treatments.
11. Liquid floor treatments.
12. Curing materials.
   a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
13. Joint fillers.
14. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Intended placement method.
9. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:
   1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
      a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
   1. Concrete Class designation.
   2. Location within Project.
   3. Exposure Class designation.
   4. Formed Surface Finish designation and final finish.
   5. Final finish for floors.
   6. Curing process.
   7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:
   1. Installer: Include copies of applicable ACI certificates.
   2. Ready-mixed concrete manufacturer.
   3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Curing compounds.
   4. Floor and slab treatments.
   5. Bonding agents.
   6. Adhesives.
   7. Vapor retarders.
   8. Semirigid joint filler.
   9. Joint-filler strips.
   10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:
   1. Portland cement.
   2. Fly ash.
   3. Slag cement.
   4. Blended hydraulic cement.
   5. Silica fume.
   6. Performance-based hydraulic cement.
   7. Aggregates.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:
   1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
   2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
   1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
   1. Include the following information in each test report:
      a. Admixture dosage rates.
      b. Slump.
      c. Air content.
      d. Seven-day compressive strength.
      e. 28-day compressive strength.
      f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
   1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   3. Do not use frozen materials or materials containing ice or snow.
   4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
   5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
   1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:
   1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
   2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
   3. Obtain aggregate from single source.
   4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
   2. Fly Ash: ASTM C618, Class C or F.
   3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
   4. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, portland-limestone cement.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. Retarding Admixture: ASTM C494/C494M, Type B.
   3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
   5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
   7. Porosity Inhibiting Concrete Admixture: ASTM C494, Type S.
      a. Basis-of-Design Product: Subject to compliance with requirements, provide Barrier One PIA Concrete Admixture.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Stego Industries, LLC.
      b. W. R. Meadows, Inc.

2.4 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ChemMasters, Inc.
      b. Dayton Superior Corporation.
      c. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
      d. Sika Corporation.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
   1. Color:
      a. Ambient Temperature Below 50 deg F: Black.
      b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
      c. Ambient Temperature Above 85 deg F: White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ChemMasters, Inc.
      b. Dayton Superior Corporation.
      c. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
      d. W. R. Meadows, Inc.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Floor Slab Protective Covering: 8-feet-wide cellulose fabric.

2.6 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Other Pozzolans: 25 percent by mass.
   2. Slag Cement: 50 percent by mass.
   3. Silica Fume: 10 percent by mass.

4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.8 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, and grade beams.
1. Exposure Class: ACI 318 F2.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 5 inches, plus or minus 1 inch.
5. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

B. Class B: Normal-weight concrete used for foundation walls.
1. Exposure Class: ACI 318 F2.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 5 inches, plus or minus 1 inch.
5. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd..
5. Slump Limit: 5 inches, plus or minus 1 inch.
6. Air Content:
   a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

7. Porosity Inhibiting Concrete Admixture for slabs to receive floor coverings: Advanced concrete enhancement technology to integrally densify and reduce slab permeability, capable of eliminating the movement of critical level moisture vapor emissions into and out of the concrete.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
   2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
   1. Daily access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
   4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
   1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
   2. Face laps away from exposed direction of concrete pour.

3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
   a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
   1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
   2. Place joints perpendicular to main reinforcement.
      a. Continue reinforcement across construction joints unless otherwise indicated.
      b. Do not continue reinforcement through sides of strip placements of floors and slabs.
   3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:
   1. Install dowel bars and support assemblies at joints where indicated on Drawings.

2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
   1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
   2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
   1. If a section cannot be placed continuously, provide construction joints as indicated.
   2. Deposit concrete to avoid segregation.
   3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      a. Do not use vibrators to transport concrete inside forms.
      b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Do not place concrete floors and slabs in a checkerboard sequence.
   2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Maintain reinforcement in position on chairs during concrete placement.
   4. Screed slab surfaces with a straightedge and strike off to correct elevations.
   5. Level concrete, cut high areas, and fill low areas.
   6. Slope surfaces uniformly to drains where required.
   7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
   8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:
   1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
      a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
      b. Remove projections larger than 1 inch.
      c. Tie holes do not require patching.
      d. Surface Tolerance: ACI 117 Class D.
      e. Apply to concrete surfaces not exposed to public view.
   2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
      a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
      b. Remove projections larger than 1/4 inch.
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 Class B.
      e. Locations: Apply to concrete surfaces to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
   3. ACI 301 Surface Finish SF-3.0:
      a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
      b. Remove projections larger than 1/8 inch.
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 Class A.
      e. Locations: Apply to concrete surfaces exposed to public view,.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:
   1. Smooth-Rubbed Finish:
      a. Perform no later than one day after form removal.
      b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
      c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.

2. Grout-Cleaned Rubbed Finish:
   a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
   b. Do not clean concrete surfaces as Work progresses.
   c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
   d. Wet concrete surfaces.
   e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

C. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
   2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:
   1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
   2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
   3. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:
   1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
   2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
   3. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish:
   1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
   2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
   a. Slabs on Ground:
      1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17, for thin floor coverings.
      2) Specified overall values of flatness, F_F 50; and of levelness, F_L 25; with minimum local values of flatness, F_F 40; and of levelness, F_L 17, for polished concrete floors.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
   1. Coordinate required final finish with Architect before application.
   2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
   2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
   1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
   2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
   3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
   1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Cast anchor-bolt insert into bases.
   c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
   2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
   3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
   1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
   2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
   3. If forms remain during curing period, moist cure after loosening forms.
   4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
      a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
      b. Continuous Sprinkling: Maintain concrete surface continuously wet.
      c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
      d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
      e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
         1) Recoat areas subject to heavy rainfall within three hours after initial application.
         2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
   1. Begin curing immediately after finishing concrete.
   2. Interior Concrete Floors:
      a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
         1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
         2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.
         3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
            a) Water.
            b) Continuous water-fog spray.
      b. Floors to Receive Polished Finish: Contractor has option of the following:
         1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
         2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
            a) Water.
            b) Continuous water-fog spray.
      c. Floors to Receive Curing Compound:
         1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
         2) Recoat areas subjected to heavy rainfall within three hours after initial application.
         3) Maintain continuity of coating, and repair damage during curing period.
         4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least one month(s).
   2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete:
   1. Repair and patch defective areas when approved by Architect.
   2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
      a. Limit cut depth to 3/4 inch.
      b. Make edges of cuts perpendicular to concrete surface.
      c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
      d. Fill and compact with patching mortar before bonding agent has dried.
      e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
      a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
      b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
   a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
   a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
   a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
   b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.
   e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
   1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
   2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
   3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
      a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
         1) Project name.
         2) Name of testing agency.
         3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
         4) Name of concrete manufacturer.
         5) Date and time of inspection, sampling, and field testing.
         6) Date and time of concrete placement.
         7) Location in Work of concrete represented by samples.
         8) Date and time sample was obtained.
         9) Truck and batch ticket numbers.
         10) Design compressive strength at 28 days.
         11) Concrete mixture designation, proportions, and materials.
         12) Field test results.
         13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
         14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:
   1. Verification of use of required design mixture.
   2. Concrete placement, including conveying and depositing.
   3. Curing procedures and maintenance of curing temperature.

4. Verification of concrete strength before removal of shores and forms from beams and slabs.
5. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
   a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.
   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
   a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
   a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
   b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
   a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
   b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
   c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

10. Additional Tests:
    a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
        1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:
    1. Protect from petroleum stains.
    2. Diaper hydraulic equipment used over concrete surfaces.
    3. Prohibit vehicles from interior concrete slabs.
    4. Prohibit use of pipe-cutting machinery over concrete surfaces.
    5. Prohibit placement of steel items on concrete surfaces.
    6. Prohibit use of acids or acidic detergents over concrete surfaces.
    7. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Polished concrete finishing.

B. Related Requirements:

   1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of product requiring color selection.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Cast-in-place concrete subcontractor.
      e. Polished concrete finishing Subcontractor.
      f. Provide a mockup of proposed finish.

   2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.4 QUALITY ASSURANCE

A. Field Sample Panels: After approval of samples, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.
   1. Locate panels as indicated or, if not indicated, as directed by Architect.

2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
3. Demolish and remove field sample panels when directed.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ARDEX Americas.
      b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
      c. Laticrete International, Inc.
      d. PROSOCO, Inc.
   2. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 POLISHING

A. Polish: Level 2: Low sheen, 400 grit.

B. Apply polished concrete finish system to cured and prepared slabs.
   1. Machine grind floor surfaces to receive polished finishes level and smooth.
   2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
   3. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
   4. Control and dispose of waste products produced by grinding and polishing operations.
   5. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

SECTION 035113 - CEMENTITIOUS ROOF DECK (CEMENTITIOUS WOOD FIBER PLANK)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cementitious wood fiber plank roof deck and form system

B. Related Sections:
   1. Division 5 Sections: Steel Framing.
   2. Division 6 Sections: Wood Framing.
   3. Division 7 Sections: Roofing.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   3. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   4. ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
   5. ASTM D2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics.
   6. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

B. Underwriters Laboratories, Inc. (UL):
   1. UL 580 Standard for Safety for Tests for Uplift Resistance of Roof Assemblies.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide roof deck assembly designed and tested according to the following:
   1. Underwriters Laboratories UL 580 (UL Class 90 Design)

B. Performance Requirements:
   1. Provide a roof deck system that has been manufactured, fabricated and installed to provide deflection of Less than L/240 at design load.

1.4 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product data and installation instructions.

C. Shop Drawings: Provide drawings indicating locations and spacing of planks and purlins.

D. Samples: Submit selection and verification samples as follows:
   1. Set of 6-inch square samples for each wood fiber deck unit required, showing full range of exposed texture to be expected in completed work.
   2. Labeled set of all accessories required for a complete installation.

E. Quality Assurance/Control Submittals: Submit the following:
   1. Test Reports: Upon request, submit certified test reports from recognized test laboratories.
   2. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

F. Closeout Submittals: Submit the following:
   1. Warranty documents specified herein.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.

B. Preinstallation Meetings: Conduct preinstallation to coordinate fastening requiments, roof membrane integration, etc.

1.6 DELIVERY, STORAGE & HANDLING

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Provide labels indicating brand name, deck style, plank size and plank thickness.

B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
   1. Prevent soiling, physical damage or wetting.
   2. Store cartons open at each end to stabilize moisture content and temperature.

1.7 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
   1. Warranty Period: 15 years beginning with date of substantial completion.

PART 2 - PRODUCTS

2.1 ROOF DECK AND FORM SYSTEMS

A. Manufacturer: Tectum Inc.
   1. Armstrong World Industries

B. Proprietary Systems. Cementitious deck form board systems, including the following configurations:
   1. Tectum Roof Deck Plank.

2.2 ROOF DECK PANEL COMPONENTS

A. Proprietary Products. Cementitious deck form board products, including the following:
   1. Tectum E Roof Deck Panels:
      a. Material: Aspen wood fibers bonded with inorganic hydraulic cement, bonded to expanded polystyrene (EPS) foam insulation, bonded to top surface of 7/16 inch (11.1 mm) oriented strand board (OSB).
      b. Nominal Panel Thickness: 10 inches.
      c. Tectum Thickness: 3 inches
      d. OSB meets Voluntary Product Standard PS2-92 Performance Standard for Wood-Based Structural-Use Panels.
      e. EPS Core Compliance (ASTM C578): Exceeds Type I.
      f. EPS Classification: Bears UL classification mark.
      g. EPS Nominal Density: 1.0 pcf (16.02 kg/m3).
      h. EPS Thermal Resistance (ASTM C177, ASTM C518 at 40 degrees F (4 degrees C)): 4.17 per inch.
      i. EPS Thermal Resistance (ASTM C177, ASTM C518 at 75 degrees F (24 degrees C)): 3.85 per inch.

2.3 ACCESSORIES – Tectum Roof Deck- System(s) E and E-N

A. Provide accessories as follows:
   1. Tectum Screws:
      a. Material: Steel.
      b. Type: as needed for loads indicated and as required to comply with Michigan Building Code
   2. Construction Adhesive:
      a. Manufacturer: Miracle Construction Adhesive.
      b. Type: Adhesive SFA-66.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the roof deck panel manufacturer.

3.2 EXAMINATION

A. Site Verification of Conditions:
   1. Verify that site conditions are acceptable for installation of roof deck panel system.
   2. Do not proceed with installation of roof deck panel system until unacceptable conditions are corrected.

3.3 INSTALLATION

A. Roof Deck Plank Installation:
   1. Place planks on joists with square cut ends butted tightly together.
      a. Stagger end joints.
      b. Tectum panels must be supported by bent plates (steel or other support) at all transitions of the roof. This includes but is not limited to the ridge, valleys, perimeter and panel direction change. Panels must have a minimum of 1 inch bearing and should be glued and screwed at these transitions.
      c. Panel ends must fall over structural supports and have a minimum of 1 inch bearing.
   2. Secure planks to joists with screws and spacing recommended by plank manufacturer.
   3. Do not allow foot traffic on planks until after screws are installed.
   4. Apply adhesive recommended by manufacturer to ensure diaphragm performance as designed.

B. Roof Deck Composite Plank:
   1. Cut plank neatly to abut parapets, around openings and penetrations.
   2. Apply adhesive recommended by manufacturer to ensure diaphragm performance as designed.

3.4 CLEANING

A. Clean exposed surfaces of all deck surfaces.

B. Remove and replace work that cannot be successfully repaired to eliminate evidence of structural damage.

3.5 PROTECTION

A. Protect installed work from damage due to weather related moisture.

B. Protect installed work from damage due to subsequent construction activity on the site so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION 035113

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Lintels.
3. Brick.
4. Mortar and grout materials.
5. Reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Accessories.
9. Mortar and grout mixes.

B. Products Installed but not Furnished under This Section:
1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.
3. Cavity wall insulation adhered to masonry backup.

C. Related Requirements:
1. Section 014339 "Mockups" for integrated exterior mockup requirements.
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 072100 "Thermal Insulation" for cavity wall insulation.
4. Section 072119 “Foamed-In-Place Insulation” for cavity wall insulation

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
1. Decorative CMUs.

2. Clay face brick.
3. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type of the following:
   1. Masonry units.
      a. Include data on material properties.
      b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
      d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing in accordance with ASTM C67/C67M.
   2. Integral water repellent used in CMUs.
   3. Cementitious materials. Include name of manufacturer, brand name, and type.
   4. Mortar admixtures.
   5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   6. Grout mixes. Include description of type and proportions of ingredients.
   7. Reinforcing bars.
   8. Joint reinforcement.
   9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
   2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 MOCKUPS

A. Wall Mockups: Build mockups to set quality standards for materials and execution and to set quality standards for installation.
   1. Build mockups for typical exterior wall in sizes approximately 72 inches long by 72 inches high by full thickness, including face and backup wythes and accessories.
      a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
      b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
      c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
      d. Include metal studs, sheathing, water-resistive barrier sheathing joint-and-penetration treatment air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
      e. Include clay face brick on one face of interior unit masonry wall mockup.
   2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
   3. Clean exposed faces of mockups with masonry cleaner as indicated.
   4. Protect accepted mockups from the elements with weather-resistant membrane.
   5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations by Change Order.
   6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

2.3 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
   1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, will show no visible water or leaks on the back of test specimen.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
         2) GCP Applied Technologies Inc.
         3) Master Builders Solutions; brand of MBCC Group.

C. CMUs: ASTM C90, medium weight, unless otherwise indicated.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
   2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
   3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

D. Decorative CMUs: ASTM C90, medium weight.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
   2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
   3. Pattern and Texture: Standard pattern, ground-face finish.
   4. Colors: Match Architect's samples;
      a. Consumer’s Concrete, Color: “Mudpie”.

b. Provide with manufacturer applied sealer.

2.4 LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
   1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Belden Brick Company (The);
         1) Brick A: Belden “Carbon Black Smooth” and Belden “Carbon Black Velour”, 2/3 Smooth, 1/3 Velour mix. Monarch Size
         2) Brick B: Belden “Dutch Gray Smooth” Utility Size
   2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
   3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
   4. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft.
   5. Application: Use where brick is exposed unless otherwise indicated.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Cemex S.A.B. de C.V.
      b. Holcim (US) Inc.
      c. Lafarge North America Inc.

d. Lehigh Hanson; HeidelbergCement Group.
e. Quikrete; The QUIKRETE Companies, LLC.

D. Mortar Cement: ASTM C1329/C1329M.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Lafarge North America Inc.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.

F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Portland Cement-Lime Mix:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Argos USA LLC.
2) Holcim (US) Inc.
3) Lehigh Hanson; HeidelbergCement Group.

2. Colored Masonry Cement:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Argos USA LLC.
2) Cemex S.A.B. de C.V.
3) Holcim (US) Inc.
4) Lafarge North America Inc.
5) Lehigh Hanson; HeidelbergCement Group.

3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments do not exceed 10 percent of portland cement by weight.
5. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.

G. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime masonry cement or mortar cement, sand, mortar pigments, water repellents, and admixtures and complying with ASTM C1714/C1714M.
1. Preblended Dry Portland Cement Mortar Mix:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Amerimix is a trademark of Bonsal American, an Oldcastle company.

2) Quikrete; The QUIKRETE Companies, LLC.
3) SPEC MIX, LLC.
4) Sakrete; CRH Americas, Oldcastle APG.

2. Preblended Dry Masonry Cement Mortar Mix
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Amerimix is a trademark of Bonsal American, an Oldcastle company.
      2) SPEC MIX, LLC.

3. Provide tinted mortar for Decorative CMU.

H. Aggregate for Mortar: ASTM C144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C404.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
      b. GCP Applied Technologies Inc.

K. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
   1. Interior Walls: Mill- galvanized carbon steel.
   2. Exterior Walls: Hot-dip galvanized carbon steel.
   3. Wire Size for Side Rods: 0.148-inch diameter.
   4. Wire Size for Cross Rods: 0.148-inch diameter.

5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Hohmann & Barnard, Inc.
b. Wire-Bond.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Heckmann Building Products, Inc.
b. Hohmann & Barnard, Inc.
c. Wire-Bond.
2. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches wide, plus two side rods at each wythe of masonry 4 inches wide or less.
3. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch cover on outside face.
4. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

F. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch-diameter, hot-dip galvanized carbon steel continuous wire.

2.8 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.

5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
8. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
1. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
2. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls unless otherwise indicated.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication.
   a. 0.064-inch- thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4-inch-thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

G. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch-thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.

4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie and washer at face of insulation.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) FERO Corporation.
      2) Hohmann & Barnard, Inc.
      3) PROSOCO, Inc.
      4) Wire-Bond.
6. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Heckmann Building Products, Inc.
      2) Hohmann & Barnard, Inc.
      3) Quality Steel and Wire LLC.
      4) Wire-Bond.
7. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours in accordance with ASTM B117.

2.9 EMBEDDED FLASHING

A. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 3 mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a permanent, clear adhesive, to produce an overall thickness of 40 mil.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, “Mighty-Flash –SA” or comparable product by one of the following:
      a. Wire-Bond.
      b. York Manufacturing, Inc.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

C. Termination Bars for Flexible Flashing: Stainless steel bars 0.075 inch by 1 inch.

2.10 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vents: Use the following unless otherwise indicated:
   1. Cellular Plastic Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Heckmann Building Products, Inc.
         2) Hohmann & Barnard, Inc.
         3) Mortar Net Solutions.
         4) Wire-Bond.
   2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
      a. Manufacturers: Subject to compliance with requirements, provide products by the following:
         1) Mortar Net Solutions.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Mortar Deflector: Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches dimpled surface that prevent clogging with mortar droppings.
      a. Manufacturers: Subject to compliance with requirements, provide products by the following:
         1) Mortar Net Solutions.

F. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
      b. PROSOCO, Inc.

2.11 MASONRY GRAFITTI PROTECTION

A. Water based graffiti protection to protect new and existing masonry construction from graffiti and allow for easy removal of paint. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. PROSOCO, Inc.; Blok-guard & Graffiti Control WB 15

2.12 DECORATIVE CMU SEALER

A. Sealer to protect new decorative cmu and provide gloss finish after being cleaned.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. PROSOCO, Inc.; Gloss N' Guard

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use masonry cement or mortar cement mortar unless otherwise indicated.
   3. For exterior masonry, use masonry cement or mortar cement mortar.
   4. For reinforced masonry, use masonry cement or mortar cement mortar.
   5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type M.
   3. For mortar parge coats, use Type S or Type N.
   4. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
   5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
   1. Pigments do not exceed 10 percent of portland cement by weight.

2. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.

E. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
   3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
   5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
   3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs and hollow brick as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
   5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
   1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

D. Cut joints flush where indicated to receive cavity wall insulation unless otherwise indicated.

3.6 COMPOSITE MASONRY

A. Bond wythes of composite masonry together as follows:
   1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
   1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are indicated at juncture, bond walls together as follows:
   1. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together as follows:
   1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
      a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
      b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.
   2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
      c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.
   3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not more than 8 inches clear horizontally and 16 inches clear vertically.
   4. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.
   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.8 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed tie sections in masonry joints.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
   1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.9 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   1. Provide an open space not less than 1/2-inch-wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.12 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry or lintels where indicated and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.13 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
   3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe.
   4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
   5. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
   6. Install metal drip edges. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
   7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
   8. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
   9. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
   1. Use specified weep/cavity vent products to form weep holes.
   2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
   3. Space weep holes 24 inches o.c. unless otherwise indicated.
   4. Space weep holes formed from wicking material 16 inches o.c.
   5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
   6. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
   1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches above top of pea gravel.

G. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.
   1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.14 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

H. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

J. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 7 days and at 28 days.

3.16 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
   6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
   7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

E. Install masonry graffiti coating to all new brick masonry.

F. Apply additional field applied sealer to Decorative CMU units.

3.17 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural-steel materials.
   2. Shrinkage-resistant grout.

B. Related Requirements:
   1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
   2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
   3. Section 099114 "Exterior Painting" and Section 099124 "Interior Painting" for painting requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Structural-steel materials.
   2. High-strength, bolt-nut-washer assemblies.
   3. Anchor rods.
   4. Threaded rods.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Mill test reports for structural-steel materials, including chemical and physical properties.

D. Product Test Reports: For the following:
1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:
1. ANSI/AISC 303.

2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:
1. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
   a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
   b. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Construction: Shear wall system.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip zinc coating.
   2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   1. Finish: Plain.

E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
   1. Configuration: Straight.
   2. Nuts: ASTM A563 heavy-hex carbon steel.
   3. Plate Washers: ASTM A36/A36M carbon steel.
   4. Washers: ASTM F436, Type 1, hardened carbon steel.
   5. Finish: Plain.

B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
   1. Nuts: ASTM A563 heavy-hex carbon steel.
   2. Plate Washers: ASTM A36/A36M carbon steel.
   3. Washers: ASTM F436, Type 1, hardened carbon steel.
   4. Finish: Plain.

C. Threaded Rods: ASTM A36/A36M.
   1. Nuts: ASTM A63 heavy-hex carbon steel.
   2. Washers: ASTM F436, Type 1, hardened carbon steel.
   3. Finish: Plain.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

A. Steel Primer:
   1. Comply with Section 099114 "Exterior Painting" and Section 099124 "Interior Painting."
   2. SSPC-Paint 23, latex primer.

B. Galvanized-Steel Primer: MPI#26.
   1. Etching Cleaner: MPI#25, for galvanized steel.
   2. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill,or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.10 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.11 SHOP PRIMING

A. Shop prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces of high-strength bolted, slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces unless indicated to be painted.
   6. Corrosion-resisting (weathering) steel surfaces.
   7. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
   1. SSPC-SP 11.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
   2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
   3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E165/E165M.
      b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E164.
      d. Radiographic Inspection: ASTM E94/E94M.
   4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
   1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:
1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Architecturally exposed structural steel (AESS).
   2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

1.3 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.
   1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
   1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 FILLER

A. Polyester filler intended for use in repairing dents in automobile bodies.

2.3 PRIMER

A. Steel Primer:
   1. Comply with Section 099114 "Exterior Painting" and Section 099124 "Interior Painting."

2.4 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
   1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

B. Category AESS 1:
   1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
   2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
   3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
   4. Make intermittent welds appear continuous, using filler or additional welding.
   5. Seal weld open ends of hollow structural sections with 3/8-inch closure plates.
   6. Limit butt and plug weld projections to 1/16 inch.
   7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
   8. Remove weld spatter, slivers, and similar surface discontinuities.
   9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
   10. Grind tack welds smooth unless incorporated into final welds.
   11. Remove backing and runoff tabs, and grind welds smooth.

C. Category AESS 2: In addition to requirements for Category AESS 1, comply with the following:
   1. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
   2. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
   3. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
   4. Conceal fabrication and erection markings from view in the completed structure.
   5. Make welds uniform and smooth.

D. Category AESS 3: In addition to requirements for Category AESS 1 and AESS 2, comply with the following:
   1. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
   2. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
   3. Orient HSS seams as indicated or away from view.
   4. Align and match abutting member cross sections.
   5. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch. At closed joints, maintain uniform contact within 1/16 inch
   6. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.

E. Category AESS 4: In addition to requirements for Category AESS 1, AESS 2, and AESS 3, comply with the following:
   1. Treat HSS seams to appear seamless.
   2. Contour and blend welds and weld transitions between members, removing splatter exposed to view.
   3. Fill surface imperfections with filler and sand smooth to achieve surface quality approved by Architect.
   4. Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.

2.5 SHOP PRIMING

A. Shop prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Corrosion-resisting (weathering) steel surfaces.
   5. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits.

C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
   1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
   2. Grind tack welds smooth.
   3. Remove backing and runoff tabs, and grind welds smooth.
   4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
   5. Remove erection bolts in Category AESS 4 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
   6. Fill weld access holes in Category AESS 4 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
   7. Conceal fabrication and erection markings from view in the completed structure.

3.4 REPAIR

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.

END OF SECTION 051213

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. LH-series long-span steel joists.

B. Related Requirements:
   1. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

1.2 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:
   1. Include layout, designation, number, type, location, and spacing of joists.
   2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
   3. Indicate locations and details of bearing plates to be embedded in other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
   1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

A. Deliver steel bearing plates to be built into masonry construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. New Millennium Building Systems, LLC.
   2. Vulcraft/Verco Group; a division of Nucor Corp.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.
   1. Use LRFD; data are given at factored-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Roof Joists: Vertical deflection of 1/240 of the span.

2.3 STEEL JOISTS

A. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows:
   1. Joist Type: LH-series long-span steel joists.
   2. End Arrangement: Underslung.
   3. Top-Chord Arrangement: Pitched, two ways as indicated on the Drawings.
   4. Provide holes in chord members for connecting and securing other construction to joists.
   5. Camber long-span steel joists according to SJI's "Specifications.".
   6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 PRIMERS

A. Primer:
   1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.5 STEEL JOIST ACCESSORIES

A. Bridging:
   1. Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Shop prime paint.

C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

D. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   1. Finish: Plain.

E. Welding Electrodes: Comply with AWS standards.

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Space, adjust, and align joists accurately in location before permanently fastening.
   3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

A. Touchup Painting:
   1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
      a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
      b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Acoustical roof deck.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Roof deck.
   2. Acoustical roof deck.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:
   1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
      a. Power-actuated mechanical fasteners.
      b. Acoustical roof deck.
   2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
   1. AWS D1.1/D1.1M.
   2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Epic Metals Corporation.
   2. New Millennium Building Systems, LLC.
   3. Vulcraft Group; Division of Nucor Corp.

B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 50 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Gray top surface with white underside.
   2. Deck Profile: As indicated.
   3. Profile Depth: As indicated.
   4. Design Uncoated-Steel Thickness: As indicated.
   5. Span Condition: As indicated.
   6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

A. <u>Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:</u>
   1. <u>Epic Metals Corporation.</u>
   2. <u>New Millennium Building Systems, LLC.</u>
   3. <u>Vulcraft Group; Division of Nucor Corp.</u>

B. Fabrication of Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Gray top surface with white underside.
   2. Deck Profile: As indicated.
   3. Profile Depth: As indicated.
   4. Design Uncoated-Steel Thickness: As indicated.
   5. Span Condition: As indicated.
   6. Side Laps: Overlapped or interlocking seam at Contractor's option.
   7. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
   8. Acoustical Performance: NRC 0.80, tested in accordance with ASTM C423.

2.4 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

G. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members as indicated on the Drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws, unless otherwise noted on the Drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
   1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

3.4 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:
   1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   3. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099114 "Exterior Painting" and Section 099124 "Interior Painting."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
      a. Field welds will be subject to inspection.
   2. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Load-bearing wall framing.
   2. Exterior non-load-bearing wall framing.
   3. Interior non-load-bearing wall framing.
   4. Floor joist framing.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Cold-formed steel framing materials.
   2. Load-bearing wall framing.
   3. Exterior non-load-bearing wall framing.
   4. Interior non-load-bearing wall framing.
   5. Vertical deflection clips.
   6. Single deflection track.
   7. Double deflection track.
   8. Drift clips.
   9. Floor joist framing.
   10. Post-installed anchors.
   11. Power-actuated anchors.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product certificates.

C. Product test reports.

D. Research Reports:
   1. For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. ClarkDietrich.
   2. Consolidated Fabricators Corp.; Building Products Division.
   3. Jaimes Industries.
   4. Super Stud Building Products Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and ASTM C955.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with ASTM C955 for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60, A60, AZ50, or GF30.

C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60.

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
   2. Flange Width: 1-5/8 inches.
   3. Section Properties: As indicated on the Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and matching minimum base-metal thickness of steel studs.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
   2. Flange Width: 1-5/8 inches, unless otherwise indicated.
   3. Section Properties: As indicated on the Drawings.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
   2. Flange Width: 1-5/8 inches, unless otherwise indicated.
   3. Section Properties: As indicated on the Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ClarkDietrich.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
   2. Flange Width: 1-5/8 inches, unless otherwise indicated.

3. Section Properties: As indicated on the Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips, Interior: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ClarkDietrich.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.7 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer’s standard C-shaped steel joists, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
   2. Flange Width: 1-5/8 inches, minimum, unless otherwise indicated.
   3. Section Properties: As indicated on the Drawings.

B. Steel Joist Track: Manufacturer’s standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel joists.
   2. Flange Width: 1-1/4 inches, minimum.

2.8 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.9 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
   1. Uses: Securing cold-formed steel framing to structure.
   2. Type: adhesive anchor.
   3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
   4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.10 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.

B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

D. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
   1. Anchor Spacing: To match stud spacing.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.
   1. Fasten both flanges of studs to top and bottom tracks.
   2. Space studs as follows:
      a. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
   2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.
   1. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches from abutting walls, and as follows:
   1. Joist Spacing: As indicated on Drawings.

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIRS

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Miscellaneous framing and supports.
2. Shelf angles.
3. Metal ladders.
4. Metal ships' ladders and pipe crossovers.
5. Metal bollards.
6. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:
1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for manufactured metal roof walkways and metal roof stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.

4. Slotted channel framing.
5. Manufactured metal ladders.
6. Metal ships' ladders and pipe crossovers.
7. Metal bollards.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Metal ladders.
4. Metal ships' ladders and pipe crossovers.
5. Metal bollards.
6. Loose steel lintels.

C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: 1-5/8 by 1-5/8 inches.
   2. Cold-Rolled Steel: ASTM A1008/A1008M, commercial steel, Type B; 0.0528-inch minimum thickness; unfinished.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless steel fasteners for fastening aluminum.
   2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Chemical anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. General:
   1. Comply with ANSI A14.3.

B. Steel Ladders:
   1. Space siderails 18 inches apart unless otherwise indicated.
   2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
   3. Rungs: 3/4-inch-diameter, steel bars.
   4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
   6. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
   7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
   8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.

9. Galvanize and prime exterior ladders, including brackets.
10. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

2.9 METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
   1. Treads are not to be less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height is not to be more than 9-1/2 inches.
   2. Fabricate ships' ladders, including railings from steel.
   3. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch in least dimension.
   4. Fabricate treads and platforms from rolled-steel floor plate.
   5. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

2.10 METAL BOLLARDS

A. Fabricate metal bollards from steel shapes, as indicated.
   1. Bollards to be filled with concrete and covered with HDPE safety yellow sleeve.

2.11 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Prime plates with zinc-rich primer.

2.12 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   3. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
   4. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF SHELF ANGLES

A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.3 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.4 INSTALLATION OF METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

B. Secure pipe crossovers to construction to comply with manufacturer's written instructions.

3.5 INSTALLATION OF METAL BOLLARDS

A. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
   1. Embed anchor bolts at least 4 inches in concrete.

B. Anchor bollards in concrete in formed or core-drilled holes not less than 42 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

C. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

D. Fill bollards solidly with concrete, mounding top surface to shed water.
   1. Do not fill removable bollards with concrete.

3.6 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 REPAIRS

A. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
      a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel railings.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Handrail brackets.
   3. Shop primer.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
   1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hollaender Mfg. Co.
   2. Kee Safety, Inc.
   3. TrueNorth Steel.
   4. Wagner Companies (The); R&B Wagner, Inc.

B. Tubing: ASTM A500/A500M (cold formed).

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 FASTENERS

A. Fastener Materials:
   1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/ASTM F1941M, Class Fe/Zn 5 for zinc coating.

B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
   1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast iron center of handrail 2-1/2 inches from wall.

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

C. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.6 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately.
   1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
   2. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Form changes in direction as follows:
   1. As detailed.
   2. by inserting prefabricated elbow fittings.

F. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

G. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
   1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
   2. Coordinate anchorage devices with supporting structure.

2.7 STEEL AND IRON FINISHES

A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
   1. Shop prime uncoated railings with primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" unless indicated.
   2. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.
   1. Fit exposed connections together to form tight, hairline joints.
   2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
   3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
   4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
   6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
   1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 ATTACHING RAILINGS

A. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Secure wall brackets and railing end flanges to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.

C. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.3 CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood blocking and nailers.
   2. Plywood backing panels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:
   1. Boards: 15 percent.
   2. Dimension Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
   1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2[for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground].
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
   5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:
   1. Framing for raised platforms.
   2. Framing for stages.
   3. Concealed blocking.
   4. Framing for non-load-bearing partitions.
   5. Framing for non-load-bearing exterior walls.
   6. Roof construction.
   7. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
   2. Eastern softwoods; No. 2 Common grade; NeLMA.
   3. Northern species; No. 2 Common grade; NLGA.
   4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.7 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:
   1. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locatenailers, blocking,and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
   2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
   3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

   Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061700 – ENGINEERED FRAMING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Engineered lumber framing systems for the following applications:
   1. Parapet cap engineered framing system.

1.2 RELATED SECTIONS

A. Section 061000 - Rough Carpentry

B. Section 075423 - Thermoplastic-Polyolefin (TPO) Roofing.

1.3 REFERENCES

A. American Wood Protection Association (AWPA):
   1. AWPA U1-15, UC2 Interior/Damp Use.

B. ASTM International (ASTM):
   1. ASTM E 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus. (R-Value).

C. ICC Evaluation Service:
   1. ICC-ES Report ESR-1387 -StrandGuard TimberStrand LSL 1.30E treated with zinc borate.

D. NAHB Research Center:
   1. Green Approved Product for National Green Building Certification, Certificate 00008.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's current published data including materials, standard details, and installation instructions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years' experience manufacturing similar products.

B. AWPA Standards: Materials shall meet AWPA U1-15 for Use Category UC 2. Service conditions for UC2 are interior construction, above ground, damp; protected from weather, but may be subject to sources of moisture.

C. NAHB Green Approved Product: Materials shall be NAHB Green Approved; StrandGuard TimberStrand LSL is a Green Approved Product for National Green Building Certification, Certificate 00008.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials in accordance with manufacturer's recommendations and as required to avoid damage.

1.7 PROJECT CONDITIONS

A. Maintain temperature and humidity within limits recommended by the manufacturer. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

A. Warranty: Provide manufacturer's standard limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: PreBuck, which is located at: 2555 28th St. SW; Wyoming, MI 49519; Tel: 616-309-6256; Email: request info at sales@prebuckproducts.com; Web:http://www.prebuckproducts.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of the General Conditions and Division 01.

2.2 PARAPET CAP ENGINEERED FRAMING SYSTEM

A. Parapet Cap Engineered Framing System: StrandGuard TimberStrand LSL 1.30E Engineered Lumber by PreBuck Engineered Framing Systems.
   1. Meets AWPA U1-15 for Use Category 2 (UC2).
   2. NAHB Research Center Green Approved.
   3. MDI resin, 100 percent waterproof when cured.
   4. Treated with zinc borate through complete cross section.
   5. Typical material 1-1/2 inches (38 mm) thick; built-up as required.
   6. Round 1-1/4-inch counter sunk anchor openings at 24 inches O.C.
   7. Acceptable for direct contact with concrete, non-corrosive to metals, insect and fungi resistive.
   8. Materials: StrandGuard TimberStrand LSL 1.30E Engineered Lumber, ICC ESR-1387.
      a. Treatment: Zinc borate through complete cross section.
      b. Bending Strength: 1900 psi.
      c. Tensile Strength: 1075 psi.

d. Shear Strength: 150 psi.
e. Compression - Perpendicular to Grain: 670 psi.
f. Specific Gravity: 0.50 into the face, 0.42 into the edge.
g. R-value of 1-1/2-inch thickness (ASTM E 518): 1.86.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's recommendations and in proper relationship with adjacent construction. Set members level, plumb, and true to line.

B. Coordinate construction sequence with installation of flashings and adjacent materials provided by others to prevent exterior moisture from entering or passing through completed assemblies.

C. Remove excess and waste materials from the job.

END OF SECTION 061700

SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural glued-laminated timber.
   2. Timber connectors.

1.2 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data on lumber, adhesives, fabrication, and protection.
   2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
   3. For connectors. Include installation instructions.

B. Shop Drawings:
   1. Show layout of structural glued-laminated timber system and full dimensions of each member.
   2. Indicate species and laminating combination.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in ANSI A190.1.

B. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Structural glued-laminated timber and connectors are to withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in ANSI 117 or determined according to ASTM D3737 and acceptable to authorities having jurisdiction.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with ANSI A190.1 and ANSI 117 or research/evaluation reports acceptable to authorities having jurisdiction.
   1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
   2. Provide structural glued-laminated timber made from single species.
   3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
   4. Provide structural glued-laminated timber made with wet-use adhesive complying with ANSI A190.1.

B. Species and Grades for Structural Glued-Laminated Timber:
   1. Southern pine that complies with structural properties indicated.

C. Species and Grades: For beams.
   1. Species and Beam Stress Classification: Southern pine, 24F-1.8E.
   2. Lay-up: Either balanced or unbalanced.

D. Appearance Grade: Premium, complying with AITC 110.
   1. For Premium and Architectural appearance grades, fill voids as required by AITC 110. For Premium appearance grade, use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.

2.3 TIMBER CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Simpson Strong-Tie Co., Inc.

B. Fabricate beam hangers from steel. Details as shown on Drawings.

C. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.

D. Materials: Unless otherwise indicated, fabricate from the following materials:
   1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
   2. Round steel bars complying with ASTM A575, Grade M 1020.
   3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.

E. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

2.4 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.5 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
   1. Dress exposed surfaces as needed to remove planing and surfacing marks.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
   1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry; bevel cut ends 3 inches; and do not embed more than 4 inches unless otherwise indicated.

C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

D. Install timber connectors as indicated.
   1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
   2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
   1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
   2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior trim

1.2 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

C. PVC: Polyvinyl chloride.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. Particleboard: ANSI A208.1, Grade M-2.

2.2 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
   1. Species and Grade: White oak or other species to match white oak; NHLA Clear.
   2. Maximum Moisture Content: 9 percent.
   3. Finger Jointing: Not allowed.
   4. Gluing for Width: Not allowed.
   5. Veneered Material: Allowed.
   6. Face Surface: Surfaced (smooth).
   7. Matching: Selected for compatible grain and color.

2.3 MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

C. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
   1. Use concealed shims where necessary for alignment.
   2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
   4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
   5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
   1. Do not use pieces less than 24 inches long, except where necessary.
   2. Stagger joints in adjacent and related standing and running trim.
   3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
   4. Use scarf joints for end-to-end joints.
   5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

END OF SECTION 062023

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Composites, Inc.
      b. Glasteel.
      c. Marlite, Inc.
      d. Nudo.
      e. Parkland Plastics.
   2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   3. Nominal Thickness: Not less than 0.075 inch.
   4. Surface Finish: Molded pebble texture.
   5. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: Match panels.
   2. Verify adhesives have a VOC content of 50 g/L or less.

B. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."
   1. Verify sealant has a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

3.2 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive. Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cold-applied, emulsified-asphalt dampproofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Content: Products are to comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ChemMasters, Inc.
   2. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
   3. Henry Company; a Carlisle company.
   4. Karnak Corporation.
   5. Master Builders Solutions; brand of MBCC Group.
   6. W. R. Meadows, Inc.

B. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.

C. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

2.3 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.

D. ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
   1. Thickness: Nominal 1/8 inch.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
   1. Apply dampproofing to provide continuous plane of protection.
   2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
   1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
   2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
   1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
   2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

D. Where dampproofing interior face of above-grade, exterior concrete walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply one fibered brush or spray coat at not less than 3 gal./100 sq. ft..

3.3 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

END OF SECTION 071113

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Extruded polystyrene foam-plastic board insulation.
   2. Molded (expanded) polystyrene foam-plastic board insulation.
   3. Mineral-wool blanket insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Extruded polystyrene foam-plastic board insulation.
   2. Molded (expanded) polystyrene foam-plastic board insulation.
   3. Mineral-wool blanket insulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.
   1. Products: Subject to compliance with requirements, provide the following:
      a. The Dow Chemical Company; STYROFOAM Brand CavityMate Ultra Insulation.
   2. For use as cavity wall insulation

2.3 MOLDED (EXPANDED) POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Molded (Expanded) Polystyrene Board Insulation, Type I: ASTM C578, Type I, 10-psi minimum compressive strength.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Atlas Molded Products, a division of Atlas Roofing Corporation.
      b. DiversiFoam Products.
      c. Insulfoam; Carlisle Construction Materials Company.
   2. For use as foundation insulation

2.4 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. Owens Corning.
      c. ROCKWOOL.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
   2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
   1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
   1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
   1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.
   3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Closed-cell spray polyurethane foam.
   2. Accessories

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Closed-cell spray polyurethane foam.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.9 deg F x h x sq. ft./Btu at 75 deg F.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Spray Foam Insulation; SealTite PRO Closed Cell or a comparable product by one of the following:
      a. Gaco; a brand of Firestone Building Products.
      b. Henry Company.

   2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 ACCESSORIES

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

B. Provide accessory materials as required for sealing and maintaining the vapor barrier at locations such as movement joints, opening, corners, dissimilar materials, etc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

END OF SECTION 072119

SECTION 072413 - POLYMER-BASED EXTERIOR INSULATION & FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. DFS (direct applied finish system)-clad barrier-ceiling assemblies that are field applied over substrate.

1.2 ACTION SUBMITTALS

A. Product Data: For each EIFS component, trim, and accessory.

B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An installer certified in writing by EIFS manufacturer as qualified to install manufacturer's system using trained workers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BASF Wall Systems.
   2. Dryvit Systems, Inc.
   3. Parex USA, Inc.
   4. Sto Corp.

B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as tested and compatible with EIFS components.

2.2 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with ASTM E 2568 and with the following:
   1. Weather-tightness: Resistant to water penetration from exterior.
   2. Impact Performance: ASTM E 2568, High impact resistance.
   3. Bond Integrity: Free from bond failure within EIFS components or between EIFS and substrates, resulting from exposure to fire, wind loads, weather, or other in-service conditions.

2.3 EIFS MATERIALS

A. Primer/Sealer: EIFS manufacturer's standard substrate conditioner designed to protect substrates from moisture penetration and to improve the bond between substrate and insulation adhesive.

B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

C. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multi-end strands with retained mesh tensile strength of not less than 120 lbf/in. according to ASTM E 2098.

D. Base-Coat Materials: EIFS manufacturer's standard mixture.

E. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

F. Finish-Coat Materials: EIFS manufacturer's standard acrylic-based coating with enhanced mildew resistance.
   1. Colors: As selected by Architect from manufacturer's full range.
   2. Textures: As selected by Architect from manufacturer's full range.

G. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784 and ASTM C 1063.

PART 3 - EXECUTION

3.1 EIFS INSTALLATION

A. Comply with ASTM C 1397, ASTM E 2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate.

B. Primer/Sealer: Apply over gypsum sheathing substrates and where required by EIFS manufacturer for improving adhesion of insulation to substrate.

C. Flexible-Membrane Flashing: Apply and lap to shed water; seal at openings, penetrations, terminations, and where required by EIFS manufacturer. Prime substrates if required and install flashing to comply with EIFS manufacturer's written instructions and details.

D. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, and elsewhere as indicated. Coordinate with installation of insulation.

E. Expansion Joints: Install at locations indicated and where required by EIFS manufacturer.

F. Base Coat: Apply to exposed surfaces of sheathing in minimum thickness recommended in writing by EIFS manufacturer, but not less than 1/16-inch dry-coat thickness.

G. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

H. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions in same manner as first application. Do not apply until first base coat has cured.

I. Finish Coat: Apply over drybase coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

END OF SECTION 072413

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building paper.
   2. Building wrap.
   3. Drainage wrap.
   4. Flexible flashing.
   5. Drainage material.

1.2 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E2556/E2556M, Type II air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.
   1. Products: Subject to compliance with requirements, provide the following:
      a. DuPont de Nemours, Inc.; Tyvek CommercialWrap.
   2. Water-Vapor Permeance: Minimum 20 perms per ASTM E96/E96M, Desiccant Method (Procedure A).
   3. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

B. Acrylic Seam Tape: Composite tape consisting of a pressure-sensitive acrylic adhesive, bonded to a polyethylene or polypropylene film for sealing joints and penetrations in building wrap. Provide tape from same manufacturer as approved wrap product.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. DuPont de Nemours, Inc.

   2. Width: 3 inches.

2.2 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch.
   1. Products: Subject to compliance with requirements, provide the following:
      a. DuPont de Nemours, Inc.; DuPont Flashing Tape.
   2. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover sheathing with water-resistive barrier as follows:
   1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
   2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

B. Building Wrap or Drainage Wrap: Comply with manufacturer's written instructions and warranty requirements.
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
   1. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
   2. Lap flashing over water-resistive barrier at bottom and sides of openings.
   3. Lap water-resistive barrier over flashing at heads of openings.

END OF SECTION 072500

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vapor-retarding, fluid-applied air barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air-barrier assemblies.
   1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, expansion joints, terminations, and tie-ins with adjoining construction.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.
   1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
      a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
      b. Include junction with roofing membrane foundation wall intersection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. VOC Content: 250 g/L or less.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

A. High-Build, Vapor-Retarding Air Barrier: synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.
   1. Synthetic Polymer Type:
      a. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies Inc. (formerly Grace Construction Products) ; Perm-A-Barrier Liquid NPL 10 or a comparable product by one of the following:
         1) Carlisle Coatings & Waterproofing Inc.
         2) Sto Corp.
         3) W. R. Meadows, Inc.
   2. Physical and Performance Properties:
      a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
      b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M, Desiccant Method.
      c. Ultimate Elongation: Minimum 550 percent; ASTM D 412, Die C.
      d. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested according to ASTM D 4541.
      e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
      f. UV Resistance: Can be exposed to sunlight for 90 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
   3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
   4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

D. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

E. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
   1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness not less than 40 mils, applied in one or more equal coats.

F. Do not cover air barrier until it has been tested and inspected by testing agency.

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: a qualified testing agency to perform tests and inspections.

B. Tests: As determined by testing agency from among the following tests:
   1. Air-barrier dry film thickness.
   2. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

C. Air barriers will be considered defective if they do not pass tests and inspections.
   1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
   2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074210.11 - COMPOSITE FRAMING SUPPORT (CFS) SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Composite framing support (CFS) system with in-fill insulation integrated with metal wall panels or exterior wall cladding.
   1. Substrate: Exterior sheathing over metal stud framing or concrete masonry units (CMU).

1.2 RELATED REQUIREMENTS

A. Section 042000 – Unit Masonry: Concrete masonry unit (CMU) wall substrate

B. Section 054000 – Cold-Formed Metal Framing: Metal stud substrate support framing

C. Section 072500 – Weather Barriers: Air, water, vapor barrier at exterior wall

D. Section 072726 – Fluid-Applied Membrane: Fluid applied vapor retarder

E. Section 074213 – Aluminum Plate Wall Panels: Wall cladding system

F. Section 079200 – Joint Sealants: Perimeter sealant

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate construction of wall cladding support system over substrate indicated for proper drainage, flashing, trim, back-up support, soffits, and other related Work.
   1. Review and finalize construction schedule.
   2. Verify availability of materials, installer's personnel, equipment, and facilities needed to maintain schedule.
   3. Review means and methods related to installation, including manufacturer's written instructions.
   4. Examine support conditions for compliance with requirements, including alignment and attachment to structural support system.
   5. Review flashings, wall cladding details, wall penetrations, openings, and condition of other construction that affects this Work.
   6. Review temporary protection requirements for during and after installation of this Work.

1.4 SUBMITTALS

A. See Section 013000 – Administrative Requirements, for submittal procedures.

B. Product Data: Submit for each type of product indicated; include construction details, material descriptions, dimensions of individual components and profiles, and accessories as necessary for complete fully functioning and assembled system.

C. Coordination Drawings: Submit scaled exterior elevations that provide the following items in coordination with each other and with input from installers of these items:
   1. Specifier Note: Revise following paragraphs in compliance with project requirements.
   2. CFS system attachment methods and required fasteners
   3. Sub-framing
   4. Continuous insulation support system attachment methods and required fasteners
   5. Wall-mounted items including doors, windows, louvers, and lighting fixtures
   6. Wall penetrations including pipes, electrical fixtures, and any other utilities

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.

B. Installer: Company specializing in performing work of this section and the following:
   1. Install system in strict compliance with manufacturer’s installation instructions.
   2. Have not less than three years of documented experience.
   3. Factory trained and approved by CFS system manufacturer.

C. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a licensed Structural Engineer experienced in design for this type of Work and licensed in State that Project is located.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original unopened containers and packaging with labels clearly identifying product name and manufacturer.

B. Deliver components and other manufactured items or accessories without damage or deformation.

C. Storage: Store materials in clean, dry, and level interior areas or outdoor areas for limited duration in accordance with manufacturer’s written instructions.

D. Protect components and auxiliary accessories during transportation, handling, and installation from moisture, excessive temperatures and other construction operations in accordance with manufacturer’s written instructions.

E. Handle components in strict compliance with manufacturer’s written instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface, edge or corner damage.

1.7 SITE CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work in accordance with manufacturer's written installation instructions and warranty requirements.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. CFS System Warranty: Provide written warranty by manufacturer agreeing to correct defects in manufacturing within five year or period after Date of or Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Advanced Architectural Products (A2P): SMARTci GreenGirt 1-in-1 System
   1. Address: 959 Industrial Drive, Allegan, Michigan 49010.
   2. Phone: (269) 355-1818; Fax: (866) 858-5568; Website: www.smartcisystems.com

B. Or equal.

2.2 DESCRIPTION

A. Attach CFS system components to exterior sheathing over metal stud framing or concrete masonry units (CMU).

B. Install CFS system components horizontally or on framed sheathing substrate system as indicated on drawings in compliance with specified requirements.

C. Install CFS system components horizontally or on masonry or concrete substrate system with shims as indicated on drawings in compliance with specified requirements.

2.3 PERFORMANCE REQUIREMENTS

A. System Thermal Design: Ensure installed insulation and CFS system, sub-framing, clips and cladding attachment does not have thermal bridging of fasteners or framing that creates a continuous metal path from exterior surface of insulation to interior face of insulation.
   1. System thermal design shall meet or exceed thermal design requirements in compliance with ASHRAE 90.1 or energy code.

2.4 COMPOSITE FRAMING SUPPORT (CFS) SYSTEM

A. CFS System: Provide CFS system consisting of polyester and vinyl ester bioresin matrix (FRP) with recycled materials, fire retardant additives and integral continuous metal inserts the length of profile. Reinforce CFS system with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.
   1. Depth of GreenGirt: As shown on drawings.
   2. Provide continuous non-corrosive steel insert for engagement of fasteners, at least 16 gage thick with G90 galvanized coating designation in compliance with ASTM A653/A653M.
      a. Fully engage steel insert with adjacent CFS at ends.
      b. Anchor sub-girts and other wall cladding support accessories to steel insert set into and part of CFS.
   3. Provide integral compression seal in CFS sections to ensure insulation panel will not dislodge.
   4. Provide integral anti-siphon grooves on exterior and interior flanges of CFS.

2.5 ASSEMBLY

A. Assemble CFS system using manufacturer's standard procedures and processes identical to tested units and as necessary to comply with performance requirements indicated.
   1. Comply with CFS system and dimensional and structural requirements as indicated on drawings.
   2. Erect CFS system in established sequence in accordance with manufacturer's standard installation procedures.
   3. Provide spray foam sealant on backside of cantilevered fasteners that completely puncture insulation layer.

2.6 ACCESSORIES

A. Provide accessories necessary for complete CFS system.

B. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by CFS system manufacturer for project application.
   1. Cladding to CFS System: Use standard self-tapping metal screws.
   2. CFS System to Metal Stud Wall Framing: Use standard self-tapping metal screws.
   3. CFS System to CMU: Use standard masonry or concrete screw anchors in predrilled hole.
   4. DO NOT USE powder, air, or gas actuated fasteners or actuated fastener tools. DO NOT USE impact wrenches when fastening to or from the CFS.

C. Weather Resistant Barrier (WRB): Refer to Section 072500 for requirements.

D. Sealants: Refer to Section 079200 for sealant information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas of this work, and project conditions with installer present for compliance with requirements for installation tolerances, substrates, CFS system conditions, and other conditions affecting performance of this Work.

B. Examine structural wall framing to ensure that angles, channels, studs, and other structural support members have been installed within alignment tolerances required by CFS system manufacturer.

C. Examine rough-in for components and systems penetrating CFS system to coordinate actual locations of penetrations relative to CFS systems joint locations prior to installation.

D. Verify that mechanical and electrical services for exterior walls have been installed and tested and, if appropriate, verify that adjacent materials and finishes are dry and ready to receive insulation.

E. Proceed with installation only after wall substrate surfaces have been properly prepared and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by CFS manufacturer for achieving best result for substrate under project conditions.

C. Prepare sub-framing, base angles, sills, furring, and other CFS system members and provide anchorage in accordance with ASTM C754 for substrate type and wall cladding type in accordance with manufacturer’s installation instructions.

3.3 INSTALLATION

A. Install CFS system in accordance with manufacturer's installation instructions.

B. Install system to fill-in exterior spaces without gaps or voids, and do not compress insulation panels.

C. Trim insulation neatly to fit spaces, and insulate miscellaneous gaps and voids.

D. Fit insulation tight in spaces and tight to exterior side of Mechanical/Electrical services within plane of insulation.

E. Exposed insulation must be protected from open flame.

F. Exterior wall insulation is not intended to be left exposed for extended periods of time without adequate protection.

G. Install CFS system in compliance with system orientation, sizes, and locations as indicated on drawings.

3.4 TOLERANCES

A. Shim and align CFS system within installed tolerances of 1/4 inch in 20 feet, non-cumulative, level, plumb, and on location lines as indicated.

3.5 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Ensure that insulation panels are not exposed to moisture.
   1. Remove wet insulation panels or allow them to completely dry prior to installation of CFS system.

C. Replace damaged insulation prior to Date of Substantial Completion.

END OF SECTION 074210.11

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concealed-fastener, lap-seam metal wall panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Warranties: Samples of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Rib-Profile, Concealed-Fastener Metal Wall Panels: Formed with raised, center-creased, trapezoidal major ribs; with reveal joint between panels.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide CENTRIA, a Nucor Brand; Concept Series CS-260 and CS-620 or a comparable product by one of the following:
      a. ATAS International, Inc.
      b. Morin - A Kingspan Group Company.
      c. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
   2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
      a. Nominal Thickness: 0.028 inch.
      b. Exterior Finish: Three-coat fluoropolymer.
      c. Color: Match Architect's custom colors samples.

3. Panel Coverage: 12 inches and 16 inches.
4. Panel Height: 0.875 inch.
5. Panel Pattern: Install two panels of the CS-620, then one panel of the CS-260, then repeat.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Mounting Clips: Provide clips to maintain concealed fastener system.
   4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
   1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
   2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
   3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:
   1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.
   2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 INSTALLATION

A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
   1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
   2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.

3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

B. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.13

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal composite material (MCM) panels.
   2. Metal composite material (MCM) systems.

1.2 DEFINITIONS

A. MCM: Metal composite material; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.

B. PER: Pressure-equalized rainscreen system designed for no water intrusion, with equal pressure within air cavity and outside cladding barrier.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:
   1. Include fabrication and installation layouts of MCM system; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, accessories, and special details.
   2. Accessories: Include details of flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
   3. Provide signed and sealed drawings, by a qualified design professional in Project jurisdiction, of MCM system showing compliance with performance requirements and design criteria identified for this Project.

C. Samples: For each type of MCM panel and system indicated, with factory-applied color finishes.

D. Delegated Design Submittals: For MCM system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Warranty documentation.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Fabricator: Certified MCM fabricator by the Metal Construction Association.
   2. Installer: Entity that employs installers and supervisors who are trained and approved by MCM system manufacturer.
   3. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
   4. Testing Agency: An agency acceptable to authorities having jurisdiction.

1.7 MOCKUPS

A. Build mockups to set quality standards for fabrication and installation.
   1. Build mockup, including corner, supports, attachments, and accessories. Panel sample need not be provided in the specified color.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.

B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack MCM panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on MCM panels during installation.

1.9 COORDINATION

A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Panel Integrity Warranty: Manufacturer agrees to repair or replace components of MCM panels that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Panel Finish Warranty: Manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

C. MCM System Warranty: System manufacturer's standard form in which manufacturer agrees to repair or replace components of MCM systems that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design MCM system.

B. Structural Performance: MCM systems to withstand the effects of the following loads, based on testing in accordance with ASTM E330/E330M:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283/E283M at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft..

E. Water Penetration under Dynamic Pressure: No water penetration when tested in accordance with AAMA 501.1 at the following test pressure:
   1. Test Pressure: 12 psf.

F. Pressure Cycling: Provide PER system with a pass rating in accordance with AAMA 508.
   1. Lag between the cavity and the cyclic wind pressure to not exceed 0.08 seconds.
   2. Maximum differential between the cavity and the cyclic wind pressure to not exceed 50 percent of the maximum test pressure.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL COMPOSITE MATERIAL (MCM) WALL PANELS

A. Metal Composite Material (MCM) Wall Panels: Provide MCM panels fabricated from two metal facings bonded to a solid, extruded thermoplastic core.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ALPOLIC Materials; Mitsubishi Chemical Composites.
      b. ALUCOBOND; 3A Composites USA, Inc.
   2. Core: PE.
   3. Panel Thickness: 0.157 inch.
   4. Bond Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
   5. Fire Performance: Flame-spread index less than 25 and smoke-developed index less than 450, in accordance with ASTM E84 or UL 723.

B. MCM Panel Materials:
   1. Aluminum-Faced Panels: ASTM B209 alloy as standard with manufacturer, temper as required to suit finish and forming operations] with 0.020-inch- thick, aluminum sheet facings.
      a. Exterior Finish: Three-coat fluoropolymer.
         1) Color: Match custom colors indicated on drawings.

2.3 METAL COMPOSITE MATERIAL (MCM) SYSTEM

A. PER MCM System: Provide factory-formed and -assembled, MCM panels formed into profile for PER system installation, drained at horizontal joints and at base of wall. Include attachment assembly components, panel stiffeners, and accessories required for compartmentalized and weathertight system.
   1. Products: Subject to compliance with requirements, provide the following provide one of the following:
      a. Sobotec; SL-2000.
      b. Riverside Group; R4-300.

B. System Panel Depth: As indicated on drawings.

C. Attachment Assembly Components: Manufacturer's standard formed from extruded aluminum.

2.4 ACCESSORIES

A. Metal Subframing and Furring: ASTM C955 cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 hot-dip galvanized coating designation or
ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of MCM system.

B. System Accessories: Provide components required for a complete, weathertight wall system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Use gasketed or approved coated fasteners between dissimilar metals.
   1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
   2. Steel Panels: Use stainless steel fasteners.
   3. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM system manufacturer.

2.5 FABRICATION

A. Fabricate and finish MCM panels at the factory, by panel manufacturer's standard procedures and processes, as necessary to fulfill indicated panel performance requirements demonstrated by laboratory testing.

B. Shop-fabricate MCM systems and accessories by fabricator's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with requirements of MCM panel manufacturer, of indicated system profiles, and with dimensional and structural requirements.
   1. Fabricate panels to dimensions indicated on Drawings based on an assumed design temperature of 70 deg F. Allow for ambient temperature range at time of fabrication.
   2. Formed MCM panel lines, breaks, and angles to be sharp and straight, with surfaces free from warp or buckle.
   3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.
   4. Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
   5. Attach routed-and-returned panel flanges to perimeter extrusions with manufacturer's standard fasteners.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Coil-Coated Aluminum Finish:
   1. PVDF Fluoropolymer: AAMA 2605, three-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM system supports, and other conditions affecting performance of the Work.
   1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM system manufacturer.
   2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM system manufacturer.
      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating MCM system to verify actual locations of penetrations relative to seam locations of MCM panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MCM SYSTEM

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM system supports, and other conditions affecting performance of the Work.

B. General: Install MCM system in accordance with system manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM system securely in place, with provisions for thermal and structural movement.

C. Attachment Assembly, General: Install attachment assembly required to support MCM panels and to provide a complete weathertight wall system, including tracks, drainage channels, anchor channels, perimeter extrusions.
   1. Install subframing, furring, and other panel support members and anchorages in accordance with ASTM C955.
   2. Install support system at locations, at spacings, and with fasteners recommended by MCM system manufacturer to meet listed performance requirements.

D. PER MCM System: Install vertical tracks and horizontal tracks providing compartmentalization at locations, at spacings, and with fasteners recommended by system manufacturer.
   1. Attach MCM panels by interlocking panel perimeter extrusion into tracks.
   2. Insert matching MCM spline into tracks at joint reveal locations.

E. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install accessory components required for a complete MCM system assembly including trim, copings, corners, seam covers, flashings,, fillers, closure strips, and similar items. Provide types indicated by MCM system manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

   1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install trim to fit substrates and to result in waterproof performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

G. Remove temporary protective coverings and strippable films as MCM panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films as MCM panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.

B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

3.4 PROTECTION

A. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories.
5. Asphalt materials.
6. Walkways.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For insulation and roof system component fasteners, include copy of SPRI's Directory of Roof Assemblies listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:
1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   a. Submit evidence of compliance with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Field quality-control reports.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturers: A qualified manufacturer that is listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.
   2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. This includes all edge metals e.g. copings, fascias, termination bars, etc.
   1. Warranty Period: 25 years from date of Substantial Completion.

B. Limit of Liability: No dollar limitation

C. Scope of Coverage: The scope shall include but not be limited to the list below. Repair leaks in roof system caused by:
   1. Ordinary wear and tear of the elements
   2. Manufacturing defects in system components
   3. Defective workmanship used to install materials
   4. Damage due to winds up to 72 mph
   5. Unintentional damage due to normal rooftop inspections, maintenance, or service.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897.

D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
   1. Wind Uplift Load Capacity: 90 psf.

E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced,TPO sheet.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlisle Syntec Systems.
      b. Elevate; Holcim Building Envelope.
   2. Thickness: 60 mils, nominal.
   3. Exposed Face Color: White.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
   1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
   2. Verify adhesives and sealants comply with the following limits for VOC content:
      a. Plastic Foam Adhesives: 50 g/L.
      b. Gypsum Board and Panel Adhesives: 50 g/L.
      c. Multipurpose Construction Adhesives: 70 g/L.
      d. Fiberglass Adhesives: 80 g/L.
      e. Contact Adhesives: 80 g/L.
      f. PVC Welding Compounds: 510 g/L.
      g. Other Adhesives: 250 g/L.
      h. Single-Ply Roof Membrane Sealants: 450 g/L.
      i. Nonmembrane Roof Sealants: 300 g/L.
      j. Sealant Primers for Nonporous Substrates: 250 g/L.
      k. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlisle Syntec Systems.
      b. Elevate; Holcim Building Envelope.
   2. Size: 48 by 96 inches.
   3. Thickness:
      a. Base Layer: 2.6 inches.
      b. Upper Layer: 2.6 inches

B. Tapered Insulation: Provide factory-tapered insulation boards.
   1. Material: Match roof insulation.
   2. Minimum Thickness: 1/4 inch.
   3. Slope:
      a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
      b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
   1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
   2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
   3. Verify adhesives and sealants comply with the following limits for VOC content:
      a. Plastic Foam Adhesives: 50 g/L.
      b. Gypsum Board and Panel Adhesives: 50 g/L.
      c. Multipurpose Construction Adhesives: 70 g/L.
      d. Fiberglass Adhesives: 80 g/L.
      e. Contact Adhesives: 80 g/L.
      f. PVC Welding Compounds: 510 g/L.

g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

2.6 ASPHALT MATERIALS

A. Roofing Asphalt: [ASTM D312/D312M, Type III or Type IV] [ASTM D6152/D6152M, SEBS modified].

B. Asphalt Primer: ASTM D41/D41M.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
1. Size: Approximately 36 by 60 inches.
2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
1. Submit test result within 24 hours after performing tests.
a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:
   1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
      a. Locate end joints over crests of decking.
      b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
      c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
      d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
      e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
         1) Trim insulation so that water flow is unrestricted.
      f. Fill gaps exceeding 1/4 inch with insulation.
      g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
      h. Loosely lay base layer of insulation units over substrate.
      i. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
         1) Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
         2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
   2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
      a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
      b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
      c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
   1) Trim insulation so that water flow is unrestricted.
f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
   1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
   2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
   3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Tectum Decking:
1. Install tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
   a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
   c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
      1) Trim insulation so that water flow is unrestricted.
   d. Fill gaps exceeding 1/4 inch with insulation.
   e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   f. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
      1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
      2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
   2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 INSTALLATION OF WALKWAYS

A. Flexible Walkways:
   1. Install flexible walkways at the following locations:
      a. Retain one or more subparagraphs below. Revise to suit Project.
      b. Perimeter of each rooftop unit.
      c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
      d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
      e. Top and bottom of each roof access ladder.
      f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
      g. Locations indicated on Drawings.
      h. As required by roof membrane manufacturer's warranty requirements.
   2. Provide 6-inch clearance between adjoining pads.
   3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation for every 7,500 sf and on completion.
   1. Notify Architect and Owner 48 hours in advance of date and time of inspection
   2. Submit reports to Architect.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof-edge specialties.
   2. Reglets and counterflashings.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
   2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
   3. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof specialties.
   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

1.6 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075423 “Thermoplastic-Polyolefin (TPO) Roofing."

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

B. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

C. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested in accordance with SPRI ES-1 and capable of resisting the following design pressures:
   1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 ROOF-EDGE SPECIALTIES

A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ATAS International, Inc.
      b. Berridge Manufacturing Company.
      c. Drexel Metals.
      d. Fabral; a brand of Flack Global Metals.
      e. Metal-Era, Inc.
      f. OMG Roofing Products; a Division of OMG, Inc.

g. SAF Perimeter Systems Division.
2. Metallic-Coated Steel Sheet Fascia Covers: Zinc-coated (galvanized) steel, nominal thickness as required to meet performance requirements.
   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: Match custom color of adjacent metal panels (minimum two colors).
3. Corners: Factory mitered and continuously welded.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Receiver: Manufacturer's standard material and thickness.
6. Fascia Accessories: Fascia extenders with continuous hold-down cleats.

2.3 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ATAS International, Inc.
   2. Berridge Manufacturing Company.
   3. Cheney Flashing Company.
   4. Drexel Metals.
   5. Fry Reglet Corporation.
   6. Heckmann Building Products, Inc.
   7. Metal-Era, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
   1. Stainless Steel: 0.0250 inch thick.
   2. Corners: Factory mitered and mechanically clinched and sealed watertight.
   3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
   1. Stainless Steel: 0.0250 inch thick.

D. Accessories:
   1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
   2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled, unpolished).

2.4 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.

B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

2.5 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.6 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
   1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
   2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
   3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
   4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329.

B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.7 FINISHES

A. Coil-Coated Galvanized-Steel Sheet Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.

b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

B. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.2 INSTALLATION, GENERAL

A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
   2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.3 INSTALLATION OF ROOF-EDGE SPECIALITIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.4 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Embedded Reglets: See Section 042000 "Unit Masonry" for installation of reglets.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof hatches.
   2. Pipe portals.
   3. Preformed flashing sleeves.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
   2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
   3. Section 077100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.
   4. Section 230548 "Vibration and Seismic Controls for HVAC" for special curbs designed to accommodate seismic and vibration controls.
   5. Section 233423 "HVAC Power Ventilators" for power roof-mounted ventilators.
   6. Section 237413 "Packaged, Outdoor, Central-Station Air-Handling Units" for standard curbs specified with rooftop units.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.
   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.5 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ACUDOR Products, Inc.
      b. BILCO Company (The).
      c. Babcock-Davis.
      d. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
      e. Milcor by Duravent; Duravent Group.
      f. Nystrom, Inc.
      g. Pate Company (The).

B. Type and Size:
   1. Single-leaf lid, 30 by 96 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material, Steel: Zinc-coated (galvanized) steel sheet.
   1. Thickness: Manufacturer's standard thickness for hatch size indicated.
   2. Finish: Two-coat fluoropolymer.
   3. Color: As selected by Architect from manufacturer's full range.

E. Construction:
   1. Insulation: 2-inch-thick, polyisocyanurate board.
      a. R-Value: 12.0 according to ASTM C1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide two-point latch on lids larger than 84 inches.
2. Provide remote-control operation.

G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
8. Fabricate joints exposed to weather to be watertight.
9. Fasteners: Manufacturer's standard, finished to match railing system.
10. Finish: Manufacturer's standard.
    a. Color: As selected by Architect from manufacturer's full range.

2.2 PIPE AND DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch-diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with polycarbonate roller carrying assembly accommodating up to 7-inch-diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless steel threaded rod designed for adjusting support height, accommodating up to 18 inch diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

2.3 PIPE PORTALS

A. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless steel snaplock swivel clamps.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Portals Plus; Duravent Group.

2.4 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Solution Roof and Metal Products, a division of Colony Heating.
      b. Menzies Metal Products.
      c. Thaler Metal Industries Ltd.
   2. Metal: Aluminum sheet, 0.063 inch thick.
   3. Diameter: As indicated on Drawings.
   4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Solution Roof and Metal Products, a division of Colony Heating.
      b. Menzies Metal Products.
      c. Milcor by Duravent; Duravent Group.
      d. Thaler Metal Industries Ltd.
   2. Metal: Aluminum sheet, 0.063 inch thick.
   3. Height: 13 inches.
   4. Diameter: As indicated on Drawings.
   5. Finish: Manufacturer's standard.

2.5 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
   1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
   2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.

3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
4. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 coated.
1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
3. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
4. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

D. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

G. Steel Tube: ASTM A500/A500M, round tube.

H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

I. Steel Pipe: ASTM A53/A53M, galvanized.

2.6 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.

C. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

D. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

G. Underlayment:
   1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
   2. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D4397.
   3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
   4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

H. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
   1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

J. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

K. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

L. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories accordinsg to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
   3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:
   1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
   2. Attach safety railing system to roof-hatch curb.
   3. Attach ladder-assist post according to manufacturer's written instructions.

D. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
   1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

E. Preformed Flashing-Sleeve and Flashing-Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

F. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.

1.2 ACTION SUBMITTALS

A. Product data.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
   1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

A. Listed system designs.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
   1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
      1) UL in its online directory "Product iQ."
      2) Intertek Group in its "Directory of Building Products."
      3) FM Approvals in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Description: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. 3M Building and Construction.
      b. Hilti, Inc.
      c. Passive Fire Protection Partners.
      d. Specified Technologies Inc.
      e. Tremco Incorporated.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.
   1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
   2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.
   1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
   2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor. The following floor penetrations do not require a T-rating:
      a. Those within the cavity of a wall.
      b. Floor, tub, or shower drains within a concealed space.
      c. 4-inch or smaller metal conduit penetrating directly into metal-enclosed electrical switchgear.
   3. W-Rating: Provide penetration firestopping systems with a Class 1 W-rating in accordance with UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined in accordance with UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, in accordance with ASTM E84.
   1. Verify sealant has a VOC content of 250 g/L or less.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
   1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Nonstaining silicone joint sealants.
   3. Urethane joint sealants.
   4. Mildew-resistant joint sealants.
   5. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product data.

B. Samples: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-sealant schedule.

1.3 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:
   1. Manufacturers' special warranties.
   2. Installer's special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.6 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: [As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range].

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Adfast.
      b. GE Construction Sealants; Momentive Performance Materials Inc.
      c. Sika Corporation - Building Components.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Adfast.
      b. Pecora Corporation.

c. Sika Corporation - Building Components.
d. Tremco Incorporated.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bostik; Arkema.
b. Master Builders Solutions; brand of MBCC Group.
c. Pecora Corporation.
d. Polymeric Systems, Inc.
e. Sherwin-Williams Company (The).
f. Sika Corporation - Building Components.
g. Tremco Incorporated.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. The Dow Chemical Company.
e. Tremco Incorporated.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Everkem Diversified Products, Inc.
b. Pecora Corporation.
c. Sherwin-Williams Company (The).
d. Tremco Incorporated.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Alcot Plastics Ltd.
      b. Construction Foam Products; a division of Nomaco, Inc.
      c. Master Builders Solutions; brand of MBCC Group.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

H. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
      a. Extent of Testing: Test completed and cured sealant joints as follows:
         1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
         2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
      b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
         1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
      c. Inspect tested joints and report on the following:
         1) Whether sealants filled joint cavities and are free of voids.

2) Whether sealant dimensions and configurations comply with specified requirements.
3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical joint sealants.

1.2 ACTION SUBMITTALS

A. Product data.

B. Samples: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Acoustical joint-sealant schedule.

1.3 CLOSEOUT SUBMITTALS

A. Warranty Documentation:
   1. Manufacturers' special warranties.
   2. Installer's special warranties.

1.4 WARRANTY

A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
   1. Verify sealant has a VOC content of 250 g/L or less.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Everkem Diversified Products, Inc.
      b. Grabber Construction Products, Inc.
      c. Hilti, Inc.
      d. Pecora Corporation.

e. Specified Technologies Inc.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

END OF SECTION 079219

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior standard steel doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
   1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
   1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ceco Door; AADG, Inc.; ASSA ABLOY.
   2. Curries, AADG, Inc.; ASSA ABLOY Group.
   3. Custom Metal Products.
   4. DE LA FONTAINE.
   5. LaForce, LLC.
   6. Pioneer Industries; AADG, Inc.; ASSA ABLOY.
   7. Republic Doors and Frames; a Allegion brand.
   8. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule on Drawings.
      b. Thickness: 1-3/4 inches.
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
      d. Edge Construction: Model 1, Full Flush.
      e. Core: Manufacturer's standard.

f. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.

2. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Full profile welded.

2.4 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
   2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
   3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
   1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
      b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
   2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
   4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
   5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
      a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
      b. Install frames with removable stops located on secure side of opening.
   2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
   3. Solidly pack mineral-fiber insulation inside frames.
   4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
   1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
   2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-core seven-ply flush wood veneer-faced doors and transom panels for transparent finish.
   2. Fire-rated wood door frames.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Solid-core seven-ply flush wood veneer-faced doors and transom panels for transparent finish.
   2. Fire-rated wood door frames.
   3. Light frames and louvers.

B. Product Data Submittals: For each product, including the following:
   1. Door core materials and construction.
   2. Door edge construction
   3. Door face type and characteristics.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
   1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
   2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
   3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   4. Dimensions and locations of blocking for hardware attachment.
   5. Dimensions and locations of mortises and holes for hardware.
   6. Clearances and undercuts.
   7. Requirements for veneer matching.
   8. Doors to be factory finished and application requirements.

D. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.4 FIELD CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
   2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of veneer.
      b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
   3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C.
   1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
   2. Temperature-Rise Limit: Where indicated on Drawings, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
   1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

B. Adhesives: Do not use adhesives that contain urea formaldehyde.

C. Composite Wood Products: Verify products are made without added urea formaldehyde.

2.4 SOLID-CORE SEVEN-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Seven-Ply Veneer-Faced:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABS- American Building Supply- Doormerica.
      b. General Veneer Manufacturing Co.
      c. Haley Brothers, Inc.
      d. Lambton Doors.
      e. Vancouver Door Company.
   2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
   3. ANSI/WDMA I.S. 1A Quality Grade: Premium.
   4. Faces: Single-ply wood veneer not less than 1/50-inch-thick or two-ply wood panel with wood veneer not less than 1/50 inch thick.
      a. Species: White oak.
      b. Cut: Rift cut.
      c. Match between Veneer Leaves: Slip match.
      d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
      e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
      f. Room Match:
         1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
         2) Provide door faces of compatible color and grain within each separate room or area of building.
      g. Transom Match: Continuous match.

5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
   a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
   b. Fire-Rated Pairs of Doors:
      1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
      2) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
6. Core for non-fire-rated doors, WDMA I.S. 10 structural composite lumber.
   a. Screw Withdrawal, Door Face: 550 lbf.
   b. Screw Withdrawal, Vertical Door Edge: 550 lbf.
7. Core for fire-rated doors, as required to achieve fire-protection rating indicated on Drawings.
8. Construction: Seven plies, hot-pressed or cold-pressed, bonded or unbonded.

2.5 LIGHT FRAMES AND LOUVERS

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.
   1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.
   1. Locate hardware to comply with DHI-WDHS-3.
   2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
   3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
   4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
   5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels:
   1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
   2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

3. Fabricate door and transom panels with full-width, solid-lumber meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.
1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:
1. ANSI/WDMA I.S. 1A Grade: Premium.
a. TR-6 Catalyzed Polyurethane.
2. Staining: As selected by Architect from manufacturer's full range.
3. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors:
   1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
      a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
   2. Machine doors for hardware.
   3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   4. Clearances:
      a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
      b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
      c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
      d. Comply with NFPA 80 for fire-rated doors.
   5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
   6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of access door and frame and for each finish specified.

C. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies meets the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
   1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ACUDOR Products, Inc.
      b. Babcock-Davis.
      c. Elmdor; Morris Group International, Inc.
      d. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
      e. Larsen's Manufacturing Company.

f. Milcor by Duravent; Duravent Group.
g. Nystrom, Inc.

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Optional Features: Piano hinges.
4. Locations: Ceiling.
5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
6. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage factory primed.
7. Frame Material: Same material and thickness as door.
8. Latch and Lock: Cam latch, key operated.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Stainless Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

E. Frame Anchors: Same material as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.4 FABRICATION

A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

C. Latch and Lock Hardware:
1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

2.5 FINISHES

A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-rated service doors.

B. Related Requirements:

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   2. Show locations of controls, locking devices detectors or replaceable fusible links, and other accessories.
   3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
   1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

B. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

2.2 FIRE-RATED DOOR ASSEMBLY

A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Alpine Overhead Doors, Inc.
      b. C.H.I. Overhead Doors, Inc.
      c. Clopay Building Products.
      d. Cookson; a CornellCookson company.
      e. Cornell; a CornellCookson company.
      f. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.

C. Fire Rating: 3/4 hour.

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.

F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from stainless steel and finished to match door.

G. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish.
   1. Mounting: As indicated on Drawings.

I. Locking Devices: Equip door with locking device assembly.
   1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumbturn.

J. Electric Door Operator:
   1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
   2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
   3. Motor Exposure: Interior.
   4. Motor Electrical Characteristics:
      a. Horsepower: 1/2 hp.
      b. Voltage: 115 V ac, single phase, 60 Hz.
   5. Emergency Manual Operation: Push-up type.
   6. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom bar; self-monitoring type.
   7. Control Station(s): Interior mounted.

K. Curtain Accessories: Equip door with smoke seals, automatic-closing device, push/pull handles.

L. Door Finish:
   1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
   2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   1. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.5 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
   1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.6 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors allows testing without mechanical release of the door. Automatic-closing device are to be designed for activation by the following:
   1. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
   2. Building fire-detection, smoke-detection, and -alarm systems.
   3. Door shall be easily resettable by building staff without the need of a trained service technician.

2.8 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
   1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
   2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
   1. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
   1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Fire-Rated Doors: Install according to NFPA 80.

C. Power-Operated Doors: Install according to UL 325.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sectional-door assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
   1. Design Wind Load: As indicated on Drawings.
   2. Testing: In accordance with ASTM E330/E330M.

2.2 SECTIONAL-DOOR ASSEMBLY

A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. C.H.I. Overhead Doors, Inc.
      b. Clopay Building Products.
      c. Overhead Door Corporation.
      d. Raynor Garage Doors.
      e. Wayne Dalton; a division of Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.

D. U-Value: 0.052 Btu/sq. ft. x h x deg F.

E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G90 zinc coating.
   1. Door-Section Thickness: 1-3/4 inches.
   2. Section Faces:
      a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
      b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
         1) Steel Sheet Thickness: 0.022-inch nominal coated thickness.
         2) Surface: Manufacturer's standard, flat stucco embossed.
      c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
         1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.022 inch.
   3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.

4. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
    a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
    b. Hardware Locations: Provide reinforcement for hardware attachment.
5. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation of type indicated below:
    a. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
    b. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

F. Track: Manufacturer's standard, galvanized-steel, contour track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
    a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous angle attached to track and wall.
    b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door.

H. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:
1. Clear Acrylic Plastic: 3 mm thick, transparent, smooth or polished, and formulated to be UV resistant. Provide double insulating units.

I. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
   1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
      a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
   2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
      a. Roller-Tire Material: Case-hardened steel.
   3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.

J. Locking Device:
   1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

K. Counterbalance Mechanism:
   1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
   2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
      a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
   3. Cables: Galvanized-steel, multistrand, lifting cables.
   4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
   5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
   6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

L. Manual Door Operator:
   1. Push-Up Operation: Lift handles and pull rope for raising and lowering doors located on inside and outside of bottom section; with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf.

M. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.

3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
4. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
5. Operator Type: Manufacturer's standard for door requirements.
6. Motor: Reversible-type with controller (disconnect switch) for exterior, dusty, wet, or humid motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
    a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor 1/2 hp.
    b. Electrical Characteristics:
        1) Phase: Single phase.
        2) Volts: 115 V.
7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    a. Monitored Entrapment Protection: Electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
9. Control Station: Flush mounted, three-position (open, close, and stop) control.
    a. Operation: Push button.
    b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.
    c. Features: Provide the following:
        1) Vehicle detection operation.
        2) Explosion- and dust-ignition-proof control wiring.
        3) Audible and visual signals that comply with regulatory requirements for accessibility.
10. Emergency Manual Operation: Push-up type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

N. Metal Finish:
   1. High-Performance, Organic, Aluminum Finish (Two-Coat Fluoropolymer): Containing not less than 70 percent polyvinylidene fluoride resin by weight).
      a. Color and Gloss: Match Architect's sample of custom color to match storefront/curtinawall frames.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:
   1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
   2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum-framed entrance and storefront systems.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:
   1. Plans, elevations, sections, full-size details, and attachments to other work.
   2. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
   3. Point-to-point wiring diagrams.

C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Fabricator of products.
   2. Entity that employs installers and supervisors who are trained and approved by manufacturer.
   3. Authorized representative who is trained and approved by manufacturer.
   4. Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer.

B. Egress Door Inspector Qualifications:
   1. Inspector for field quality-control inspections of egress door assemblies to comply with qualifications set forth in NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."

2. Inspector for field quality-control inspections of egress door assemblies to be certified under DHI's certification program as a Fire and Egress Door Assembly Inspector (FDAI) or a Certified Fire and Egress Door Assembly Inspector (CFDAI).

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

B. Structural Loads:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.

C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
   2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
   3. Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.

D. Structural: Test in accordance with ASTM E330/E330M as follows:
   1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than seconds.

E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

F. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
   1. Air Leakage:
      a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
      b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
   2. Condensation Resistance Factor (CRF):
      a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
      b. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide OldCastle BuildingEnvelope (OBE); Series 6000XT or a comparable product by one of the following:
   1. EFCO Corporation.
   2. Kawneer Company, Inc.; Arconic Corporation.
   3. Tubelite Inc.
   4. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Exterior Framing Construction: Thermally broken.
   2. Interior Vestibule Framing Construction: Nonthermal.
   3. Glazing System: Retained mechanically with gaskets on four sides.
   4. Finish: High-performance organic finish.
   5. Fabrication Method: Field-fabricated stick system.
   6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   7. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

A. Entrance Doors (FRP)
   1. Flush FRP doors shall be SL-17 as manufactured by Special Lite. No substitutions.
   2. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
      a. Provide non-removable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:
1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
   1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color and Gloss: Match Architect's sample of custom color to match curtainwall and metal wall panel.

PART 3 - EXECUTION

3.1 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

K. Install entrance doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

L. Install glazing as specified in Section 088000 "Glazing."

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glazed aluminum curtain wall systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each type of exposed finish required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.5 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

B. Structural Loads:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.

C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches.
   2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
   3. Cantilever Deflection: Limited to 2l/175 at unsupported cantilevers.

D. Structural: Test in accordance with ASTM E330/E330M as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

F. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
   1. Air Leakage:
      a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
   2. Condensation Resistance Factor (CRF):
      a. Fixed Glazing and Framing Areas: CRF for the system of not less than 65 as determined in accordance with AAMA 1503.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide OldCastle BuildingEnvelope (OBE) ; Reliance. or a comparable product by one of the following:
   1. EFCO Corporation.
   2. Kawneer Company, Inc.; Arconic Corporation.
   3. Tubelite Inc.
   4. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.
   5. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Construction: Thermally broken.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Front.
   4. Finish: Superior-performance organic finish.
   5. System: Either stick or unitized system.
   6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
   1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.
   1. Color: Black.

C. Glazing Sealants: As recommended by manufacturer.
   1. Verify sealant has a VOC content of 250 g/L or less.

2.4 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:
   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.5 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:
   1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
   2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:
   1. Rigidly secure nonmovement joints.
   2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion.
   3. Preparation includes, but is not limited to, cleaning and priming surfaces.
   4. Seal joints watertight unless otherwise indicated.
   5. Install glazing to comply with requirements in Section 088000 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.6 ALUMINUM FINISHES

A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
   1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color and Gloss: Match Architect's sample to match metal wall panel.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

END OF SECTION 084413

SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panel.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel assemblies. Include plans, elevations, sections, details, and attachments to other work.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection Limits:
   1. Vertical Panel Assemblies: Limited to 1/120 of clear span for each assembly component.

C. Structural-Test Performance: ASTM E330.
   1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas to have U-factor of not more than 0.65 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
   2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas to have a SHGC of no greater than 0.7 as determined in accordance with NFRC 200.
   3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined in accordance with ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..

2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Kalwall Corporation.

2.3 FIBERGLASS-SANDWICH PANELS

A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

B. Panel Thickness: 2-3/4 inches.

C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.
   1. Extruded Aluminum: ASTM B221, in alloy and temper recommended in writing by manufacturer.
   2. I-Beam Construction: Thermally broken, extruded aluminum.
   3. Grid Pattern: Vertikal.

D. Exterior Face Sheet:
   1. Thickness: 0.070 inch.
   2. Color: White.
   3. Protective Weathering Surface: Integral, embedded-glass erosion barrier.

E. Interior Face Sheet:
   1. Thickness: 0.045 inch.
   2. Color: Crystal.

F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.

G. Panel Strength:
   1. Maximum Panel Deflection: 3-1/2 inches when a 4-by-12-foot panel is tested in accordance with ASTM E72 at 34 lbf/sq. ft., with a maximum 0.090-inch set deflection after five minutes.
   2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch-diameter disk in accordance with ASTM E661.

H. Panel Performance:
   1. Self-Ignition Temperature: 650 deg F or more in accordance with ASTM D1929.
   2. Smoke-Developed Index: 450 or less in accordance with ASTM E84, or 75 or less in accordance with ASTM D2843.
   3. Combustibility Classification: Class CC1 based on testing in accordance with ASTM D635.

4. Interior Finish Classification: Class B based on testing in accordance with ASTM E84.
5. Color Change: Not more than 3.0 units Delta E, when measured in accordance with ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.
   a. Outdoor Weathering Conditions: Sixty months in southern Florida.
6. Impact Resistance: No fracture or tear at impact of 230 ft. x lbf by a 3-1/4-inch-diameter, 5-lb freefalling ball in accordance with UL 972 test procedure.

2.4 ALUMINUM FRAMING SYSTEMS

A. Components: Thermally broken, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B209.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
   3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
   4. Structural Profiles: ASTM B308/B308M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123MorASTM A153/A153Mrequirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than 0.050 inch thick, finished to match framing.

I. Framing Gaskets: Manufacturer's standard.

J. Frame-System Sealants: As recommended in writing by manufacturer.

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic.

2.5 ALUMINUM FINISHES

A. Superior-Performing Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions.
   1. Do not install damaged components.
   2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
   3. Rigidly secure nonmovement joints.
   4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
   5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
   1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
   2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

END OF SECTION 084523

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum windows for exterior locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. Window: 10 years from date of Substantial Completion.
      b. Glazing Units: 10 years from date of Substantial Completion.
      c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
   1. Minimum Performance Class: CW.
   2. Minimum Performance Grade: CW50.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.32 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 52.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

2.2 ALUMINUM WINDOWS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. OldCastle BuildingEnvelope (OBE).
   2. Peerless Products Inc.
   3. TRACO.
   4. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.

B. Types: As indicated on Drawings.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
   1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Insulating-Glass Units: ASTM E2190.
   1. Glass: ASTM C1036, Type 1, Class 1, q3.
      a. Tint: Clear.
      b. Kind: Fully tempered where indicated on Drawings.
   2. Lites: Two.
   3. Filling: Fill space between glass lites with.
   4. Low-E Coating: Pyrolytic on second surface SN68.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

F. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.
   1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

G. Casement and Projected Window Hardware:
   1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
      a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.
   2. Hinges: Non-friction type, not less than two per sash.
   3. Lock: Manufacturer's standard.
   4. Limit Devices: Limit clear opening to for ventilation; with custodial key release.

H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
   1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

C. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
   1. Type and Location: Full, inside for outswing sashes.

B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.

C. Glass-Fiber Mesh Fabric: 20-by-20 or 20-by-30 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.
   1. Mesh Color: Manufacturer's standard.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
   1. Color and Gloss: Black.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

H. This is for use at windows in reading nooks only.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hinges.
2. Continuous, gear-type hinges.
3. Mortise locks.
4. Electric strikes.
5. Electromechanical locks.
6. Surface bolts.
7. Manual flush bolts.
8. Automatic flush bolts.
9. Self-latching flush bolts.
10. Exit devices and auxiliary items.
11. Lock cylinders.
12. Key control cabinet.
13. Operating trim.
14. Coordinators.
15. Carry-open bars.
16. Astragals.
17. Surface closers.
18. Concealed closers.
19. Closer holder release devices.
20. Wall- and floor-mounted stops.
21. Electromagnetic door holders.
22. Overhead stops and holders.
23. Door gasketing.
24. Thresholds.
25. Sliding door hardware.
26. Folding door hardware.
27. Metal protective trim units.
28. Auxiliary door hardware.
29. Auxiliary electrified door hardware.

1.2 PREINSTALLATION MEETINGS

A. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings: For electrified door hardware.
1. Diagrams for power, signal, and control wiring.

2. Details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
   1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
   2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
      a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
      b. Exit Devices: Two years from date of Substantial Completion.
      c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of door hardware from single manufacturer.
   1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1.

2.3 HINGES

A. Hinges: ANSI/BHMA A156.1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. Bommer Industries, Inc.
      c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.4 CONTINUOUS HINGES

A. Continuous, Gear-Type Hinges: ANSI/BHMA A156.26; minimum 0.120-inch-thick, extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings. Minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. Bommer Industries, Inc.
      c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

d. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
   1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
   2. Deadbolts: Minimum 1.25-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:
   1. Levers: Forged.
   2. Escutcheons (Roses): Forged.
   3. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

F. Mortise Locks: ANSI/BHMA A156.13, Security Grade 1; stamped steel case with steel or brass parts; Series 1000.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. SARGENT Manufacturing Company; ASSA ABLOY.

2.6 ELECTRIC STRIKES

A. Electric Strikes: ANSI/BHMA A156.31; with faceplate to suit lock and frame.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
      b. Allegion plc.

2.7 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: ANSI/BHMA A156.25, Grade 1; motor or solenoid driven; with strike that suits frame.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.

b. SARGENT Manufacturing Company; ASSA ABLOY.
2. Type: Mortise deadbolt.

2.8 SURFACE BOLTS

A. Surface Bolts: ANSI/BHMA A156.16.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allegion plc.
b. Trimco.

2.9 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: ANSI/BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Adams Rite Manufacturing Company, an ASSA ABLOY Group company.
b. Allegion plc.

2.10 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allegion plc.
b. SARGENT Manufacturing Company; ASSA ABLOY.

2.11 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allegion plc.
b. BEST Access Solutions, Inc.; dormakaba USA Inc.
c. SARGENT Manufacturing Company; ASSA ABLOY.

B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
1. Core Type: Removable.

C. High-Security Lock Cylinders: ANSI/BHMA A156.30, Grade 1 permanent cores that are removable; face finished to match lockset.

D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.12 KEYING

A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
   1. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
      a. Provide three-cylinder change keys and five each of master, grand master, and great-grand master keys.
   2. Existing System:
      a. Master key or grand master key locks to Owner's existing system.
   3. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.
   1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
      a. Notation: "DO NOT DUPLICATE."

2.13 KEY CONTROL SYSTEM

A. Key Control Cabinet: ANSI/BHMA A156.28; metal cabinet with baked-enamel finish, containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Key Boxes and Cabinets.
      b. HPC, a Hudson Lock Company.
      c. Interlogix; Carrier Global Corporation.
   2. Multiple-Drawer Cabinet: cabinet with drawers equipped with key-holding panels, key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.

2.14 OPERATING TRIM

A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.15 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: ANSI/BHMA A156.3; consisting of active-leaf, hold-open lever, and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: ANSI/BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: ANSI/BHMA A156.22.

2.16 SURFACE CLOSERS

A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. SARGENT Manufacturing Company; ASSA ABLOY.

2.17 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.18 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: ANSI/BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interfaced with fire-alarm system for labeled fire-rated door assemblies. Also interfaced with lockdown system.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. SARGENT Manufacturing Company; ASSA ABLOY.

2.19 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: ANSI/BHMA A156.8.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. Rixson Specialty Door Controls; ASSA ABLOY.
      c. SARGENT Manufacturing Company; ASSA ABLOY.

2.20 DOOR GASKETING

A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. National Guard Products, Inc.
      b. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
      c. Reese Enterprises, Inc.
      d. Sealeze.

B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg, as follows:
   1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
   2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
   3. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.

2.21 THRESHOLDS

A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. National Guard Products, Inc.
      b. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
      c. Rixson Specialty Door Controls; ASSA ABLOY.

2.22 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allegion plc.
      b. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.23 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
   2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as directed by Owner.
   2. Furnish permanent cores to Owner for installation.

E. Key Control System:
   1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
   1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
   1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.3 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.4 DOOR HARDWARE SCHEDULE

Hardware Group No. 01

For use on Door #(s):
312.1 312.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16" F	630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS45(X)	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 02

For use on Door #(s):
108.1 204A.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 03A	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 03

For use on Door #(s):
205A.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 03A	626	SCH
1	EA	OH STOP	100S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 04

For use on Door #(s):
310.4

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 03A	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT	689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 05

For use on Door #(s):
105.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	Exit Lock	L9025 03A	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61	689	LCN
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR WEATHERSTRIP BY DOOR/FRAME MANUFACTURER	✓	

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG.

Hardware Group No. 06

For use on Door #(s):
306.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	Exit Lock	L9025 03A	626	SCH
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61	689	LCN
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER
2	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR WEATHERSTRIP BY DOOR/FRAME MANUFACTURER	✓	

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR CONTACTS MONITOR WHETHER THE DOORS ARE OPENED, CLOSED OR HELD OPEN TOO LONG.

Hardware Group No. 07

For use on Door #(s):
106.1 111.1 221.1 316.1 318A.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/IND	LV9040 03A 09-544 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488S	BK	ZER

Hardware Group No. 08

For use on Door #(s):
216A.1 217A.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PRIVACY LOCK W/IND	LV9040 03A 09-544 L283-722	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP SRI ST-1630 TBSRT	689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S	BK	ZER

Hardware Group No. 09

For use on Door #(s):
103.1 105.1 214.1 307A.1 312A.1 318.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	LV9070BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 10

For use on Door #(s):
312B.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	LV9070BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	OH STOP	100S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 11

For use on Door #(s):
310B.1 310C.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	LV9070BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
2	EA	OH STOP	100S	630	GLY
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 12

For use on Door #(s):
318B.1 407A.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	LV9070BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 13

For use on Door #(s):
218.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	LV9070BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 14

For use on Door #(s):
216.1 217.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	LV9070BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 15

For use on Door #(s):
109.1 115.1 320.1 321.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	LV9080BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 16

For use on Door #(s):
213.1 315.1 322.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	LV9080BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS45(X)	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 17

For use on Door #(s):
308.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	LV9080BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT	689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 18

For use on Door #(s):
306.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	LV9080BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 19

For use on Door #(s):
307.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	LV9080BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	ARMOR PLATE	8400 36" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP/HOLDER	WS45(X)	626	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 20

For use on Door #(s):
311.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	LV9080BDC 03A	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 21

For use on Door #(s):

214.2	219.1	220.1	317.1	318.1	319.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	ELEC CLASSROOM LOCK	AD-300-MS-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES.

Hardware Group No. 22

For use on Door #(s):
407.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	ELEC CLASSROOM LOCK	AD-300-MS-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT		689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488S		BK	ZER
1	EA	DOOR BOTTOM	364AA-Z49		AA	ZER
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES.

Hardware Group No. 23

For use on Door #(s):

112.1	113.1	114.1	202.1	203.1	206.1
207.1	208.1	209.1	210.1	302.1	303.1
304.1	305.1	402.1	403.1	404.1	405.1
406.1					

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	ELEC CLASSROOM LOCK	AD-300-MS-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PUSH-SIDE		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES.

Hardware Group No. 24

For use on Door #(s):
407.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	ELEC CLASSROOM LOCK	AD-300-MS-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PUSH-SIDE		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488S		BK	ZER
1	EA	DOOR BOTTOM	364AA-Z49		AA	ZER
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. FREE EGRESS AT ALL TIMES.

Hardware Group No. 25

For use on Door #(s):
102.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	EU MORTISE LOCK	LV9092BDCEU 03A RX CON	✓	626	SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
1	EA	INTERCOM SYSTEM	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
2	EA	DESK MOUNT BUTTON	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER OR PRESSING DESK MOUNT BUTTON LOCATED AT RECEPTION DESK WILL MOMENTARILY UNLOCK THE ELECTRIFIED TRIM ALLOWING ACCESS. THE REQUEST TO EXIT FEATURE OF THE LOCK TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 26

For use on Door #(s):
102.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	EU MORTISE LOCK	LV9095BDCEU 03A RX CON	✓	626	SCH
2	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PULL-SIDE		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
2	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	PUSH TO ENTER BUTTON	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
2	EA	DESK MOUNT BUTTON	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. UNLOCKED HOURS: DOOR NORMALLY CLOSED AND LOCKED AND PUSH TO ENTER BUTTON ON SCHOOL CORRIDOR SIDE SHALL BE ENABLED VIA ACCESS CONTROL SYSTEM. PRESSING PUSH TO ENTER BUTTON ON SCHOOL CORRIDOR SIDE WILL MOMENTARILY UNLOCK THE ELECTRIFIED TRIM ALLOWING ACCESS FROM SCHOOL CORRIDOR INTO OFFICE. OFFICE SIDE ALWAYS LOCKED PREVENTING FREE PASSAGE FROM OFFICE INTO THE SCHOOL. PRESENTING A VALID CREDENTIAL TO THE READER ON SCHOOL OFFICE SIDE, OR PRESSING DESK MOUNT BUTTON LOCATED AT RECEPTION DESK, WILL MOMENTARILY UNLOCK THE ELECTRIFIED TRIM ALLOWING ACCESS FROM OFFICE INTO SCHOOL.

3. LOCKED HOURS: DOOR NORMALLY CLOSED AND LOCKED AND PUSH TO ENTER BUTTON ON SCHOOL CORRIDOR SIDE SHALL BE DISABLED VIA ACCESS CONTROL SYSTEM, THUS LOCKED IN BOTH DIRECTIONS. PRESENTING A VALID CREDENTIAL TO THE READER ON EITHER SIDE OR PRESSING DESK MOUNT BUTTON LOCATED AT RECEPTION DESK, WILL MOMENTARILY UNLOCK THE ELECTRIFIED TRIM ALLOWING ACCESS.
4. THE REQUEST TO EXIT FEATURE OF THE LOCK TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 27

For use on Door #(s):
107.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	INSTITUTION LOCK	LV9082BDC 03A		626	SCH
2	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	ELECTRIC STRIKE	6211 FSE CON	✓	630	VON
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT		689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM ELECTRIC STRIKE TO POWER SUPPLY	✓		SCH
2	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM. PRESENTING A VALID CREDENTIAL TO EITHER READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS/EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM.

Hardware Group No. 28

For use on Door #(s):
309.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	STOREROOM LOCK	LV9080BD 03A	626	SCH
1	EA	SFIC CONST CORE	80-035 (AS REQ'D)		SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61	689	LCN
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER
2	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR CONTACTS MONITOR WHETHER THE DOORS ARE OPENED, CLOSED OR HELD OPEN TOO LONG.

Hardware Group No. 29

For use on Door #(s):
408.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
2	EA	DUMMY PUSH BAR	350	626	VON
2	EA	DOOR PULL	VR910 DT	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61	689	LCN
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

Hardware Group No. 30

For use on Door #(s):
204.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PUSH-SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 31

For use on Door #(s):
310.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 32

For use on Door #(s):
215.1 215.3

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224HD	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
2	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	MORTISE CYLINDER	1E74 (LESS CORE)	626	BES
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER		BES
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 33

For use on Door #(s):

101.1 101.2 101.4 101.5

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		628	IVE
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	PANIC HARDWARE	LD-9850WDC-EO-SNB		626	VON
1	EA	ELEC PANIC HARDWARE	QEL-9850WDC-NL-CON-SNB - RHRA	✓	626	VON
2	EA	METAL EDGE WRAP	AS REQUIRED			
1	EA	RIM CYLINDER	1E72 (LESS CORE)		626	BES
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
2	EA	SURFACE CLOSER	4040XP EDA TBSRT		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850 (COORDINATE VOLTAGE AS REQ'D)	✓	689	LCN
2	EA	SILENCER	SR64		GRY	IVE
1	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.

   ALL WIRING AND CONDUIT BY ELECTRICAL CONTRACTOR. COORDINATE ALL WIRING AND INSTALLATION WITH ELECTRICAL AND SECURITY CONTRACTORS.

2. DOORS NORMALLY HELD OPEN BY MAGNETIC HOLD OPENS. MAGNETIC HOLD OPENS ARE WIRED TO THE LOCKDOWN SYSTEM. WHEN SYSTEM IS ACTIVATED, THE MAGNETS RELEASE, AND THE DOORS CLOSE AND LOCK. DOORS CAN ALSO BE MANUALLY RELEASED FROM THE MAGNETS.

3. WHEN DOORS ARE CLOSED AND LOCKED, PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY RETRACT THE PANIC DEVICE LATCH ALLOWING ACCESS. DOORS TO REMAIN LOCKED WITH LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES

Hardware Group No. 34

For use on Door #(s):
204.1 205.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	PANIC HARDWARE	LD-98-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993R-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT - PUSH-SIDE		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES.

Hardware Group No. 35

For use on Door #(s):
215.2 215.4 310.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	PANIC HARDWARE	LD-98-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993R-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES

Hardware Group No. 36

For use on Door #(s):
110.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	PANIC HARDWARE	LD-98-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993R-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES.

Hardware Group No. 37

For use on Door #(s):
310.3

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		628	IVE
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
2	EA	PANIC HARDWARE	LD-98-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993R-70-MTK-TLR-B - PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	626	SCE
1	EA	MORTISE CYLINDER	1E74 (LESS CORE)		626	BES
2	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
2	EA	SILENCER	SR64		GRY	IVE
		PIBS/POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		

NOTES:

1. ACCESS CONTROLS CONTRACTOR TO COORDINATE DOOR AND FRAME PREP WITH HARDWARE CONTRACTOR.
2. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
3. LOCKSET IS NORMALLY SECURE. PRESENTING VALID CREDENTIAL TO CARD READER WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY. LOCKDOWN AND DOOR MONITORING FUNCTIONALITY TO BE PROGRAMMED BY THE ACCESS CONTROL CONTRACTOR AND COORDINATED WITH OWNER PRIOR TO INSTALLATION. KEYPAD USED FOR ACCESS DURING LOCKDOWN. FREE EGRESS AT ALL TIMES.

Hardware Group No. 38

For use on Door #(s):
100.4

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-OP-110MD-CON	✓	626	VON
1	EA	RIM CYLINDER	1E72 (LESS CORE)		626	BES
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	DOOR PULL	VR910 NL		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	✓	689	LCN
2	EA	ACTUATOR, JAMB MOUNT	8310-818T	✓	630	LCN
2	EA	SURFACE MOUNT BOX	8310-819S			LCN
1	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
1	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY RETRACT THE PANIC DEVICE LATCH (ALLOWING ACCESS) AND ACTIVATE EXTERIOR AUTO OPERATOR ACTUATOR. PUSHING EXTERIOR AUTO OPERATOR ACTUATOR AT THIS TIME WILL SIGNAL AUTO OPERATOR TO MOMENTARILY OPEN THE DOOR. PUSH INTERIOR ACTUATOR AT ANY TIME WILL MOMENTARILY RETRACT THE PANIC DEVICE LATCH AND SIGNAL AUTO OPERATOR TO MOMENTARILY OPEN THE DOOR.

3. DEVICE IS ALSO CAPABLE OF BEING ELECTRONICALLY DOGGED DOWN FOR CERTAIN TIMES OF THE DAY VIA THE ACCESS CONTROL SYSTEM, THUS IN PUSH/PULL MODE. PUSHING EITHER AUTO OPERATOR ACTUATOR WILL SIGNAL AUTO OPERATOR TO MOMENTARILY OPEN THE DOOR.
4. THE REQUEST TO EXIT FEATURE OF THE DEVICE TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 39

For use on Door #(s):
100.5 100.6

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON	✓	626	VON
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM.
3. DEVICE IS ALSO CAPABLE OF BEING ELECTRONICALLY DOGGED DOWN FOR CERTAIN TIMES OF THE DAY VIA THE ACCESS CONTROL SYSTEM, THUS IN PUSH/PULL MODE.
4. THE REQUEST TO EXIT FEATURE OF THE DEVICE TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 40

For use on Door #(s):
100.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-OP-110MD-CON	✓	626	VON
1	EA	RIM CYLINDER	1E72 (LESS CORE)		626	BES
1	EA	SFIC CONST CORE	80-035 (AS REQ'D)			SCH
1	EA	PERMANENT CORE	CONTRACTOR SUPPLIED - TO BE COMBINATED BY OWNER			BES
1	EA	DOOR PULL	VR910 NL		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	✓	689	LCN
1	EA	WEATHER RING	8310-801			LCN
1	EA	ACTUATOR, JAMB MOUNT	8310-818T	✓	630	LCN
1	EA	SURFACE MOUNT BOX	8310-819S			LCN
1	EA	ACTUATOR, WALL MOUNT	8310-853T	✓	630	LCN
1	EA	SURFACE MOUNT BOX	8310-867S			LCN
1	EA	DOOR SWEEP	8192AA		AA	ZER
1	EA	THRESHOLD	655A		A	ZER
1	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
1	EA	INTERCOM SYSTEM	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY RETRACT THE PANIC DEVICE LATCH (ALLOWING ACCESS) AND ACTIVATE EXTERIOR AUTO OPERATOR ACTUATOR. PUSHING EXTERIOR AUTO OPERATOR ACTUATOR AT THIS TIME WILL SIGNAL AUTO OPERATOR TO MOMENTARILY OPEN THE DOOR. PUSH INTERIOR ACTUATOR AT ANY TIME WILL MOMENTARILY RETRACT THE PANIC DEVICE LATCH AND SIGNAL AUTO OPERATOR TO MOMENTARILY OPEN THE DOOR.
3. DEVICE IS ALSO CAPABLE OF BEING ELECTRONICALLY DOGGED DOWN FOR CERTAIN TIMES OF THE DAY VIA THE ACCESS CONTROL SYSTEM, THUS IN PUSH/PULL MODE. PUSHING EITHER AUTO OPERATOR ACTUATOR WILL SIGNAL AUTO OPERATOR TO MOMENTARILY OPEN THE DOOR.
4. THE REQUEST TO EXIT FEATURE OF THE DEVICE TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 41

For use on Door #(s):
100.2 100.3

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON	✓	626	VON
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	EA	DOOR SWEEP	8192AA		AA	ZER
1	EA	THRESHOLD	655A		A	ZER
1	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
1	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM.
3. DEVICE IS ALSO CAPABLE OF BEING ELECTRONICALLY DOGGED DOWN FOR CERTAIN TIMES OF THE DAY VIA THE ACCESS CONTROL SYSTEM, THUS IN PUSH/PULL MODE.
4. THE REQUEST TO EXIT FEATURE OF THE DEVICE TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOOR TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 42

For use on Door #(s):
408.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	MULLION	FIXED MULLION			
1	EA	ELEC PANIC HARDWARE	RX-98-EO-CON	✓	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON	✓	626	VON
2	EA	DOOR PULL	VR910 DT		630	IVE
2	EA	OH STOP	100S		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61		689	LCN
2	EA	DOOR SWEEP	8192AA		AA	ZER
1	EA	THRESHOLD	655A		A	ZER
2	EA	WIRE HARNESS	CON-XX/XXP (AS REQ'D) - ELECTRIFIED HARDWARE TO POWER TRANSFER (EVALUATE CONDITIONS AND MODIFY WIRE LENGTH AS REQ'D)	✓		SCH
2	EA	WIRE HARNESS	CON-192P - WIRE EXTENSION FROM POWER TRANSFER TO POWER SUPPLY	✓		SCH
1	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
2	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		
			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOORS NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY RETRACT THE PANIC DEVICE LATCH ALLOWING ACCESS. THE REQUEST TO EXIT FEATURE OF THE DEVICE TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACTS MONITOR WHETHER THE DOORS ARE OPENED, CLOSED OR HELD OPEN TOO LONG. DOORS TO REMAIN LOCKED UPON LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 43

For use on Door #(s):
307.2 312.3

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	PANIC HARDWARE	98-EO		626	VON
1	EA	ELECTRIC STRIKE	6300 FSE	✓	630	VON
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	OH STOP & HOLDER	100H		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	EA	DOOR SWEEP	8192AA		AA	ZER
1	EA	THRESHOLD	655A		A	ZER
1	EA	CARD READER	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	MOTION SENSOR	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓		
1	EA	POWER SUPPLY	PROVIDED BY ACCESS CONTROL CONTRACTOR - COORDINATE POWER SUPPLY REQUIREMENTS W/SECURITY PROVIDER	✓		

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. THE MOTION SENSOR TO SHUNT THE ALARM OUTPUT OF THE DOOR CONTACT DURING VALID EGRESS. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG. DOORS TO REMAIN LOCKED WITH LOSS OF POWER OR ACTIVATION OF LOCKDOWN SYSTEM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 44

For use on Door #(s):
101.3 201.1 301.1

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
1	EA	MULLION	FIXED MULLION		
2	EA	PANIC HARDWARE	LD-98-EO	626	VON
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61	689	LCN
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER
2	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR WEATHERSTRIP BY DOOR/FRAME MANUFACTURER	✓	

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR CONTACTS MONITOR WHETHER THE DOORS ARE OPENED, CLOSED OR HELD OPEN TOO LONG.

Hardware Group No. 45

For use on Door #(s):
110.2 205.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	98-EO	626	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61	689	LCN
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR	✓	

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR CONTACT MONITORS WHETHER THE DOOR IS OPENED, CLOSED OR HELD OPEN TOO LONG.

Hardware Group No. 46

For use on Door #(s):
308.2

Each to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	PANIC HARDWARE	LD-9875-EO	626	VON
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61	689	LCN
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER
2	EA	DOOR CONTACT	PROVIDED BY ACCESS CONTROL CONTRACTOR WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

1. OPERATIONAL DESCRIPTION: COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.
2. DOOR CONTACTS MONITOR WHETHER THE DOORS ARE OPENED, CLOSED OR HELD OPEN TOO LONG.

Hardware Group No. 47

For use on Door #(s):
307.3 311.1 311.3

Each to have:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
		HARDWARE BY DOOR MANUFACTURER		

END OF SECTION 087100

SECTION 087113 - POWER DOOR OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low-energy door operators for swinging doors.

1.2 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For power door operators.
   1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of power door operators that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASSA ABLOY Entrance Systems; ASSA ABLOY.
   2. Horton Automatics; Overhead Door Corporation.
   3. LCN; Allegion plc.
   4. SARGENT Manufacturing Company; ASSA ABLOY.
   5. STANLEY Access Technologies LLC; STANLEY Security Solutions, Inc.

2.2 POWER DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
   1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to power door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
   2. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of indicated on drawings.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

C. Electrohydraulic Operating System: Self-contained, low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

D. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch-thick, extruded or formed aluminum and extending full width of door opening, including door jambs, to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

E. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch-thick, extruded or formed aluminum; continuous over full width of operator-controlled door opening; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

F. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

G. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.19.

B. Performance Requirements:
   1. Opening Force if Power Fails: Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
   2. Entrapment-Prevention Force: Not more than 15 lbf required to prevent stopped door from closing or opening.

C. Configuration: Operator to control single swinging door.
   1. Traffic Pattern: One way.
   2. Operator Mounting: Surface.

D. Operation: Power opening and power-assisted spring closing. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

E. Operating System: Electromechanical.

F. Microprocessor Control Unit: Solid-state controller.

G. Features:
   1. Adjustable opening and closing speed.
   2. Adjustable opening and closing force.
   3. Adjustable backcheck.
   4. Adjustable hold-open time from zero to 30 seconds.
   5. Adjustable time delay.
   6. Adjustable acceleration.
   7. Obstruction recycle.
   8. On-off/hold-open switch to control electric power to operator.

H. Activation Device: Touchless switch on each side of door to activate door operator.

I. Exposed Finish: Finish matching door and frame.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extrusions: ASTM B221.
   2. Sheet: ASTM B209.

B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.5 CONTROLS

A. General: Provide controls in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate devices with door operation and door operator mechanisms.

B. Touchless Switch: Hands-free activation door-control switch with flat motion sensor face-plate with contrasting-colored, engraved message.
   1. Configuration: 1.68-by-4.56-inch jamb-style face plate.
      a. Mounting: As indicated on Drawings.
   2. Face-Plate Material: Stainless steel with backlight acrylic window.
   3. Message: International symbol of accessibility and "Wave to Open" and wave symbol.

C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.6 ACCESSORIES

A. Signage: As required by cited BHMA standard for type of door and its operation.
   1. Application Process: Decals.
   2. Provide sign materials with instructions for field application when operators are installed.

2.7 FABRICATION

A. Factory fabricate power door operators to comply with indicated standards.

B. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.

C. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install power door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.

B. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.

C. Controls: Install devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel.

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

E. Adjusting: Adjust power door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
   1. Adjust operators on exterior doors for tight closure.
   2. Readjust power door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

F. Demonstration: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power door operators.

END OF SECTION 087113

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Glass products.
2. Laminated glass.
3. Insulating glass.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

B. Product test reports.

C. Preconstruction adhesion and compatibility test report.

D. Sample warranties.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
   1. Design Wind Pressures: As indicated on Drawings.
   2. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
   2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
   3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

E. Acoustic Performance:
   1. Exterior Glazing: 35 OITC for laminated insulated glass.

2.2 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
   2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum.[Provide glass that complies with performance requirements and is not less than thickness indicated.]

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass LLC; SunGuard SN 68 or a comparable product by one of the following:
      a. Cardinal Glass Industries, Inc.
      b. Pilkington North America; NSG Group.
      c. Vitro Architectural Glass.

D. Silicone-Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. OldCastle BuildingEnvelope (OBE).

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Pilkington North America; NSG Group.

   2. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   4. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Perimeter Spacer: Polypropylene-covered stainless steel in color selected by Architect.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Saint-Gobain Glass Corp.
         2) Technoform Glass Insulation North America.
         3) Thermix; a brand of Ensinger USA.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:
   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Sika Corporation.
      d. The Dow Chemical Company.
      e. Tremco Incorporated.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks:
   1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
   2. Type recommended in writing by sealant or glass manufacturer.

C. Spacers:
   1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
   2. Type recommended in writing by sealant or glass manufacturer.

D. Edge Blocks:
   1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
   2. Type recommended in writing by sealant or glass manufacturer.

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

3.2 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.3 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.4 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
   1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.5 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type: Heat-strengthened float glass.
   1. Minimum Thickness: 6 mm.
   2. Safety glazing required.

3.6 LAMINATED GLASS SCHEDULE

A. Clear Laminated Glass Type: Two plies of fully tempered float glass.
   1. Minimum Thickness of Each Glass Ply: 4 mm.
   2. Interlayer Thickness: 0.030 inch.

3. Install in all glazed openings in doors, sidelights, and borrowed lights in gymnasium.

3.7 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Tinted Insulating Glass Type:
1. Basis-of-Design Product: Guardian SN 68 on CrystalGray
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted heat-strengthened float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Clear heat-strengthened float glass.
7. Low-E Coating: Pyrolytic on second surface.
8. Safety glazing required.

B. Silicone-Coated, Low-E, Insulating Spandrel Glass Type:
1. Basis-of-Design Product: Guardian SN68 on CrystalGray.
2. Coating Color: As selected by Architect from manufacturer's full range.
3. Overall Unit Thickness: 1 inch.
4. Minimum Thickness of Each Glass Lite: 6 mm.
5. Outdoor Lite: Clear heat-strengthened float glass.
6. Interspace Content: Argon.
7. Indoor Lite: Clear heat-strengthened float glass.
8. Low-E Coating: Pyrolytic on second surface.
9. Opaque Coating Location: Fourth surface.

3.8 INSULATING-LAMINATED-GLASS SCHEDULE

A. Low-E-Coated, Tinted, Insulating Laminated Glass Type:
1. Basis-of-Design Product: Guardian SN68 on CrystalGray.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Outdoor Lite: 6 mm.
4. Outdoor Lite: Tinted heat-strengthened float glass.
5. Tint Color: Gray.
6. Interspace Content: Argon.
7. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
   a. Minimum Thickness of Each Glass Ply: 3 mm.
   b. Interlayer Thickness: 0.060 inch.
8. Low-E Coating: Pyrolytic on second surface.
9. Safety glazing required.

END OF SECTION 088000

SECTION 088716 - SAFETY AND SECURITY WINDOW FILM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Safety and security window film.

B. Film attachment systems.

1.2 REFERENCES

A. Underwriters Laboratories Inc. (UL):
   1. UL 972 - Burglary Resisting Glazing Material.

1.3 SUBMITTALS

A. Product Data: Manufacturer's current technical literature on each product to be used, including:
   1. Manufacturer's Data Sheets.
   2. Preparation instructions and recommendations.
   3. Installation methods.

B. Verification Samples: For each film specified, two samples representing actual film color and pattern.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
   1. Provide documentation that the adhesive used on the specified film is a Pressure Sensitive Adhesive (PSA).

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film and/or film attachment system.
      e. Amount of film and/or film attachment system installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.

4. Provide an EFilm application analysis to determine available energy cost reduction and savings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Follow Manufacturer's instructions for storage and handling.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of any hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.7 WARRANTY

A. At project closeout, provide to Owner's Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.1 CLEAR MICROLAYERED SAFETY AND SECURITY WINDOW FILM

A. 3M Scotchshield Ultra S800 Safety and Security Window Film. Optically clear microlayered polyester film, nominally 8 mils (0.008 inch) thick, with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film is clear and does not contain dyed polyester. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film is microlayered with both plastic and ductile polyester layers for tear resistance.

2.2 IMPACT PROTECTION FILM ATTACHMENT SYSTEMS

A. 3M Impact Protection Attachment Sealant (IPA): Weatherable, UV-resistant, moisture curable structural sealant wet glaze.
   1. Color:
      a. Black.
   2. Material Properties (as supplied):
      a. Typical Cure Time: 3 - 7 days (25 degrees C, 50% RH).
      b. Full Adhesion: 7 - 14 days.
      c. Tack-Free Time (ASTM D 5895): 21 minutes (25 degrees C, 50% RH).
      d. Flow, Sag or Slump (ASTM D 2202): 0 inches.
      e. Specific Gravity: 1.4.

f. Working Time: 10 - 20 minutes (25 degrees C, 50% RH).
g. VOC Content: 16 g / L.

3. Material Properties (as cured - 21 days at 25 degrees C, 50% RH):
   a. Ultimate Tensile Strength (ASTM D412): 380 psi (2.62 MPa).
   b. Ultimate Elongation (ASTM D412): 640 psi.
   c. Durometer Hardness, Shore A (ASTM D2240): 38-39 points.
   d. Tear Strength, Die B (ASTM D624): 72 ppi.
4. Uniformity: Product shall have uniform consistency and appearance, with no clumping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Film Examination:
   1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   2. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
   3. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
   4. Commencement of installation constitutes acceptance of conditions.

B. Impact Protection Attachment Sealant Examination:
   1. If application of window film is/was the responsibility of another installer, notification in writing shall be made of deviations from manufacturer's recommended installation tolerances and conditions.
   2. Filmed glass surfaces receiving new attachment should first be examined to verify that they are free from defects and imperfections, and that the film edges extend sufficiently to the frame edges.
   3. Do not proceed with installation until film and frame surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
   4. Conduct an adhesion test to the frame surface may be conducted by applying a 4 – 6 inch long bead, approximately 0.5 - 1 inch in width, masking one side of the frame surface underneath the strip with tape. Allow the Impact Protection Attachment Sealant to cure for 7 days and test adhesion by pulling up on the masked end and a 90 degree angle. If cohesive failure is observed (adhesive residue left behind on the frame surface), adhesion is acceptable; if adhesive failure is observed (clean peel from the frame), adhesion is unacceptable and product is not recommended.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Attachment Sealant film attachment systems.

3.3 INSTALLATION

A. Film Installation:
   1. Install in accordance with manufacturer's instructions.
   2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
   3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
   4. Apply film to glass and lightly spray film with slip solution.
   5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
   6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
   7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

B. Impact Protection Attachment Sealant Installation:
   1. The film attachment system shall be applied according to the specifications of the Manufacturer by an Authorized Dealer/Applicator. Refer to 3M publication, 70-0709-0322-7, 3M Impact Protection Attachment Sealant Attachment System Installation Instructions.
      a. For blast hazard mitigation: minimum 1/2 inch bead overlap on both frame and film (excluding glazing stops or compression gaskets).
      b. For impact resistance and building envelope protection: minimum 3/8 inch bead overlap on both frame and film (excluding glazing stops or compression gaskets).
   2. To ensure a straight and consistent bead width is achieved, masking tape may be applied to film and frame surfaces prior to application.
   3. With prior approval of the building owner or property manager, existing compression gaskets may be partially removed or trimmed to allow for a thinner bead and stronger anchorage. If removing the gaskets, sections shall be trimmed approximately 3 inches in length and inserted with appropriate spacing along all sides of the window to help secure the glazing during application and curing of the Impact Protection Attachment Sealant.
   4. The Impact Protection Attachment Sealant shall be dispensed with a caulk gun with nozzle opening diameter sized to match the approximate size of the desired bead width.
   5. A plastic putty knife or other tool with a clean straight edge shall be used to trowel and smooth out the adhesive. The completed adhesive bead shall be relatively triangular in shape.
   6. Any masking tape used shall be carefully removed within 10 minutes after applying the wet glaze.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION 088716

SECTION 088813 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-protection-rated glazing.

1.2 DEFINITIONS

A. Fire-Protection-Rated Glazing: Glazing that prevents spread of fire and smoke and complies with requirements for rated openings; incapable of blocking radiant heat

B. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

C. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumenscent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Glass: For each glass type, obtain from single source from single manufacturer.

B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Low-Iron Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.

C. Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
   2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

2.5 FIRE-PROTECTION-RATED GLAZING

A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing in accordance with NFPA 257 or UL 9, including hose-stream test, and shall comply with NFPA 80.
   1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from hose-stream test.

B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether glazing has passed hose-stream test; whether glazing meets 450 deg F temperature-rise limitation; and fire-resistance rating in minutes.

C. Fire-Protection-Rated Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; complying with 16 CFR 1201, Category II.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Technical Glass Products; an Allegion brand; FireLite Plus®.

2.6 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. The Dow Chemical Company.
      c. Tremco Incorporated.
   2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

C. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
   2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

D. Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
   1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088813

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fixed extruded-aluminum louvers.
   2. Blank-off panels for louvers

B. Related Requirements:
   1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
   1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
   2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
   1. Wind Loads:
      a. Determine loads based on pressures as indicated on Drawings.

B. Seismic Performance:
   1. As indicated on Drawings.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Wind-Driven-Rain-Resistant Louver, Extruded Aluminum:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Airline Louvers; Mestek, Inc.
      b. Airolite Company, LLC (The).
      c. Architectural Louvers Co.; Harray, LLC.
      d. Construction Specialties, Inc.
      e. Greenheck Fan Corporation.
      f. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
   2. Louver Depth: 4 inches.
   3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
   4. Louver Performance Ratings:
      a. Free Area: Not less than 7.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
      b. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area intake velocity.
      c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 400 fpm.
   5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
   1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:
   1. Insect Screening, Stainless Steel: 18-by-18 mesh, 0.009-inch wire.

2.5 BLANK-OFF PANELS

A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
   1. Thickness: 1 inch.
   2. Metal Facing Sheets, Aluminum: Not less than 0.032-inch nominal thickness.
   3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam Insert insulation material.
   4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
   5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
   6. Panel Finish: Same type of finish applied to louvers, but black color.
   7. Attach blank-off panels with clips.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.
   1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
   2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
   3. For color-finished louvers, use fasteners with heads that match color of louvers.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
   1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
   1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
   2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
   3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
   4. Exterior Corners: Prefabricated corner units with mitered blades with concealed close-fitting splices and with fully recessed mullions at corners.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
   1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color and Gloss: Match custom aluminum door frame color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
   1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Framing systems.
   2. Suspension systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
   1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless otherwise indicated
   2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
      a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

C. Studs and Track: AISI S220 and ASTM C645, Section 10.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ClarkDietrich.
      b. Jaimes Industries.
      c. MRI Steel Framing, LLC.

d. Marino\WARE.
e. SCAFCO Steel Stud Company; Stone Group of Companies.
f. Steel Network, Inc. (The).
g. Telling Industries.

2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
3. Depth: As indicated on Drawings.

D. High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. Marino\WARE.
c. Phillips Manufacturing Co.
d. SCAFCO Steel Stud Company; Stone Group of Companies.
e. Steel Construction Systems; Stone Group of Companies.
f. Telling Industries.
2. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.
3. Depth: As indicated on Drawings.

E. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 2-inch minimum vertical movement.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) ClarkDietrich.
2) Fire Trak Corp.
3) Marino\WARE.
4) SCAFCO Steel Stud Company; Stone Group of Companies.
5) Steel Network, Inc. (The).
6) Super Stud Building Products Inc.
2. Single Long-Leg Track System: Top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
3. Double-Track System: Top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) ClarkDietrich.
2) MRI Steel Framing, LLC.

3) Marino\WARE.
4) Metal-Lite.
5) SCAFCO Steel Stud Company; Stone Group of Companies.
6) Steel Network, Inc. (The).
7) Telling Industries.

F. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. Marino\WARE.
c. SCAFCO Steel Stud Company; Stone Group of Companies.
d. Steel Network, Inc. (The).

G. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. MBA Building Supplies.
c. MRI Steel Framing, LLC.
d. Marino\WARE.
e. SCAFCO Steel Stud Company; Stone Group of Companies.
f. Steel Network, Inc. (The).
2. Minimum Base-Steel Thickness: 0.0179 inch.

H. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. MBA Building Supplies.
c. MRI Steel Framing, LLC.
d. Marino\WARE.
e. SCAFCO Steel Stud Company; Stone Group of Companies.
f. Steel Construction Systems; Stone Group of Companies.
2. Depth: 1-1/2 inches.
3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

I. Hat-Shaped, Rigid Furring Channels:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. Jaimes Industries.
c. MBA Metal Framing.

d. Marino\WARE.
e. SCAFCO Steel Stud Company; Stone Group of Companies.
2. Minimum Base-Steel Thickness: 0.0179 inch.
3. Depth: As indicated on Drawings.

J. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. MRI Steel Framing, LLC.
c. Marino\WARE.
d. Steel Construction Systems; Stone Group of Companies.
2. Configuration: Asymmetrical.

K. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

L. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. MBA Metal Framing.
c. MRI Steel Framing, LLC.
d. Marino\WARE.
e. SCAFCO Steel Stud Company; Stone Group of Companies.
f. Steel Network, Inc. (The).

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
a. Uses: Securing hangers to structure.
b. Type: Torque-controlled, expansion anchor.
c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
   1. Depth: 2-1/2 inches.

F. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
   2. Steel Studs and Tracks: Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
      a. Minimum Base-Steel Thickness: 0.0190 inch.
      b. Depth: As indicated on Drawings.
   3. High-Strength Steel Studs and Tracks:
      a. Minimum Base-Steel Thickness: 0.0180 inch.
      b. Depth: As indicated on Drawings.
   4. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.
      a. Minimum Base-Steel Thickness: 0.0179 inch.
   5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
      a. Configuration: Asymmetrical.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
   1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
   2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:
   1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
   2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
   3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 INSTALLATION OF SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

3.4 FIELD QUALITY CONTROL

A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Exterior gypsum board for ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product data.

B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested in accordance with ASTM C1629/C1629M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed; SAINT-GOBAIN.
      b. Georgia-Pacific Gypsum LLC.
      c. Gold Bond Building Products, LLC provided by National Gypsum Company.
      d. USG Corporation.
   2. Core: 5/8 inch, Type X.
   3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
   4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.

5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. USG Corporation.
2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company.
2. Core: As indicated on Drawings.

B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company.
   d. USG Corporation.
2. Core: As indicated on Drawings.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.

c. L-Bead: L-shaped; exposed long flange receives joint compound.
d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
e. Expansion (control) joint.

B. Exterior Trim: ASTM C1047.
1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
2. Shapes:
a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:
1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
   1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.2 FINISHING OF GYPSUM BOARD

A. Prefill open joints and damaged surface areas.

B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

C. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: Where indicated on Drawings.

4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
5. Level 5: Where indicated on Drawings.
   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

D. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ceramic mosaic tile.
   2. Porcelain tile.
   3. Waterproof membranes.
   4. Crack isolation membranes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:
   1. Each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer is a Five-Star member of the National Tile Contractors Association.
   2. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of membranes and large format tile.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Factory-Mounted Mosaic Ceramic Tile Type: .
   1. Tile Color and Pattern: Match Architect's sample.
   2. Grout Color: Match Architect's sample.
   3. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
      a. Base Cove: Cove, module size 1 by 1 inch.
      b. Base Cap: Bead (bullnose), module size 1 by 1 inch.
      c. External Corners for Thinset Mortar Installations: Bead (bullnose), module size 1 by 1 inch.
      d. Internal Corners: Cove, module size 1 by 1 inch.
      e. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Porcelain Tile Type:
   1. Tile Color, Glaze, and Pattern: Match Architect's sample.
   2. Grout Color: Match Architect's sample.

2.3 WATERPROOF MEMBRANES

A. Waterproof Membrane, Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Schluter Systems L.P; KERDI.

2.4 CRACK ISOLATION MEMBRANES

A. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Schluter Systems L.P; DITRA.

2.5 SETTING MATERIALS

A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. H.B. Fuller Construction Products Inc. / TEC.
      b. LATICRETE SUPERCAP, LLC.
      c. MAPEI Corporation.

2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. For wall applications, provide nonsagging mortar.

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High-Performance Tile Grout: ANSI A118.7.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ARDEX Americas.
   b. Custom Building Products.
   c. H.B. Fuller Construction Products Inc. / TEC.
   d. Laticrete International, Inc.
   e. MAPEI Corporation.
2. Polymer Type:
   a. Dry, redispersible form, prepackaged with other dry ingredients.

C. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ARDEX Americas.
   b. H.B. Fuller Construction Products Inc. / TEC.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.

D. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless steel, ASTM A276/A276M or ASTM A666, 300 Series exposed-edge material.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Schluter Systems L.P.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
      a. Tile floors in wet areas.
      b. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Ceramic Mosaic Tile: 1/16 inch.
   2. Porcelain Tile: 1/8 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Metal Edge Strips: Install at locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

K. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

L. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:
   1. TCNA F125-Full: Thinset mortar on crack isolation membrane.
      a. Thinset Mortar: Improved modified dry-set mortar.
      b. Grout: High-performance unsanded grout.

B. Interior Wall Installations, Masonry or Concrete:
   1. TCNA W202: Thinset mortar.
      a. Thinset Mortar: Improved modified dry-set mortar.
      b. Grout: High-performance sanded or Water-cleanable epoxy grout.

C. Interior Wall Installations, Wood or Metal Studs or Furring:
   1. TCNA W243: Thinset mortar on gypsum board.
      a. Thinset Mortar: Improved modified dry-set mortar.
      b. Grout: High-performance sanded grout.

D. Shower Receptor and Wall Installations:
   1. TCNA B421: Thinset mortar on waterproof membrane over solid backing.
      a. Thinset Mortar: mortar.
      b. Grout: High-performance sanded grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical panels.
   2. Metal suspension system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Class A in accordance with ASTM E1264.
   2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong Ceiling & Wall Solutions.
   2. CertainTeed; SAINT-GOBAIN.
   3. USG Corporation.

B. Acoustical Panel Standard: Manufacturer's standard panels in accordance with ASTM E1264.

C. Color: White.

D. Edge/Joint Detail: Square.

E. Thickness: 3/4 inch.

F. Modular Size: 24 by 24 inches.

2.3 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong Ceiling & Wall Solutions.
   2. CertainTeed; SAINT-GOBAIN.
   3. USG Corporation.

B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
   1. Structural Classification: Heavy-duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   3. Face Design: Flat, flush.
   4. Cap Material: Cold-rolled steel.
      a. Use Aluminum for grid in servery and kitchen spaces.
   5. Cap Finish: Painted white.

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

3. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.
   b. Install panels with pattern running in one direction parallel to short axis of space.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Thermoset-rubber base.
   2. Thermoplastic-rubber base.
   3. Rubber stair accessories.
   4. Rubber molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexco Corporation.
   2. Johnsonite; a Tarkett company.
   3. Roppe Corporation; Roppe Holding Company.

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
   1. Style and Location:
      a. Style B, Cove.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Colors: Match Architect's sample.

2.2 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Roppe Corporation; Roppe Holding Company.
   2. VPI Corporation.

B. Description: Rubber stair-tread nosing, reducer strip for resilient floor covering, transition strips.

C. Profile and Dimensions: As indicated.

D. Locations: Provide rubber molding accessories in areas indicated.

E. Colors and Patterns: [As indicated by manufacturer's designations] [Match Architect's sample] <Insert colors and patterns>.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
   1. Verify adhesives have a VOC content of 50 g/L or less and 60 g/L or less for rubber stair treads.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Cope corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. Tightly adhere to substrates throughout length of each piece.
   3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Unbacked vinyl sheet flooring.
   2. Vinyl sheet flooring with backing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color, texture, and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 UNBACKED VINYL SHEET FLOORING

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Protect-All Commercial Flooring as manufactured by Oscoda Plastics.

B. Product Standard: ASTM F1913.

C. Thickness: 0.250 inch.

D. Wearing Surface: Smooth.

E. Sheet Width: 5 feet.

F. Seamless-Installation Method: Heat welded.

G. Colors and Patterns: Match Architect's samples.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

C. Seamless-Installation Accessories:
   1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
      a. Colors: Match flooring.

D. Integral-Flash-Cove-Base Accessories:
   1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
   2. Cap Strip: Square metal cap provided or approved by resilient sheet flooring manufacturer.
   3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.
   1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.2 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:
   1. Maintain uniformity of flooring direction.
   2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
   3. Match edges of flooring for color shading at seams.
   4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:
   1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
   1. Install metal corners at inside and outside corners.

END OF SECTION 096516

SECTION 096543 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Linoleum sheet flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for flooring installation and seaming methods indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LINOLEUM SHEET FLOORING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Forbo Flooring Systems.
   2. Johnsonite; a Tarkett company.

B. Linoleum Sheet Flooring: ASTM F2034, Type I, linoleum sheet with backing.
   1. Roll Size: In manufacturer's standard length, but not less than 78 inches wide.

C. Thickness: 0.10 inch.

D. Heat-Welding Bead: For seamless installation, solid-strand product of linoleum flooring manufacturer.
   1. Colors: Match linoleum flooring.

E. Colors and Patterns: Match Architect's sample.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.
   1. Verify adhesives have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
   4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
      a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install flooring until materials are the same temperature as space where they are to be installed.
   1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for installing flooring.

B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

E. Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

G. Heat-Welded Seams: For seamless installation, comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.3 LINOLEUM SHEET FLOORING INSTALLATION

A. Unroll linoleum sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out linoleum sheet flooring as follows:
   1. Maintain uniformity of flooring direction.
   2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
   3. Match edges of flooring for color shading at seams.
   4. Avoid cross seams.
   5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

3.4 CLEANING AND PROTECTION

A. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

END OF SECTION 096543

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sheet vinyl flooring.

1.2 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details and locations of the following:
   1. Border tiles.
   2. Floor patterns.
   3. Layout, colors, widths, and dimensions of game lines and markers.
   4. Locations of floor inserts for athletic equipment installed through flooring.
   5. Seam locations for sheet flooring.

C. Samples: For each exposed product and for each type, color, and pattern specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Sheet Vinyl Flooring Installer Qualifications: An experienced installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOORING

A. Products: Subject to compliance with requirements, provide the following:
   1. Gerflor USA; Sport M Plus Dry-Tex.

B. Description: Sheet vinyl flooring specifically designed for adhered athletic flooring applications.

C. Seaming Method: Chemically bonded.

D. Applied Finish: Factory-applied UV urethane.

E. Roll Size: Not less than 48 inches wide by longest length that is practical to minimize splicing during installation.

F. Color and Pattern: As indicated by manufacturer's designations.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
   1. Verify adhesives have a VOC content of 50 g/L or less.

C. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.
   1. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Alkalinity Testing: Perform pH testing according to ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
   3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
      a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.3 SHEET FLOORING INSTALLATION

A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out sheet flooring as follows:
   1. Maintain uniformity of flooring direction.
   2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
   3. Match edges of flooring for color shading at seams.
   4. Locate seams according to approved Shop Drawings.

C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
   1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.
   1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.

2. Chemically Bonded Seams: Comply with ASTM F693. Seal seams to prevent openings from forming between cut edges and to prevent penetration of dirt, liquids, and other substances into seams.

3.4 GAME LINES AND MARKERS

A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

B. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.

3.5 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing flooring installation:
   1. Remove adhesive and other blemishes from flooring surfaces.
   2. Sweep and vacuum flooring thoroughly.
   3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
   1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Modular carpet tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.5 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.
   2. Warranty Period: Lifetime from date of Substantial Completion for Kinetix.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Color: Match Architect's samples.

B. Pattern: Match Architect's samples.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Applied Treatments:
   1. Soil-Resistance Treatment: Manufacturer's standard treatment.
   2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
      a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

3. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
4. Colorfastness to Light: Not less than 4 after 400 SFU (AATCC fading units) according to AATCC 16, Option E.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
   1. Verify adhesives have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:
   1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
      a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
      c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8-inch-wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 098400 - CEMENTITIOUS WOOD FIBER WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cementitious wood fiber plank acoustical wall system

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   2. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
   3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
   4. ASTM E 1264 Classification for Acoustical Ceiling Products

1.3 SYSTEM DESCRIPTION

A. Direct attached wall acoustical systems manufactured from cementitious wood fiber.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of Tectum® DesignArt acoustical wall unit required.

B. Shop Drawings: Layout and details of Tectum® DesignArt show locations of items that are to be coordinated.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical wall components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. Coordination of Work: Coordinate panels with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE & HANDLING

A. Deliver acoustical wall units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Provide labels indicating brand name, style, size and thickness.

C. Before installing acoustical wall units, permit them to reach room temperature and a stabilized moisture content.

D. Handle acoustical wall units carefully to avoid chipping edges or damaged units in any way.

1.7 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

B. Do not install wall panels until building is closed in and HVAC system is operational.

C. Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.

D. Maintain the following conditions in areas where acoustical materials are to be installed 24 hours before, during and after installation:
   1. Relative Humidity: 65 - 75%.
   2. Uniform Temperature: 55 - 70 degrees F (13 - 21 degrees C).

1.8 WARRANTY

A. Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
   1. Defects in materials or factory workmanship.

B. Warranty Period: Thirty (30) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

A. Tectum DesignArt Custom Wall Panels:

2.2 ACOUSTICAL WALL UNITS

A. Acoustical Panels Type AP-1:
   1. Surface Texture: Coarse
   2. Composition: Aspen wood fibers bonded with inorganic hydraulic cement
   3. Color: Natural
   4. Size: 24x24”
   5. Thickness: 2”
   6. Edge Profile: Square
   7. Shape: Bands, Rings, and Circle as indicated
   8. Flame Spread: ASTM E 1264; (Fire Class A)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer’s printed recommendations.

3.2 PREPARATION

A. Measure each wall area and establish layout of Tectum® DesignArt units. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install system in accordance manufacturer’s installation instructions. Follow the requirements of the International Building Code and in accordance with the local building code and the authorities having jurisdiction.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Comply with manufacturer’s instructions for cleaning and touch up of minor finish damage. Remove any products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION 098400

SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, sound-absorbing acoustical panel units tested for acoustical performance.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For unit assembly and installation.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Conwed; Respond A
   2. Jasco; Quiet Touch
   3. Sound Seal; S-2000

4. Golterman & Sabo; Acousti-Panel
   a. Core-Face Layer: Manufacturer's standard impact-resistant, acoustically transparent, copolymer sheet.
5. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
6. Edge Profile: Square.
7. Corner Detail in Elevation: Square with continuous edge profile indicated.
8. Reveals between Panels: Flush reveals.
9. Facing Material: As indicated on Drawings.
10. Acoustical Performance: Sound absorption NRC of not less than 0.90 according to ASTM C423 for Type A mounting according to ASTM E795.
11. Nominal Overall Panel Thickness: 2 inches.

2.3 MATERIALS

A. Core Materials: Manufacturer's standard.
   1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
   2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively, and with perforated surface.
   3. Impact-Resistant, Acoustically Transparent, Copolymer Sheet for Face Layer: 1/16- to 1/8-inch-thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.
   4. Wood and Plywood: Manufacturer's standard plywood or clear, vertical grain, straight, kiln-dried hardwood.
      a. Fire-retardant treated by pressure process with a flame-spread index of 25 or less when tested according to ASTM E84 or UL 723, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
         1) Treated material shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity.
         2) Kiln-dry material after treatment to 19 percent or less for lumber and 15 percent or less for plywood.

B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
   1. Applied Treatments: Stain resistance.

C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit.

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
   1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.2 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Surface preparation and application of paint systems on exterior substrates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of topcoat product.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
   2. PPG Paints; PPG Industries, Inc.
   3. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
   4. Valspar; a brand of The Sherwin-Williams Company.

2.2 PAINT PRODUCTS

A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "MPI Approved Products List."

B. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 50 g/L.
   3. Dry-Fog Coatings: 150 g/L.
   4. Primers, Sealers, and Undercoaters: 100 g/L.
   5. Rust-Preventive Coatings: 100 g/L.
   6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Shellacs, Clear: 730 g/L.
   9. Shellacs, Pigmented: 550 g/L.

D. Colors: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

B. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. CMU Substrates:
   1. Latex System:
      a. Prime Coat: Block filler, latex, interior/exterior.
      b. Intermediate Coat: Latex, exterior, matching topcoat.
      c. Semigloss Topcoat: Latex, exterior, semigloss (MPI Gloss Level 5).

B. Steel and Iron Substrates:
   1. Alkyd System:
      a. Alkyd Prime Coat: Primer, alkyd, anticorrosive, for metal.
      b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
      c. Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5).

C. Galvanized-Metal Substrates:
   1. Latex System:
      a. Water-Based Prime Coat: Primer, galvanized, water based.
      b. Intermediate Coat: Latex, exterior, matching topcoat.
      c. Semigloss Topcoat: Latex, exterior, semigloss (MPI Gloss Level 5).

END OF SECTION 099114

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of topcoat product.

C. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
   2. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
   3. The Sherwin-Williams Company
   4. Valspar; a brand of The Sherwin-Williams Company.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Dry-Fog Coatings: 400 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.
   5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
   6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Shellacs, Clear: 730 g/L.
   9. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Verify interior paints and coatings comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

B. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

C. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

C. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Paint the following work where exposed in equipment rooms:
      a. Tanks that do not have factory-applied final finishes.
   2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:
   1. Latex System:
      a. Block Filler: Block filler, latex, interior/exterior.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior (MPI Gloss Level 3).

B. Steel Substrates:
   1. Latex System, Alkyd Primer:
      a. Prime Coat: Primer, alkyd, quick dry, for metal.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior, semigloss (MPI Gloss Level 5).
   2. Alkyd, Dry-Fall System, MPI INT 5.1D:
      a. Prime Coat: Primer, alkyd, quick dry, for metal.
      b. Topcoat: Dry fall, alkyd, flat.

C. Galvanized-Metal Substrates:
   1. Latex System:
      a. Prime Coat: Primer, galvanized, water based.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior, semigloss (MPI Gloss Level 5).

D. Aluminum (Not Anodized or Otherwise Coated) Substrates:
   1. Latex System:
      a. Prime Coat: Primer, quick dry, for aluminum.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior, semigloss (MPI Gloss Level 5).

E. Gypsum Board Substrates:
   1. Latex over Latex Sealer System:
      a. Prime Coat: Primer sealer, latex, interior.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior (MPI Gloss Level 3).

F. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.
   1. Latex System:
      a. Prime Coat: Primer sealer, latex, interior.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior, flat (MPI Gloss Level 1).

END OF SECTION 099124

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood stains.
   2. Transparent finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of finish system and in each color and gloss of finish required.

C. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
   2. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
   3. PPG Paints; PPG Industries, Inc.
   4. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
   5. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

A. Material Compatibility:
   1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Clear Wood Finishes, Varnishes: 350 g/L.
   2. Clear Wood Finishes, Lacquers: 550 g/L.
   3. Shellacs, Clear: 730 g/L.
   4. Stains: 250 g/L.

C. Low-Emitting Materials: Verify interior paints and coatings comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 WOOD STAINS

A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. PPG Paints; PPG Industries, Inc.
      b. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
      c. Sherwin-Williams Company (The).

2.4 TRANSPARENT FINISHES

A. Varnish, Interior, Flat/Satin: Solvent-based, alkyd-type, clear flat/satin varnish for new or properly prepared, previously varnished interior wood surfaces.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Sherwin-Williams Company (The).
   2. Gloss and Sheen Level: Manufacturer's standard flat finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

B. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
   1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
   1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
   2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction:
   1. Polyurethane Varnish over Stain System:
      a. Stain Coat: Stain, semitransparent, for interior wood.
      b. First Intermediate Coat: Polyurethane varnish matching topcoat.
      c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
      d. Topcoat: Varnish, interior, polyurethane, oil modified, flat.

B. Wood Substrates, Wood Paneling and Trim (Reading Nooks):
   1. Polyurethane Varnish over Stain System:
      a. Stain Coat: Stain, semitransparent, for interior wood.
      b. First Intermediate Coat: Polyurethane varnish matching topcoat.
      c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
      d. Topcoat: Varnish, interior, polyurethane, oil modified, satin.

END OF SECTION 099300

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Visual display board assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For visual display units.
   1. Include plans, elevations, sections, details, and attachment to other work.
   2. Show locations of panel joints

C. Product Schedule: For visual display units.

1.3 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. 50 years from date of Substantial Completion.
      b. Life of the building.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ADP Lemco.
   2. ASI Visual Display Products.
   3. Bangor Cork.
   4. CIG JAN Products, Ltd.
   5. Claridge Products and Equipment, Inc.
   6. Marsh Industries, Inc.
   7. PolyVision Corporation.

8. ghent; a GMi Company.

B. Visual Display Board Assembly: factory fabricated.
1. Assembly: markerboard.
2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
1. Color: White.

D. Tackboard Panel: Plastic-impregnated-cork tackboard panel on core indicated.
1. Color and Pattern: As indicated by manufacturer's designations.

E. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; slim size and standard shape.
1. Aluminum Finish: Clear anodic finish.

F. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.

G. Combination Assemblies: Provide hidden spline between abutting sections of visual display panels.

H. Chalktray: Manufacturer's standard; continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.

I. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.
1. Size: 1-inch-high by full length of visual display unit.
2. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of display rail or fraction thereof.
3. Tackboard Insert Color: As selected by Architect from full range of industry colors.
4. Aluminum Color: Match finish of visual display assembly trim.

J. Paper Holder Display Rail: Extruded aluminum; designed to hold paper by clamping action.

2.3 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
1. Face Sheet Thickness: 0.021-inch uncoated base metal thickness.

2. Manufacturer's Standard Core: Minimum 1/4-inch-thick, with manufacturer's standard moisture-barrier backing.

2.4 TACKBOARD PANELS

A. Tackboard Panels:
1. Facing:
a. 1/4-inch-thick, plastic-impregnated cork.
2. Core:
a. Manufacturer's standard.

2.5 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish; with surface-burning characteristics indicated.

C. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout; with surface-burning characteristics indicated.

D. Hardboard: ANSI A135.4, tempered.

E. Particleboard: ANSI A208.1, Grade M-1.

F. MDF: ANSI A208.2, Grade 130.

G. Fiberboard: ASTM C208 cellulosic fiber insulating board.

H. Extruded Aluminum: ASTM B221, Alloy 6063.

I. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
1. Verify adhesives have a VOC content of 50 g/L or less.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies:
   1. Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.
   2. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

C. Sliding Visual Display Units: Install units at mounting heights indicated. Attach to wall framing with fasteners at not more than 16 inches o.c.

END OF SECTION 101100

SECTION 101200 - DISPLAY CASES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bulletin boards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For display cases and bulletin boards.
   1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

2.2 BULLETIN BOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ADP Lemco.
   2. Aarco Products, Inc.
   3. C.R. Laurence Co., Inc.; CRH Americas, Inc.
   4. CIG JAN Products, Ltd.
   5. Claridge Products and Equipment, Inc.
   6. ghent; a GMi Company.

B. General: Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard panel on back inside surface and operable glazed doors at front.
   1. Frame and Cabinet Profile: Square frame section with square cabinet corners.
   2. Mounting: Surface mounted.
   3. Size: As indicated on Drawings by 4 inches deep.

C. Aluminum-Framed Cabinet: Extruded aluminum; with clear anodic finish.

D. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
   1. Number of Doors: Two.

E. Back Panel: Manufacturer's standard polyester-fabric-faced tackboard panel.
   1. Color: As selected by Architect from full range of industry colors.

2.3 MATERIALS

A. Composite Wood Products: Verify products are made without added urea formaldehyde.

B. Hardboard: ANSI A135.4, tempered.

C. Fiberboard: ASTM C208.

D. Particleboard: ANSI A208.1, Grade M-1.

E. Hardwood Plywood: HPVA HP-1.

F. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.

G. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto burlap backing; with washable vinyl finish and integral color throughout.

H. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd.; with flame-spread index of 25 or less when tested in accordance with ASTM E84.

I. Extruded-Aluminum Bars and Shapes: ASTM B221, Alloy 6063.

J. Aluminum Tubing: ASTM B429/B429M, Alloy 6063.

K. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

L. High-Pressure Plastic Laminate: ISO 4586-3.

M. Adhesives: Do not use adhesives that contain urea formaldehyde.

N. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 FABRICATION

A. Fabricate bulletin boards to requirements indicated for dimensions, design, and thickness and finish of materials.

B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.

C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Bulletin Boards: Attach units to wall surfaces with concealed clips, hangers, or grounds.

END OF SECTION 101200

SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal plaques.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.
   1. Include fabrication and installation details and attachments to other work.
   2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

2.2 METAL PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Plaque Material: Cast brass.
   2. Plaque Thickness: 0.50 inch.
   3. Finishes:
      a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
      b. Overcoat: Manufacturer's standard baked-on clear coating.
   4. Background Texture: As selected by Architect from manufacturer's full range.

5. Integrally Cast Border Style: Projected bevel.
6. Mounting: Rosette-head through fasteners.

2.3 MATERIALS

A. Brass Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated.

B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   3. Plaque Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
      b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.
   1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
   5. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.
   1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL PLAQUES

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
   1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
   2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
   3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
   4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
   1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
      a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
      b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
   2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
   3. Brackets: Remove loose debris from substrate surface and install bracket supports in position, so that plaque is correctly located and aligned.
   4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

C. Remove temporary protective coverings and strippable films as plaques are installed.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dimensional characters.
      a. Cutout dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

B. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 DIMENSIONAL CHARACTERS

A. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
   1. Character Material: Sheet or plate aluminum.
   2. Character Height: As indicated on Drawings.
   3. Thickness: 0.25 inch.
   4. Finishes:
      a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color matching Architect's sample.
      b. Overcoat: Manufacturer's standard baked-on clear coating.
   5. Mounting: Concealed studs.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
   3. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   4. Sign Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
      b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.4 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

4. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match Architect's sample color unless otherwise indicated.
2. Stainless Steel Brackets: Factory finish brackets to match Architect's sample finish unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
3. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 101450 - SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Room and door signs.

1.2 REFERENCE STANDARDS

A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.

B. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.

1.3 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, raised characters and braille, fonts, and colors.
   1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect/Engineer at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect/Engineer prior to fabrication.

C. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

2.2 MANUFACTURERS

A. Flat Signs:
   1. Best Sign Systems, Inc: www.bestsigns.com.
   2. Mohawk Sign Systems, Inc: www.mohawksign.com.
   3. Seton Identification Products: www.seton.com/aec.
   4. Appenix

2.3 SIGNAGE APPLICATIONS

A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II Braille.
   3. Character Height: 1-1/2 inch.
   4. Sign Height: 6 inches, unless otherwise indicated.
   5. Office/Classroom Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name. Width to be minimum 12”
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator. Width to be minimum 12”
   7. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
   8. Rest Rooms: Identify with pictograms, the names "BOYS" and "GIRLS" or “INCLUSIVE”, room numbers to be determined later, and Braille. Pictograms to be age appropriate.

2.4 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
   3. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
   4. Wall Mounting of One-Sided Signs: Tape adhesive.
   5. Subsurface-Applied Graphics to be applied to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
      a. Graphics to be district or school logo.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: Clear.
   4. Character Color: Contrasting color.

2.5 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/16 inch.

2.6 NON-TACTILE SIGNAGE MEDIA

A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
   1. Sign Color: Clear.
   2. Total Thickness: 1/8 inch.

2.7 SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

2.8 ACCESSORIES

A. Provide back plate for signs to be mounted on glass

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs where indicated:
   1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
   2. If no location is indicated obtain Owner's instructions.
   3. Coordinate signage text with owner prior to fabrication

D. Protect from damage until Substantial Completion; repair or replace damage items.

3.3 SCHEDULE

A. Provide new room signage for all spaces and every entry point to spaces

B. Provide one evacuation map for every classroom and lab.

END OF SECTION 101450

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-plastic toilet compartments.

B. Related Requirements:
   1. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings: Plans, elevations, sections, details, and attachment details.

C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.

B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
   1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.

C. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Global Partitions.
   2. General Partitions Mfg. Corp.
   3. Hadrian Inc.; Zurn Industries, LLC.

4. Metpar Corp.
5. Scranton Products.

B. Toilet-Enclosure Style: Overhead braced.

C. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than 1-inch-thick, seamless, with eased edges, and with homogenous color throughout thickness of material. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's continuous, extruded-aluminum or stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color: One color in each room.

D. Pilaster Shoes: Manufacturer's standard design; solid plastic or stainless steel.
1. Plastic Color: Matching pilaster.

E. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; solid plastic.
a. Plastic Color: Matching panel.

2.3 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. Mount with through bolts.
1. Hinges:
a. Manufacturer's paired, wraparound, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.
1) Material, Paired Hinge: Aluminum.
b. Manufacturer's continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
1) Material, Continuous Hinge: Manufacturer's standard.
c. Manufacturer's integral hinge for solid-plastic doors, allowing emergency access by lifting door.
1) Material, Integral Hinge: Nylon gravity cam unit with stainless steel pins/screws.
d. Manufacturer's standard hinge.
2. Latch and Keeper: Manufacturer's surface-mounted latch unit, designed for emergency access, and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
a. Material: Chrome-plated zamac.
3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
a. Material: Chrome-plated zamac.

4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.
   a. Material: Chrome-plated zamac.
5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
   a. Material: Chrome-plated zamac.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221.

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

D. Stainless Steel Castings: ASTM A743/A743M.

E. Zamac: ASTM B86, commercial zinc-alloy die castings.

2.5 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet enclosures and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
   1. Maximum Clearances:
      a. Pilasters and Panels or Screens: 1/2 inch.
      b. Panels or Screens and Walls: 1 inch.
   2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
      a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
      b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102113.19

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.
   2. Public-use shower room accessories.
   3. Custodial accessories.

1.2 ACTION SUBMITTALS

A. Product data.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
   1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
   2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. See Drawings for equipment.

2.3 PUBLIC-USE SHOWERROOM ACCESSORIES

A. See Drawings for equipment.

2.4 CUSTODIAL ACCESSORIES

A. See Drawings for equipment.

2.5 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.
   1. Key all alike.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
   1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Babcock-Davis.
      b. Guardian Fire Equipment, Inc.
      c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
      d. Larsen's Manufacturing Company.
      e. Nystrom, Inc.
      f. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.
   1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Stainless steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
   1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Stainless steel sheet.

F. Door Material: Stainless steel sheet.

G. Door Style: Center glass panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
   3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
   4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet door.
         2) Application Process: Decals.
         3) Lettering Color: Red.
         4) Orientation: Horizontal.

K. Materials:
   1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.
      a. Finish: ASTM A480/A480M No. 4 directional satin finish,
   2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply decals at locations indicated.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amerex Corporation.
      b. Ansul; brand of Johnson Controls International plc, Building Solutions North America.

c. Babcock-Davis.
d. Badger Fire Protection; a Carrier company.
e. Buckeye Fire Equipment Company.
f. Guardian Fire Equipment, Inc.
g. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
h. Kidde; Carrier Global Corporation.
i. Larsen's Manufacturing Company.
j. Potter Roemer LLC; a Division of Morris Group International.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type: UL-rated 4A:80B:C nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amerex Corporation.
b. Ansul; brand of Johnson Controls International plc, Building Solutions North America.
c. Badger Fire Protection; a Carrier company.
d. Buckeye Fire Equipment Company.
e. Guardian Fire Equipment, Inc.
f. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
g. Kidde; Carrier Global Corporation.
h. Larsen's Manufacturing Company.
i. Potter Roemer LLC; a Division of Morris Group International.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
   1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Knocked-down corridor lockers.
   2. Knocked-down athletic lockers.
   3. Locker benches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For metal lockers.
   1. Include plans, elevations, sections, and attachment details.
   2. Include locker identification system and numbering sequence.

C. Samples: For each color specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
   1. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in ICC A117.1.

2.2 KNOCKED-DOWN CORRIDOR LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Storage Solutions.
   2. Hadrian Inc.; Zurn Industries, LLC.
   3. Lyon LLC.
   4. Penco Products, Inc.

5. Republic Storage Systems, LLC.

B. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
   1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
   2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
   3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
   4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
   5. Door Style: Vented panel as follows:
      a. Concealed Vents: Slotted perforations in top and bottom horizontal door return flanges.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
   1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
   2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
   3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

E. Hinges:
   1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
   1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
      a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
      b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.

G. Locks: Built-in combination locks.

H. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

I. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

J. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet.
   1. Closures: Hipped-end type.

K. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.

L. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

M. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.

N. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet.

O. Materials:
   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.

P. Finish: Baked enamel or powder coat.
   1. Color: Match Architect's sample of P-4, P-5, P-6, and P-7.
      a. Provide P-6 painted lockers in kitchen

2.3 KNOCKED-DOWN ATHLETIC LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Storage Solutions.
   2. Hadrian Inc.; Zurn Industries, LLC.
   3. Lyon LLC.
   4. Penco Products, Inc.
   5. Republic Storage Systems, LLC.

B. Perforated Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
   1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
   1. Tops and Bottoms: 0.060-inch nominal thickness, with single bend at edges.
   2. Backs: 0.048-inch nominal thickness.
   3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Unperforated Sides: Fabricated from 0.048-inch nominal-thickness steel sheet.

E. Perforated Sides: Fabricated from 0.060-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations.

F. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet or 0.097-inch nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

G. Hinges:
   1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

H. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
   1. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock with steel padlock loop that projects through recessed cup and is finished to match metal locker body.
      a. Latch Hook: Equip each door with one latch hook.

I. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.

J. Door Handle and Latch for Box Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

K. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

L. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

M. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
   1. Closures: Vertical-end type.

N. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.

O. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

P. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.

Q. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

R. Materials:
   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.

S. Finish: Baked enamel or powder coat.
   1. Color: Match Architect's sample of paint P6

2.4 LOCKS

A. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
   1. Bolt Operation: automatically locking spring bolt.

2.5 LOCKER BENCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AJW Architectural Products.
   2. ASI Storage Solutions.
   3. Art Metal Products.
   4. Hadrian Inc.; Zurn Industries, LLC.
   5. Lyon LLC.
   6. Penco Products, Inc.

B. Provide bench units with overall assembly height to comply with ADA requirements.

C. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
   1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick except provide 20- to 24-inch-wide tops where accessible benches are indicated.
   2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

D. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.
   1. Color: Match metal lockers.

E. Materials:
   1. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
   2. Steel Tube: ASTM A500/A500M, cold rolled.

2.6 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:
   1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
   2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

D. Knocked-Down Construction: Fabricate metal lockers by assembling at Project site or preassembling at plant prior to shipping, using manufacturer's nuts, bolts, screws, or rivets.

E. Accessible Lockers: Fabricate as follows:
   1. Locate bottom shelf no lower than 15 inches above the floor.
   2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

G. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

I. Boxed End Panels: Fabricated with 1-inch-wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

J. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.
   1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
   2. Anchor single rows of metal lockers to walls near top and bottom of lockers.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
   1. Attach recess trim to recessed metal lockers with concealed clips.
   2. Attach filler panels with concealed fasteners.
   3. Attach sloping-top units to metal lockers, with closures at exposed ends.
   4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
   5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart.

END OF SECTION 105113

SECTION 107500 - FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ground-mounted aluminum flagpoles.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
   1. Wind Loads: Wind speed and exposure factor as noted according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles.".
   2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Flagpole; a Kearney-National Inc. company.
   2. Atlantic Fiberglass Products, Inc.
   3. Baartol Company.
   4. Concord Industries, Inc.
   5. Eder Flag Manufacturing Company, Inc.
   6. Ewing Flagpoles.
   7. Lingo Inc.; Acme Flagpole Company Division.
   8. Millerbernd Manufacturing Company.
   9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
   10. PLP Composite Technologies, Inc.
   11. Pole-Tech Company Inc.
   12. U.S. Flag & Flagpole Supply, LP.
   13. USS Manufacturing Inc.

2.2 FLAGPOLES

A. Exposed Height: As noted in the schedule.

B. Aluminum Flagpoles: Provide entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than 0.064-inch-nominal wall thickness. Provide with 3/16-inch steel bottom plate and support plate; 3/4-inch-diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole. Provide flashing collar of same material and finish as flagpole.

D. Cast-Metal Shoe Base: For anchor-bolt mounting; provide with anchor bolts.

E. Finial Ball: Provide finial mounted flagpole light as manufactured by Flagpole Beacon or equal. Light shall rotate with the flag: Lights shall be LED and integral to the finial ball. Minimum 6” dia. Fabricate from 0.063-inch spun aluminum, finished to match flagpole.

F. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch-diameter, braided polypropylene halyard and 9-inch cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
   1. Halyards and Cleats: Two at each flagpole.
   2. Halyard Flag Snaps: Stainless-steel swivel snap hooks. Furnish two per halyard.

2.3 MISCELLANEOUS MATERIALS

A. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107.

B. Sand: ASTM C 33, fine aggregate.

C. Elastomeric Joint Sealant: Joint sealant complying with requirements in Section 079200 "Joint Sealants."

2.4 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Ground Set: Place foundation tube, center, and brace to prevent displacement during concreting. Install flagpole, plumb, in foundation tube. Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

3.2 SCHEDULE

A. Provide (1) 35-foot pole for a US flag

B. Provide a US flag. Flag shall be shall be 5’ x 8’. Flags shall be constructed of polyester.

END OF SECTION 107500

SECTION 111200 - PARKING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Automatic barrier gates.
   2. Vehicle detectors.
   3. Entry terminals.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For parking control equipment.
   1. Include plans, elevations, sections and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 AUTOMATIC BARRIER GATES

A. General: Provide parking control device consisting of operator and controller housed in a weathertight, tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a signal from access or revenue control device. Fabricate unit with gate-arm height in down position of not more than 35 inches above pavement.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASPS Access Security & Parking Systems Inc.
      b. Automatic Systems.
      c. Engineered Parking Systems, Inc.
      d. Magnetic AutoControl USA.
      e. Parking Systems, Inc.

2. Standards: Barrier gate operators that are listed and labeled according to UL 325 by a qualified testing agency.

B. Controller: Factory-sealed, solid-state, plug-in type, with galvanized-steel box for wiring connections. Noncommunicating type.
   1. Noncommunicating Type:
      a. Capable of logic for one- and two-way lanes.
      b. Separate momentary contacts for transient patrons, monthly patrons, vehicle entries, and vehicle exits.
   2. Physical Characteristics:
      a. On-off power supply switch.
      b. Automatic-manual switch.
      c. Differential counter.
      d. Communication port.
      e. Internal resettable counters.
      f. Thermal-overload protection with manual reset.
      g. Plug-in connectors for two vehicle loop detectors.
      h. Thermostatically controlled heater with on/off/auto switch.
      i. Thermostatically controlled fan with on/off/auto switch.
      j. Switch to test motor and limit switches.
      k. Emergency manual disconnect.
      l. Battery backup.
      m. Single, 115-V ac grounded power receptacle.
   3. Operational Characteristics:
      a. Able to store successive inputs and sequentially processing each one.
      b. Automatic instant-reversing obstacle detector mechanism that stops downward motion of gate arm if arm contacts or nears an object and that immediately returns arm to upward position. Include a zero- to 60-second, variable-time reset device.
      c. Directional arming logic.
      d. Broken gate-arm monitoring.
      e. Programmable timer.
      f. Diagnostic mode for on-site testing, with LEDs for inputs and outputs.
      g. Automatic and continuous testing of inputs and outputs.
      h. Reversible arm capability for right- or left-handed operation.

C. Cabinets: Fabricated from sheet metal with seams welded and ground smooth; approximately 15 inches square by 40 inches tall. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
   1. Steel Sheet: Not less than 0.097-inch-thick, galvanized- steel sheet.
      a. Finish cabinet, interior and exterior, with manufacturer's standard baked-enamel or powder-coat finish.

D. Straight Gate Arm: Fiberglass, PVC, or polycarbonate.
   1. Traffic-Side Face: Reflective painted finish and black diagonal stripes.
   2. Length: 10 feet.

3. Mounting Flange: Provide with breakaway feature to ensure a clean break if arm is struck by vehicle.

E. Operator: UL labeled and listed, Class II. 1/3 hp;-V, 60-Hz, single-phase, instant-reversing, continuous-duty motor for operating gate arm. Transmit power to gate-arm drive shaft through the speed reducer to harmonic-acting crank and connecting rod. Fabricate crank, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.
   1. Opening Time: Three seconds.
   2. Inherently adjustable, torque limiting clutch for safety.

F. Characteristics:
   1. Audible alarm that activates as part of a safety device system.
   2. Additional obstruction detector; noncontact infrared.
   3. Gate-arm warning safety signs on both sides of unit to limit traffic to vehicular traffic.
   4. Low-voltage red warning lights that illuminate when gate is in down position.
   5. Low-voltage light on cabinet top that flashes or changes from red to green when barrier gate is operating.
   6. Emergency fail open

2.2 VEHICLE DETECTORS

A. General: Provide detection devices that sense presence or transit of vehicles and emit signals activating gate-arm operators.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASPS Access Security & Parking Systems Inc.
      b. Amano Cincinnati, Inc.
      c. Delta Scientific Corporation.
      d. Engineered Parking Systems, Inc.
      e. Magnetic AutoControl USA.
      f. Parking Systems, Inc.

B. Vehicle Loop Detector System: Self-tuning electronic presence detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, designed to hold gate arm open until traffic clears. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location indicated on Drawings, as recommended in writing by detection system manufacturer for saw-cut installation.
   1. Field-Assembled Loop: Wire, in size indicated for field assembly.
   2. Operation:
      a. Recognize vehicles within 6 inches of each other on standard-sized loop.
      b. Recognize vehicle direction by detecting vehicle moving from one loop to another.
      c. Generate reverse count if vehicle backs up after generating directional count in forward direction.

d. Continuous diagnostic monitoring and memory for intermittently operating and failed loops.
e. Crosstalk test between adjacent loops.

2.3 ENTRY TERMINALS

A. General: Provide entry terminals with mechanisms, components, and controllers housed in cabinet enclosures.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASPS Access Security & Parking Systems Inc.
b. Amano Cincinnati, Inc.
c. CAME Americas Automation LLC.
d. Engineered Parking Systems, Inc.
e. Parking Systems, Inc.

B. Physical Characteristics:
1. Battery backup for clock and RAM memory.
2. Thermostatically controlled heater with on/off/auto switch.
3. Thermostatically controlled fan with on/off/auto switch.
4. Access card reader.
5. Keypad
6. Intercom.

C. Operational Characteristics:
1. Operation: Online communication to remote computer.
2. Activation by access card or remote control.
a. On activation by means other than button, credentials are recorded and signal is automatically sent to raise barrier gate.
3. Programmable timer for closing barrier gate.
4. Built-in-service diagnostics.

D. Cabinets: Fabricated from sheet metal with seams welded and ground smooth, approximately 15 inches square by 40 inches tall; consisting of base and top components. Provide single, gasketed access door for each base component with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet. Fabricate top component so it can be unlocked and opened for ticket loading and maintenance. Include flush-mounted lock in rear of top, keyed the same as base component lock.
1. Steel Sheet: Not less than 0.097-inch-thick, galvanized- steel sheet.
a. Finish cabinet, interior and exterior, with manufacturer's standard white baked-enamel or powder-coat finish.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install parking control equipment as required for complete and integrated installation.
   1. Rough-in electrical connections.

3.2 INSTALLATION OF AUTOMATIC BARRIER GATES

A. Anchor cabinets to concrete bases with anchor bolts or expansion anchors, and mount barrier gate arms.
   1. Install barrier gates according to UL 325.

3.3 INSTALLATION OF VEHICLE DETECTORS

A. Cut grooves in pavement and bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.

3.4 INSTALLATION OF ENTRY TERMINALS

A. Attach cabinets to concrete bases with anchor bolts or expansion anchors.
   1. Connect equipment to remote computer.

3.5 INSTALLATION OF ELECTRICAL

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain parking control equipment.

END OF SECTION 111200

SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cooking appliances.
   2. Refrigeration appliances.
   3. Cleaning appliances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Field quality-control reports.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 COOKING APPLIANCES

A. Microwave Oven:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amana; Whirlpool Corporation.
      b. Bosch US; BSH Home Appliances Corporation.
      c. Fisher & Paykel Appliances Ltd.
      d. Frigidaire.

e. GE Appliances; Haier Group.
f. Kenmore; Transformco SR Brands LLC.
g. KitchenAid; Whirlpool Corporation.
h. LG Electronics USA, Inc.; LG Electronics Inc.
i. Sharp Electronics Corp.
j. Whirlpool Corporation.

2. Microwave Power Rating: Manufacturer's standard.
3. Material: Stainless steel.

2.3 REFRIGERATION APPLIANCES

A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amana; Whirlpool Corporation.
b. Bosch US; BSH Home Appliances Corporation.
c. Fisher & Paykel Appliances Ltd.
d. Frigidaire.
e. GE Appliances; Haier Group.
f. Kenmore; Transformco SR Brands LLC.
g. KitchenAid; Whirlpool Corporation.
h. LG Electronics USA, Inc.; LG Electronics Inc.
i. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
j. Whirlpool Corporation.
2. Type: Freestanding Built in Undercounter.
3. Storage Capacity:
a. Refrigeration Compartment Volume: 15.6 cu. ft.
b. Freezer Volume: 5.13 cu. ft.
4. General Features:
a. Interior light in refrigeration compartment.
b. Automatic defrost.
c. Interior light in freezer compartment.
d. Automatic icemaker and storage bin.
5. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
6. Front Panel(s): Stainless steel.

2.4 CLEANING APPLIANCES

A. Dishwasher: Complying with AHAM DW-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amana; Whirlpool Corporation.
b. Bosch US; BSH Home Appliances Corporation.
c. Fisher & Paykel Appliances Ltd.
d. Frigidaire.
e. GE Appliances; Haier Group.

f. Gaggenau; BSH Home Appliances Corporation.
g. Kenmore; Transformco SR Brands LLC.
h. KitchenAid; Whirlpool Corporation.
i. Viking Range, LLC; Middleby Corporation.
j. Whirlpool Corporation.

2. Type: Built-in undercounter.
   a. Counter is 34 inches AFF to surface
3. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
4. Front Panel: Stainless steel.

B. Clothes Washer: Complying with AHAM HLW-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amana; Whirlpool Corporation.
   b. Bosch US; BSH Home Appliances Corporation.
   c. Fisher & Paykel Appliances Ltd.
   d. Frigidaire.
   e. GE Appliances; Haier Group.
   f. Kenmore; Transformco SR Brands LLC.
   g. Maytag; Whirlpool Corporation.
   h. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
   i. Whirlpool Corporation.
2. Type: Freestanding, top-loading unit.
3. Capacity: 3.8 cu. ft.
4. Agitator: Center spindle.
5. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
6. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
7. Appliance Finish: Enamel.

C. Clothes Dryer: Complying with AHAM HLD-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amana; Whirlpool Corporation.
   b. Bosch US; BSH Home Appliances Corporation.
   c. Fisher & Paykel Appliances Ltd.
   d. GE Appliances; Haier Group.
   e. Kenmore; Transformco SR Brands LLC.
   f. LG Electronics USA, Inc.; LG Electronics Inc.
   g. Maytag; Whirlpool Corporation.
   h. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
   i. Whirlpool Corporation.
2. Type: Freestanding, frontloading, electric unit.
3. Capacity: 5.7 cu. ft.

4. Features:
   a. Interior drum light.
5. Appliance Finish: Enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

END OF SECTION 113013

SECTION 114000 - FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All Drawings, General and Supplementary Conditions, Division 1, Specifications, and related contract documents apply to this section and the requirements may exceed those shown in this section. The Food Service Engineering Consultants on this project are JRA Food Service Consultants, LLC in Grand Rapids, Michigan (616-454-4433) and is responsible to the Architect and Owner for ascertaining that the Food Service Equipment Contractor complies with all the requirements of this section.

1.2 SUMMARY

A. As listed in this division, the Food Service Equipment Contractor shall furnish all labor, material, work, equipment, transportation, accessories, taxes, etc. for a complete and continuous installation in accordance with the requirements of these plans and specifications and related documents.

B. The FSEC shall familiarize themselves with local conditions affecting the cost of the work and examine the site and all Food Service Equipment contract documents including Architectural drawings, and contract documents, all of which constitute the responsibility of the FSEC.

1.3 SUBSTITUTIONS AND VOLUNTARY ALTERNATES

A. The first manufacturer of equipment listed in the item specifications is intended to be the basis of the base bid. All other manufacturers must conform to the specifications, size, accessories, materials, capacity, etc.

B. A proposed substitution on any specified equipment must be submitted to the Consultant 10 days in advance of the bid date and must include all manufacturers shop drawings and data sheets on the proposed equipment. The supplier shall pay any additional costs incurred for changes, engineering services, utilities, construction, etc. that may be incurred by said substitutions.

1.4 INTERPRETATION OF DOCUMENTS

A. Prior to receipt of bids, all questions, clarification, and changes in the documents shall be executed by addendum. After award of contract, all changes shall be performed by bulletin.

B. FSEC shall submit an itemized price breakdown to the Consultant on their letterhead for each piece of equipment including labor, freight, manufacturer, quantity, taxes, etc. as applicable.

C. Any deletions of equipment by the Owner and/or Consultant prior to approval and/or release of the shop drawings, brochures, etc. shall be credited to the Owner at the itemized price as listed in the itemized price breakdown and include all equipment costs, freight, labor, taxes etc. Pricing shall not be credited at the amount listed on the Schedule of Values.

D. Any additions to equipment by the Owner and/or Consultant that result in cost increases after approval and/or release of shop drawings, brochures, etc. shall be immediately noted by the FSEC and a written request with prices for a bulletin shall be issued by the FSEC to the Consultant.

E. The General Specifications are applicable to items listed in the item specifications.

1.5 ABBREVIATIONS

A. The following abbreviations are used herein unless otherwise noted on the plans or item specifications.

A	Amps
AFF	Above Finish Floor
BTC	Branch To Connection
CFM	Cubic Feet of Air Per Minute
C.P.	Chrome Plated
CW	Cold Water - 25 PSI
DCO	Duplex Convenience Outlet - 20 amp
DFA	Drop From Above
E.C.	Electrical Trades
FL DR	Floor Drain - Wade W1104
FFD	Funnel Floor Drain - Wade 1104-EF4
FL SK	Floor Sink - 12" - Wade W9144-15
FPM	Feet Per Minute
FSEC	Food Service Equipment Contractor
F.S.C.	Food Service Consultant
G	Natural Gas - 7" water column
GP	General Purpose
G.S.	General Specifications
G.C.	General Trades
HVAC	Heating Ventilation HVAC Trades
HP	Horsepower
HW	Hot Water - 140 degree - 25 PSI
J.B.	Junction Box
KW	Kilowatt
N.S.R.	No Service Required
N.I.C.	Not in FSEC contract
P.C.	Plumbing Trades
S.O.M.	Standard of Manufacturer
s.s.	Stainless Steel
SS	Steam Supply - 25 PSI
SR	Steam Return

V	Volts
VIF	Verify in field
W	Waste Outlet
W.G.	Water Gauge - Static Pressure

1.6 CONFORMITY

A. All equipment furnished under these specifications shall be newly manufactured and installed in strict conformity with all codes, regulations and requirements of the State Board of Health, the National Sanitation Foundation Standards, or any state or local agency.

B. All equipment shall conform to the current standards and bear the seal of UL, NEMA, ASME, AGA, OSHA, NFPA, etc. where applicable and/or otherwise conform to the requirements of the authorities having jurisdiction.

C. Wherever the requirements of the specifications and drawings are in excess of the regulations, the specifications and drawings shall govern. Whenever the regulations are in excess of the specifications and drawings, the regulations shall govern.

D. Wherever the requirements of the specifications are in excess of the drawings, the specifications shall govern.

E. Wherever the requirements of the drawings are in excess of the specifications, the drawings shall govern.

1.7 PERMITS - LICENSES - PHONE CALLS

A. Provide to the proper authorities all notices required by law, obtain all refrigeration permits, licenses, etc., and pay any legal fees necessary for the due and faithful performance of the work, and which may arise incidental to the fulfilling of the foodservice documents. The Owner shall pay for any health department plan review or license fees.

B. Permits shall be provided as required. Refer to the Construction Managers scope of work.

C. Accept all collect phone calls relating to food service equipment that pertain to the project until warranty has expired on the equipment.

1.8 SUBMITTAL OF BUYOUT BROCHURES AND SHOP DRAWINGS

A. Shop drawing and brochure requirements may also be listed in the general requirements or other areas of the documents. Provide submittals as per those requirements or as listed below - whichever is greater.

B. All shop drawings, rough-in drawings, equipment brochures, etc. shall be submitted at one time within 20 days of the notice to proceed. Said items are subject to the terms and conditions of the plans and specifications for the entire project. All drawings which are submitted for distribution shall be clear and concise and have the following notes printed on each and every sheet:

Name of the F.S.E.C.
Name and location of the project.
Name of the Architect.
Name of the Consultant.
Name of the General Contractor.
Drawing number.
Date of drawing and revisions.

The following statement: The (name of F.S.E.C.) is solely responsible for the accuracy and completeness of these drawings and specifications, and we approve them for construction purposes. Signed: (Officer, Partner, etc.)

C. All submitted data shall be reviewed for general compliance only and does not alleviate the F.S.E.C. from providing equipment as per the intent of the plans and specifications.

D. Owner shall not be responsible for any equipment ordered or prior to receipt of Consultant approved brochures or shop drawings.

E. If applicable, the F.S.E.C. shall visit site to verify requirements of existing or relocated equipment prior to submittals.

1.9 BUYOUT BROCHURES

A. As soon as possible, prepare a buy-out equipment brochure in PDF format with copies of manufacturer's specification sheet or literature on each item, along with a list of the model, manufacturer, quantity, connections required, accessories, etc. for each item and component or accessories. Material on all items shall be assembled in order and no consideration will be given to partial lists submitted from time to time.

1.10 ROUGH-IN DRAWING AND MECHANICAL DATA

A. As soon as possible, submit an electronic drawing in PDF format at 1/4” scale to locate accurately the utility connections for each item of equipment requiring water, gas, electrical, and drain. Listed on the drawings shall be dimensions to required utilities and located from a center line of a structural column or another positive reference point.

B. Upon final approval of data, distribute copies to all trades, Owner, Architect, health department, etc. as required.

C. Drawings shall be at 1/4" scale or larger and indicate each electrical and mechanical roughing-in required for all new and/or relocated or future or purveyor supplied (the Owner shall provide proper data on purveyor supplied equipment) food service equipment as listed in the plans or specifications. Include all electrical and convenience outlets, gas, water, steam, ventilation, drains, floor depressions, wall openings, weights, ceiling recess or access panels, sleeves, beverage lines, roof data, refrigeration, etc.

D. Furnish all necessary assistance to the various trades and be responsible for the proper location of sleeves and conduits through which the utility lines are to be drawn. A field inspection shall be made before the finished floors are laid to make any necessary relocations of the utility sleeves, rough-ins and conduits, and immediate written notice shall be provided if rough in problems have occurred.

1.11 SUBMITTALS OF SHOP DRAWINGS

A. Completely detail and submit shop drawings (s.s. fabrication, fire protection, ventilation, plastic laminate fabrication, walk ins, sneeze guards, cafeteria serving counters, hoods, etc.) in electronic PDF format showing all items to be provided under this section of the specifications. Drawings to be submitted for review at 1/2" per foot scale or larger. Upon final review of data, distribute copies to all trades, Owner, Architect, etc. as required.

B. The drawings shall show all elevations, sections, dimensions, mechanical and electrical requirements, related details of construction, installation and related work which require cutting, close fitting, etc. as required for installation.

C. Submit proper notifications in writing of any departures from the contract drawings or specifications which may be necessary to permit installation of the equipment. Fabrication should not be started until after final approvals are received and final field measurements are taken.

1.12 MAINTENANCE MANUALS

A. At time of demonstration, provide to the person in charge of the kitchen a minimum of three bound current copies of kitchen plans, roughing-in drawings, any and all warranties, instructions, parts lists, operating instructions for each piece of mechanical equipment, as built shop drawings, and "Buy-Out" brochures.

B. Manuals shall include a typewritten list in the front of the manual listing the names, addresses, and telephone numbers of local servicing agencies and manufacturer’s representatives for all equipment.

1.13 SAMPLES

A. Submit all required samples for approval, if required, of all hardware, plastic laminate, paint, etc. before starting fabrication. Other samples shall be supplied as required.

1.14 MEASUREMENTS

A. Measurements required to size and place the food service equipment shall not be taken from drawings but shall be made at the structure from the actual spaces reserved therefore, and giving due consideration to any architectural, structural or mechanical discrepancies that may occur during construction of the building. Verify size of all of Owners equipment and small wares (dishes, trays, pans, etc.) and Purveyor supplied equipment (urns, soda systems, beverage dispensers, etc.), if applicable. Field dimensions shall be taken at the earliest opportunity so as not to delay deliveries.

B. Verify in field any and all measurements before doing any work on equipment that may be affected by the physical conditions and be responsible for the correction of same.

C. Inspect equipment for proper operation prior to relocation. Advise if equipment is defective or needs rework which is not included in the original contract and submit a written quotation for said work.

D. Coordinate Owners and/or Purveyor supplied equipment (coffee makers, beverage equipment, cash registers, soda equipment, etc.) as required for rough-in data, installation, etc.

E. Measurements for tight fitting equipment shall allow no more than 1/4" between wall and equipment that shall be trimmed and/or sealed as required.

1.15 WARRANTY

A. Provide a written warranty for all equipment against defects in workmanship and material for one (1) year from date of substantial completion and acceptance, excluding refrigeration units which shall carry an additional four-year warranty and a ten-year warranty on all walk-in panels. This shall cover any replacements and/or repair costs of such defective material, including transportation, labor, and materials for all equipment. This one-year free service, warranty and guarantee shall be available within 24 hours of notification on all equipment except refrigeration.

B. Provide one-year free service, warranty and guarantee within 12 hours of notification on walk-In refrigeration and units must be operational within 24 hours after service call.

C. This warranty is not intended to cover equipment which has been overly abused or items that have not had proper periodic maintenance (door gaskets, uncleaned refrigeration condensers, etc.) during the one-year period.

1.16 DELIVERY AND STORAGE

A. Furnish all labor, material, equipment, etc. as required to unload and store all equipment.

B. No equipment shall be delivered to the site unless it has been ascertained that storage space is available.

C. Make all arrangements to deliver, unload, and store all equipment and shall assume all responsibility for safeguarding the equipment until it is accepted by the Owner.

D. Unless noted in the item specifications, remove and store any existing and/or relocated equipment that is removed from the kitchen during the construction period.

PART 2 - GENERAL SPECIFICATIONS - PRODUCTS

2.1 MANUFACTURER'S STANDARDS

A. It is the intention of these specifications to provide a type of equipment conforming to manufacturer's standards and only minor variations in construction will be accepted, provided that these variations do not detract from the finished appearance, durability, general function or in any way affect general overall size, capacity, strength, etc. of equipment.

B. Manufacturer's catalog designation of material and/or fabricated equipment used in the following specifications are intended to illustrate and represent the standards which will be required by the owner. Equipment furnished must closely conform thereto in design, construction, capacity, and function to make and model called for. Where such catalog designations are given, the items shall be complete as described and shown in the catalog unless exceptions are in itemized specifications.

C. When more than one manufacturer is listed in the Item Specification, only one manufacturer shall be acceptable for items of a similar nature (fabrication, cooking equipment, refrigerators, shelving, carts, etc.) to insure uniformity of design, installation, service, etc.

2.2 FABRICATION STANDARDS

A. Unless noted under itemized specifications or on plans, the following specifications shall govern the construction of all fabricated and buyout equipment and installation and shall apply to the individual item as if it were written therein in its entirety.

2.3 FABRICATED EQUIPMENT

A. It is required that all custom fabricated items (counters, tables, sinks, dish tables, etc.) described in the plans and specifications, other than by name and catalog number, be constructed of 300 series stainless steel and be manufactured by one fabricator (Metal-Masters Inc, Advance Tabco Co., Kevry Co., Pushard Co., LTI Co., John Boos, Keystone Fabricators Co., Titan Co. and McCallum Co. are the approved fabricators) with the plant, personnel and engineering facilities to properly design, detail, and manufacture high quality kitchen equipment.

B. All work in the above category shall be standard unit assembly, by one foodservice equipment manufacturer of uniform design, material and finish.

2.4 BACKSPLASHES

A. Where edges of the top are adjacent to walls, column, equipment or enclosures, they shall be turned up to provide a backsplash which shall be tight fitting (1/4" or less). Unless noted, all backsplashes shall be formed by turning up 10" and flanged back 2-1/2" at 45 degrees and down 1" and attach to wall with 6" by 2" s.s. "Z" clips on 3'-0" centers. Ends of backsplash shall be fitted with closure plates. Weld a full s.s. enclosure panel for exposed rear backsplash.

B. Tops adjacent to refrigerators, ovens or cabinets shall be turned up 4" with top edges feathered slightly to form a tight fit of 1/4" or less. Seal with mastic compound.

2.5 BOLTS, SCREWS AND RIVETS

A. All exposed surfaces of equipment shall be free of bolt, screw and rivet heads. Wherever bolts are used to fasten tops and trim to paneling, body of counters and similar equipment, such bolts shall be of an approved type and shall be corrosion resistant metal of the same alloy as the metal to which they are fastened with acorn type nuts to eliminate sharp edges.

2.6 CASTERS

A. Provide heavy duty casters with double ball bearing raceways, heavy gauge fork and races and have minimum capacity of 250 pounds per caster. Casters shall be provided with brakes. Wheel shall be non-marking urethane.

2.7 CODES AND SANITATION

A. All food service equipment under this contract shall meet the requirements and bear the label of the National Sanitation Foundation. Specifications set forth are considered minimum and are to be superseded by any superior requirements in effect as of this date by the National Sanitation Foundation or the State Health Department. Any differences of opinion on sanitation shall be referred to the State Health Department for arbitration.

2.8 CORNERS

A. All corners shall be fully rounded and made integral and of the same sheet as the top and rolled edges. Radii of all rolled edges to be equal and rolled 2" diameter at least 180 degrees. Filler pieces or soldering shall not be used in place of all welded, seamless construction.

2.9 CUTTING BOARDS

A. Provide Read Products or Mapletex Co. 1/2" minimum thick reversible boards as per plan as manufactured by Read Products Inc. when attached to grills or similar equipment, provide s.s. mounting brackets.

2.10 DISHTABLES

A. Provide NSF approved series SC-DT dish tables with 14 gauge 304 s.s. coved corner construction as manufactured by Metal-masters Co. or equal with 10" backsplash as previously specified where adjacent to walls and remainder of tables to have 3" high roll rim and be mounted on 12 gauge under-channeling, 16 gauge s.s. cross rails and legs with s.s. gussets and s.s. adjustable bullet feet and/or flange type feet. Tops shall be pitched to dishwasher to avoid standing water and undersides shall have sound deadening material and be attached to walls with s.s. "Z" clips.

B. Provide removable 18 gauge s.s. under-shelving which has 2" rolled up edges at rear and roll down edge at front and be supported on s.s. cross rails on all sides. Notch all corners to fit legs and piping. Under-shelving shall not interfere with booster heater or adjacent equipment.

C. Provide s.s. recessed drain trough with drainer in all soiled dish tables. Unit shall not interfere with dishwasher control panels or adjacent equipment.

D. Disposer cones and/or scrapping trough shall be integrally welded into top and also provide s.s. brackets for switch and holes in backsplash return for vacuum breaker. Trough shall be size and shape as per plan by 6" deep with coved corner construction and sloped to disposer. Provide 20" long s.s. pan formed removable trough covers. Provide T&S Co. 2905 water inlet at shallow end of trough and every 3'-0" and at change in directions. Inlets shall be controlled by a 2600 mixing valve mounted on a s.s. bracket mounted under dish table and be interconnected to water line and solenoid so water flows thru inlets when disposer in operation.

E. Provide integral s.s. pass thru sill extending thru wall as per plans and specifications with flat side splashes and turn down front with closed ends. Provide 1" rear turndown at table at 30 degrees so sill is higher than dish table. Provide wood bracing on sill as required for support. Verify requirements of roll up door by prior to installation of tables.

F. Provide raised roll rim in lieu of 3" high roll rim at front edge of soiled dish table when used as a pass thru dish deposit area.

2.11 DOORS

A. SLIDING DOORS - Sliding doors shall be constructed of 16 gauge s.s. or material listed in the item specifications with roller bearing slides.

B. SINGLE PAN - Construction, 16 gauge s.s. with 3/4" thick sound deadening fiberglass between the two thicknesses of metal. Back panel to be 20 gauge steel. Door to operate on top hung ball bearing rollers. Bottom edge of doors to be square and fitted with a groove that rides over a s.s. pin at center point.

C. All doors shall be fitted with stops and locks. Handles shall be die stamped s.s. flush mounted.

D. HINGED DOORS - All hinged doors for cabinet bodies and enclosed bases shall be double pan construction. Doors shall be flush mounted and be fitted with s.s. piano type full length hinges. They shall be furnished with friction catch and s.s. recessed handles, locks, and two rubber button noise eliminators, one at each corner on handle side.

2.12 DRAWERS

A. All drawer inserts shall be coved corner die stamped out of one piece of 18 gauge s.s. or plastic and shall set loosely in a channel frame so it can be lifted out for cleaning. Top edges are to be flanged out 1/2".

B. The supporting frame shall be welded steel channel with s.s. drawer face welded to frame so there will be no exposed screws or rivets on the face which shall extend 3/4" out at top and down 3/4" with 1/2" hemmed edge and radius corners to form drawer handle. Provide two rubber button shock stop noise eliminators one on each side of the drawer face at the top.

C. Provide heavy duty s.s. drawer slides with heavy duty s.s. ball bearing wheels. Slides and frame to be so designed as to allow full opening of drawer and to be reinforced to support 150 lbs. when fully extended.

D. Adjustable stops are to be provided for each drawer at the fully open position. Drawers on open base tables shall be enclosed in an 18 gauge housing of steel. Drawer guides are to be sloped to provide self-closing action.

E. All drawers shall be 20" by 20" by 5" deep.

2.13 ENCLOSED BASE CABINETS

A. All enclosed bases or cabinet bodies shall be similar to Delfield Company or equal Mark VII series and constructed with 14 gauge s.s. tops and 18 gauge s.s. bodies and be enclosed on the ends and sides. The bases and bottom shelves shall be reinforced with channels and angle bracing and gussets as required. Additional angles and channel cross members shall be provided to reinforce shelves and support tops as required for counter top equipment (urn, ice dispensers, drink dispensers, etc.) as shown on plan.

B. All free corners of enclosed bases or cabinet bodies shall be rounded on a 5/8" radius and all corners against walls and other fixtures shall be square. In the case of fixtures fitting against or between walls, the bodies shall be set 1" from the wall line, but the tops will extend back to the wall line to permit space for rough-ins and adjustment to the wall irregularities. The ends of the cabinet bodies shall extend to the wall line and be sealed and/or trimmed as required.

C. These fixtures shall be constructed with 6" s.s. adjustable legs, unless set on masonry or steel bases as called for in the itemized specifications.

2.14 FIELD JOINTS

A. All field joints shall be welded with rod of same basic composition as sheets or parts welded. Welds shall be free of pits, cracks, cross graining or discolorations and shall be ground and polished to the original finish of the metal. No soldered or bolted joints shall be used unless noted in item specifications and shall be properly sealed and bolted.

2.15 GRINDING AND POLISHING

A. All exposed welded joints shall be ground flush with the adjoining material and neatly finished to harmonize therewith. Services shall be free of depressions. Wherever sheared edges occur, they shall be free of burrs, projections and fins to eliminate all danger of cutting or laceration when the hand is drawn over such sheared edges. Where miters or bull nosed corners occur, they shall be neatly ground to a uniform condition, and in no case will overlapping material be acceptable. All exposed surfaces shall be satin finish except rim which shall be a highly polished and buffed finish. Satin finish shall be comparable to the commercial mill finish known as No. 4 for s.s. No cross graining on equipment is acceptable.

2.16 GUARDS

A. All machines shall be furnished fully enclosed with guards built in accordance with safety codes and regulations of State or Governmental agency having jurisdiction.

2.17 HOT FOOD WELLS

A. Provide insulated food wells with coved corner s.s. interior and the electrical element attached to the underside of well. When units are specified with drains, the manufacturer shall provide a drain assembly with bushing and a universal joint as required to manifold and interconnect all wells with a master and individual valves and Drain handles shall be easily accessible from employee side of counter. All wells shall be inter-wired to master switch with indicator light. Provide galvanized access panel below wells to protect wiring. Units shall be heated by 208/240 volt 1200 watt electric elements with thermostatic control with guard ring and pilot light or 3600 BTU gas burner with individual control and removable heavy steel radiant plate set above heating device.

2.18 INTERIOR SHELVES

A. All interior shelves in cabinet bodies and enclosed bases shall be 18 gauge s.s. or as called for in the itemized specifications. Turn up on back and ends of shelf shall be 1-1/2" high and coved on 3/4" radius. The front edge shall be turned down 1-1/2" and back 1/2". All shelves shall be rigidly reinforced below to prevent sagging. Provide ferruled cutouts in shelves for drain lines, conduits, etc.

2.19 LEGS - FEET - FRAMES

A. All legs and pipe stands for open base tables, dish tables, etc. shall be constructed of 16 gauge s.s. tubing unless noted, with cross rails and braces of the same materials. All joints between legs, under-shelves and cross braces are to be welded and ground smooth.

B. Cross rails must be supplied to reinforce each leg. Legs anchored to gussets at top only and without cross rails are not acceptable. Pipe stands and frames furnished on all pipe base fixtures shall have legs of 1-5/8" O.D. 16 gauge s.s. tubing, cross rails of 1" O.D. 16 gauge s.s. tubing unless noted.

C. Top of stand shall be fitted into s.s. gussets welded to reinforcing structure on underside of the table top, spaced not over 3"-6" on centers.

D. All legs shall be fitted with adjustable s.s. bullet shaped feet with bottom of pipe legs to be finished off smoothly and overlap the stem to provide sanitary fitting and prevent the accumulation of grease or other debris at this joint. Provide s.s. flange type feet securely anchored for island style counters, sinks, etc.

E. All pipe legs or vertical members are to be set back from edge of table tops a sufficient distance to offset any interference with workers, walls, columns or other equipment.

F. Provide 6" adjustable legs with adjustable s.s. bullet foot for fabricated and/or buyout equipment with minimum capacity of 1500 pounds each.

2.20 MATERIALS AND STRUCTURAL SHAPES

A. Angles, bars, channels, piping, pipe legs, etc. used shall be uniformly ductile in quality and free of hard spots, runs, checks, and other surface defects. Except as otherwise specified, all such sections shall be milled steel galvanized by the hot dip process, all free of runs and blisters, uncoated spots or patches. S.S. shall be 18-8 composition (302 alloy) standard with No. 4 finish and polished to 180 grit and welded as previously specified. Provide butyl sealant sound deadening between tops and all structural supports or as required.

2.21 NAME PLATES

A. Each item of equipment shall have a corrosion resistant metal name plate with model number, serial number, name and address of the manufacturer securely fastened to equipment in a non- conspicuous area. All mechanical and electrical controls, switches, disconnects, remote compressors, etc. shall be labelled with metal or engraved phenolic plastic signage.

2.22 OVERSHELVES AND WALL SHELVES

A. Provide 10" wide NSF 16 gauge s.s. over-shelves or wall shelves unless noted in the plans or item specifications. Provide wall mounted shelves with rear and sides to be turned up square 1" and front edge to have sanitary roll rim. Provide heavy gauge s.s. wall mounting brackets 6" from ends of shelf with maximum of 4'-0" on centers.

B. Provide all over-shelves with sanitary rolled edges and bull nose corners on all four sides unless equipment is mounted on shelf (microwave, toaster, dishes, etc.) and provide 1/2" turn up at rear for that portion of the over-shelf. Provide s.s. tubular support standards as required for shelf mounted equipment and with provisions for mounting to table or counter top.

C. Provide all wall backing and/or structural support as required for shelves to support 50 pounds per square foot and coordinate installation of same with trades.

2.23 PAINTING

A. All galvanized material and black steel shall be thoroughly cleansed of all oil and foreign matter and given two (2) coats of enamel paint as selected.

2.24 ROLLED RIMS AND EDGES

A. Standard roll rim shall be coved up 3" with 1/2" diameter roll at 180 degrees and bullnose corners.

B. Square edge shall be turned down 2" at 90 degrees with 3/4" tight hem at bottom.

C. Marine edge shall be turned up 1/2" on a 45 degree angle and turned down 2" with 3/4" tight hem at bottom.

D. Wherever table tops are used in connection with sinks, the top shall be fabricated with a 1/2" high raised roll rim spillage edge unless otherwise specified. Top to be integrally raised approximately 1/2" at all edges and then rolled down 2" at 210 degrees with bull nose corners.

2.25 REINFORCED STRUCTURES

A. Counter, table, and cabinet framework shall be constructed of steel angles horizontally and channels vertically, made in sections to permit assembly on job with tops field welded. Vertical fronts and sides of cafeteria counters and similar enclosures are to be reinforced with channels on approximately 3'-0" centers to support the tray slide brackets.

B. Unless otherwise specified, angles or channel frames and similar cross bracing on not over 2'-0" centers to be provided under all counter and table tops to stiffen tops and furnish fastening supports for leg flanges.

2.26 SINKS

A. Provide 14 gauge s.s. coved corner sink bowls integrally welded as per plan with welded seamless construction with scored bottom towards a die stamped drain outlet with a Fisher lever handle waste and connected overflow located 1" below drain board and shall not interfere with plumbing, adjacent walls, equipment, etc. Provide 14 gauge s.s. bracket for drain stem. All multiple compartment sinks shall be double walled construction. When sinks are built into enclosed base counters, provide access holes for lever waste handle stem.

2.27 TABLE TOPS

A. METAL - Metal table tops to be 34" high and be constructed of 14 gauge 302 s.s. with NSF roll rim construction and bull nose corners unless otherwise noted. All seams and coved corners shall be welded, ground smooth and polished. Provide ferruled access holes for cutouts for water lines, cords and plugs, etc. as required in table tops, counter tops, urn stands, etc. All open base tables shall be reinforced with 12 gauge angles or channels. Provide welded cross angle or channel members shall be placed at each pair of legs with gussets, welded cross rails and feet as previously specified.

B. One angle runner, running lengthwise shall be provided on tops up to 30" wide; two provided on tops over 30" wide. All tops shall be reinforced so that there will be no noticeable deflection and all reinforcements shall be stud welded to the underside of the top. No rivets or bolts to be used through the top. Provide sound deadening material between tops and reinforcing members and underside of tops. Field joints are to be provided in the top where necessary.

2.28 UNDERSHELVES

A. The under-shelves on open base tables, dish tables, etc. shall be a solid removable 16 gauge s.s. shelf unless noted in the itemized specifications. Shelf is to be turned up at rear and down on all front and side (down on all island units) edges 1-1/2" with corners at legs cut out and mounted on the support stringers on all four sides. Provide ferruled access holes as required for drain lines, water lines, conduits, etc.

2.29 VENTILATION-HOODS-DUCTWORK

A. Unless otherwise stated in the item specifications, provide 300 series 18 gauge s.s hoods similar to Captive Air Co. or Duo Aire Co. or Accurex Co. and be manufactured in accordance with and bear the seal of NSF, UL, and NFPA 96. Hoods shall be mounted 6'-8" above finished floor and must overhang all equipment by a minimum of 6" at front (18" for drawer type broilers) and sides and be furnished with a full complement of s.s. UL filters, filter frame with grease cup, recessed LED lights inter-wired to junction box on top of hood and to switch on face of hood, duct collars, fire dampers, hangers, hemmed 18 gauge s.s. end panels, s.s. closure panels from top of hood to ceiling, cutouts and trim for power distribution system or columns, etc. Provide insulated NFPA integral 3" stand-off behind hood when installed on non-rated wall. Walls for hood mounting shall be rated as required by code.

B. All exhaust fans shall be UL-762 rated vertical discharge fans with insulated curb, hinged base with grease collection device, mounted and inter-wired starter and disconnect, adjustable drive assembly and be sized for CFM as per plans with a sound classification of "average" and not to exceed 12 sones.

C. All makeup air units shall be sized for CFM as per plan. Unit shall be fully factory built with supply fan, filter section with bird screen, motorized inlet dampers, metal cabinet with weather proof epoxy coated finish in color as selected by Owner, 12" legs and rails, curb, vibration eliminators, factory wired control panel and disconnect with wiring harness and pigtails for interlock of exhaust fan and make-up air unit to switch panel on face of hood or remotely located. If required by code provide a pre-heat section (gas, electric, steam or hot water) which shall provide a minimum degree rise capability (as shown in item specifications and/or as required by local code) complete with full modulating controls, thermostat, etc. as required for a complete system. Provide all UL listed components.

D. All ductwork shall be constructed and installed as per SMACNA minimum gauges and requirements. Make-up air ductwork shall be insulated and of rigid metal construction. Flex duct will not be allowed. Provide welded 16 gauge black iron exhaust ductwork as per code requirements and conform to all building requirements and obstructions with all dimensions subject to verification in field. Provide all ductwork with cleanouts every 6'-0" of horizontal run (with pitch as per code) and at changes in direction, access panel, dampers, curbs, flashing, flanges, plenums, supports, insulation, etc. as required by code and to provide a watertight system. Fire rating shall be provided as noted on the food service plans and in the item specifications.

E. System is to be factory tested and balanced as required for proper operation with written report to Architect and Owner.

F. Roof openings, structural support, fire proofing, and final connections shall be provided as outline in the Construction manager scope of work.

G. If required by code, cooking exhaust hoods shall have an Ansul Co. R-102 or equal chemical fire protection system and will be listed separately in the specifications.

2.30 WALK INS AND REFRIGERATION

A. Provide NSF and UL approved walk ins as per the item specifications size and shape as per plan by 8'-6" high and furnished with prefabricated modular construction tongue and groove cam lock style panels for walls with coved vinyl screed, ceilings, and floors with 4" foamed in place UL-25 flame spread class No. 1 urethane insulation with a minimum "R" factor of 32 and a "K" factor of 0.121. Wall and ceiling panels shall have 0.040 stucco embossed aluminum or 20 gauge 304 s.s. finish and floor panels shall be 0.100 smooth aluminum or 18 gauge s.s. with a rating of 700 pounds per square foot with non-skid floor strips. All panels shall have a ten-year guarantee and be installed with a watertight seal. Provide 4" s.s. high coved base molding at all exposed exterior and interior walls securely anchored and sealed as required. Provide ceiling hangers and structural supports as required.

B. If floorless construction is required refer to the Construction Manager scope of work. Provide 4" urethane insulation and vapor barriers for sub floor and tile floor. Provide coved floor screeds below wall panels anchored to red wood vapor barriers which shall extend up thru and 1/8” above the level of the finished floor, 6 mil polyethylene vapor barrier, etc. as per the manufacturers standard requirements. Supply and coordinate installation of walk-ins to assure proper fit of floor recesses, sizes, tile, insulation, grout, vapor barriers, drainage, etc.

C. Provide one surface mounted LED light fixture mounted above door for the first 50 square feet of floor space and one additional ceiling mounted fixture as shown on the plans. Lighting shall provide a minimum of 35 foot candles at 36" above floor. The light above door shall be inter-wired to switch and junction box, but all additional lights shall be installed and wired in field with conduit located outside the compartments.

D. Provide 36" by 78" in-fitting doors with magnetic gaskets, three C.P. cam lift hinges, s.s. front, 24" high interior aluminum tread plate kick plate, cylinder locks, and automatic door closer. Doors shall be mounted in reinforced panel with FRP or s.s. door jambs with thermal break and thermostatically controlled heater strip, s.s. heavy gauge heated threshold, safety release, digital thermometer, and virgin plastic full width door curtains mounted 6" above door header. Provide non heated relief air vents for cooler and inter-wired heated vents for all freezer compartments mounted above doors.

E. Provide removable closure trim with concealed fasteners of same appearance as walk-in exterior from box to all adjacent building walls and ceilings. Provide access panels and louvers as required for service.

F. Refrigeration systems shall be complete with items as specified or as required to provide a first class system. Should any dispute arise as to the quality of equipment or workmanship, the decision shall rest with the Consultant.

G. Hermetic or scroll compressors shall be mounted on anti-noise, anti-vibration blocks, and be factory mounted in welded angle iron frame and housing with support rails, metal curbs, timed defrost, factory installed control panel, pilot light, NEMA rated disconnects and starter, etc. Compressors to be factory pre-connected for final water and electrical connections. Verify that proper ventilation of compressors is obtained.

H. Provide coil and/or compressor condensate drain lines as required and shown on the drawings. Provide drain lines terminating with trap over floor drain where shown. Drain lines to be neatly insulated with material similar to Armaflex. Any drain line run through a freezer compartment shall also have a heater coil neatly wrapped over the line, prewired and shall operate continuously. No drain piping shall interfere with shelving within the compartment nor exit through the front of a compartment. All piping shall be concealed where possible.

I. Coils shall have timed defrost and immersion type thermostat and be connected to compressors by equipment supplier using type "L" copper tubing soldered using industry acceptable refrigerant. Refrigeration lines shall be insulated in same manner and materials as coil and drain lines and shall be concealed where possible.

J. Provide refrigeration system with expansion valves, pressure controls, strainers, solenoid valves, liquid dryers, adjustable room thermostats, hangers, king and queen valves, heat exchangers, oil separators, pump-down solenoid, low ambient controls, crankcase heater, outdoor shroud, shut-off valves, sleeves, sight glass with moisture indicator and all other items necessary for a complete system.

K. All electrical components within each compartment shall be pre-wired by supplier to junction box on exterior top of compartment. Make final connections and inter-wire to lights and from walk-in coils to compressor for timed defrost in conduit as required.

L. After final connections, evacuate, pressure test, charge, start up and operate system for a period of three (3) days and make all necessary adjustment of controls as required. Operate coolers at 35 degrees and freezers at -5 degrees unless noted on plans. Provide manufacturers five-year compressor warranties and one-year free service available within 12 hour notification.

2.31 WATER INLETS

A. Water inlet locations shall be located above positive water level to prevent syphoning of liquid into the water system.

B. Wherever conditions require water inlet placed below water level, a suitable pressure type syphon breaker or double check valve shall be placed on fixture to form a part of same to prevent back syphoning.

C. Exposed syphon breakers shall be chrome plated units with chrome plated piping and slip flanges where exposed.

2.32 MECHANICAL/ELECTRICAL MATERIALS REQUIRED IN FOOD SERVICE CONTRACT

A. The equipment supplier shall include materials properly labelled and packaged as follows:

B. PLUMBING APPURTENANCES:
1. Check requirements for gas, water, steam, etc. on job before ordering equipment. Information shown on drawings or specifications does not relieve contractor of this responsibility.
2. Faucets, pre-rinse units, lever wastes, vacuum breakers, to be as manufactured as described in the item specifications.
3. Except as otherwise specified, provide each sink compartment with deck type or backsplash type faucet with minimum 12" swing spout soft flow. Where multiple sink compartments are provided, faucets may be located between compartments.
4. C.P. brass overflow fittings shall be 1-1/2" tubing fully connected to sinks at factory with lever handle quick opening wastes with tailpieces on each sink compartment.

5. Provide all solenoids, C.P. atmospheric or pressure type vacuum breakers with C.P. stems above counter tops, shock absorbers, check valves, mixing valves, gas regulators, etc. required by code or for proper operation of equipment with mounting brackets as required. Valves shall be installed where required, accessible and convenient to the operator.
6. Provide swivel gas hoses assemblies 36" or of proper length as required with quick disconnect, ball valve, caster floor locks and 3000 pound coiled restraining device, and wall brackets.
7. All steam equipment shall have valves provided with heat resistant handles, traps, gauges, etc. as required for proper operation

C. ELECTRICAL APPURTENANCES:
1. Check voltage on job before ordering equipment. Information shown on drawings or specifications does not relieve contractors of this responsibility.
2. Except where noted under item specifications, current characteristics for motors 3/4 HP or less, solenoid valves and lighting shall be 120 volt, single phase, 60 cycle, A.C. Unless otherwise noted under item specifications, motors 3/4 HP and over shall be wound for 208/240 volts, three phase, 60 cycle, A.C.
3. Provide 120 volt control circuit on all equipment that operates on voltages on or over 208 volt. All equipment requiring 120 volt control circuits (120/480 volt, 120/208 volt, etc.) shall have transformers pre-wired on equipment.
4. Cords and plugs and receptacles for equipment shall be three or four wire all rubber coiled retractable style cord with ground as required and match receptacles provided and as best suited for the equipment. Units shall be mounted in NEMA type enclosures as per code with s.s. faceplates and boxes where receptacles are exposed.
5. Thermostats, unless otherwise noted on plans or in the item specifications, shall be provided at all equipment (bain-marie, urns, dish machines, hot food table, warming cabinets, etc.) with thermostatic control.
6. Heating elements to be of voltage and phase as specified or as required to suit job.
7. Controls, thermostats, switches, contactors, low water cut off, light fixtures and bulbs, etc., necessary for the installation and proper operation of equipment shall be furnished as required along with all starters and/or motor control switches for the proper function of the equipment specified. Controls mounted on vertical surfaces shall be recessed.
8. Controls that are an integral part of equipment shall be factory installed. Controls which are to be separately mounted shall be shipped loose for field installation. Coordinate all field installation so as to not interfere with access and/or operation.
9. Provide properly sized magnetic starters line voltage type with thermal overload relays and reset for normal operation by automatic control or pushbutton station for 208/240 volt control. Enclosures shall be general purpose NEMA type 1, A.C. voltage, unless located outdoors which will require a waterproof enclosure. Remote control motors shall have magnetic starters.
10. Disconnect switches shall be type non-fusible, single throw, heavy duty industrial, quick make, quick break. Circuit breakers may be used in lieu of above disconnects as per code.

11. Provide equipment with required internal wiring between elements, switches, motors, receptacles, starters, etc. complete to a junction box. Disconnect, starter, etc. as required and are to be “left ready” for final connections. All control circuits shall be 120 volt to ground.

PART 3 - GENERAL SPECIFICATIONS - EXECUTION

3.1 INSTALLATION AND MATERIALS

A. All work required under this section shall be installed by the proper trades having jurisdiction in this area concurrent with job progress, Construction manager scope of work and related field conditions. Such installation shall be under the direction of a competent supervisor. A site inspection is recommended prior to bidding if applicable.

B. Provide for the conveyance, uncrating, erection, assembling, setting in place, trim, cutting of holes and ferrules in equipment for piping, drains, electrical outlets, etc.

C. Coordinate installation with all trades, repairing of any damage done to equipment during installation, removal of debris created by installation, startup, testing, and cleaning of all equipment (new, existing, or relocated).

D. Where necessary to move equipment to make final connections, coordinate and assist all in moving equipment and be on the job to carefully level and adjust equipment as the connections are being made. During installation, coordinate with all trades on connection details and be responsible for meeting the individual equipment manufacturer's connection requirements. Report any infractions of installation procedure in written form.

E. The fit of all equipment as it joins all walls, floors, and corners shall be tight (within 1/4") to adjacent walls, seal all equipment with NSF approved clear sealing compound and/or s.s. trim molding of proper size with concealed fasteners. Inspect the site and advise in writing and/or on shop drawings all necessary building requirements door sizes, etc. to receive the equipment and assure accuracy of fit and installation.

F. All cabinet bases and pieces of equipment which are to be set on bases or machine platforms shall be set into a sealing compound of color to match the tile mortar. Enclosures, backsplashes, and turn-backs to wall shall be pressed into a ribbon of the same material with the excess wiped out to a radius fillet. Where necessary, and to eliminate shifting and the subsequent breaking of this seal, item shall be anchored to floor and wall with suitable masonry anchors. All equipment with utility connections (island style sinks, dish tables, etc.) shall also be anchored to floor with s.s. flange type feet.

G. All equipment and materials shall be new, of prime quality, full gauge thickness of compositions indicated by names or abbreviations stated in itemized specifications.

H. Equipment batteries of one manufacturer are to be pre-fitted at the factory and provide photographic proof of such work.

I. If equipment is noted as relocated or removed during the construction period, said equipment shall be disconnected and be re-connected as directed in the Construction Manager scope of work and removed and stored unless noted in the item specifications. Coordinate and supervise this work and label equipment for reuse. Reinstall and clean equipment as per the plans and specifications. Existing equipment not scheduled for reuse shall be removed as directed in the Construction Manager scope of work.

3.2 LIMIT OF OTHER SUBCONTRACTORS/TRADES RESPONSIBILITY

A. Hood Connections:
   1. Note that kitchen grease and/or dishwasher hoods and ducts may or may not be furnished as part of this contract. Refer to the plans and item specifications. Make connections to hood and connect to exhaust fan and make up air unit as directed in the Construction Manager scope of work. All ducts shall have welded and/or watertight joints. All roof holes, flashing, structural support, fire rating, and final connections are to be provided as directed in the Construction Manager scope of work.

B. Plumbing:
   1. Provide rough-ins and piping with stop valves, elbows, nipples, couplers, traps, waste vents, gas regulators, for water, steam, gas, etc. and make final connections to the equipment as directed in the Construction Manager scope of work.
   2. Install equipment accessories (faucets, lever wastes, solenoids, valves, gas hoses, nipples, etc.) as directed in the Construction Manager scope of work.
   3. Provide water heater and janitors sink unless otherwise indicated on the plans as directed in the Construction Manager scope of work.
   4. Disconnect and reconnect relocated equipment if applicable as directed in the Construction Manager scope of work.

C. Electrical:
   1. Provide rough-ins, controls, panels, switches, wall receptacles to match equipment cords and plugs, starters, junction boxes, canopy light and fan switches, conduit, wiring, wall outlets, disconnects, etc. and make final connections to the equipment as directed in the Construction Manager scope of work.
   2. Install equipment accessories (cords, wiring harness, switches, etc.) in conduit as required by code as directed in the Construction Manager scope of work.
   3. Disconnect and reconnect relocated equipment as directed in the Construction Manager scope of work.

D. General:
   1. All concrete platforms, bases, etc. will be provided as directed in the Construction Manager scope of work. Grouting of drip pans and/or floor troughs to be installed as directed in the Construction Manager scope of work.

2. All required holes and recesses for piping and ducts will be coordinated with all trades and as directed in the Construction Manager scope of work. Provide location, size, etc. This information is to be provided in adequate time to be incorporated in the work.
3. Unless stated in the item specifications, provide all floor recesses, insulated sub floors, tile floors and vapor barriers for walk-ins as noted in the plans and as directed in the Construction Manager scope of work.
4. If applicable, remove relocated equipment from kitchen and store in adjacent area during Kitchen construction period. Coordinate removal, inspection, storage, labeling, etc. of equipment. Reinstall relocated equipment as per plan after construction is completed as directed in the Construction Manager scope of work.
5. Provide fire rated walls in kitchen for cooking equipment exhaust hoods and non-combustible materials within 18" of top of hood or as required by fire codes as directed in the Construction Manager scope of work.

3.3 TESTING

A. After installation and hook, inspect, start up, clean, adjust and test all equipment under operating conditions for 48 hours prior to acceptance by Owner. If inspection or test shows defects, such defects shall be corrected and inspection and test repeated. Certify in writing that all equipment is performing in full compliance with the plans and specifications.

3.4 DEMONSTRATION

A. After utility connections to the equipment is completed, schedule and conduct the inspection and start up and final test of equipment prior to final inspection. Schedule the demonstration with the Owner and perform the demonstration in the presence of the Owner and/or their authorized representative with a minimum of seven days notification to owner.

B. Before final inspection, remove any and all protective covering from his work and give all parts of all equipment a thorough cleaning and servicing, leaving items free from defects and remove trash from premises.

C. Provide required competent personnel for two eight-hour periods as instructors to operating and maintenance personnel on the safe and proper operation and maintenance of all equipment. Provide additional instructions up to eight additional hours during the one-year guarantee period as requested by the Owner.

D. Present all maintenance manuals and as built drawings as previously specified or requested by Consultant.

3.5 FINAL INSPECTION AND PUNCH LIST

A. After installation is completed and tested, notify the Consultant who will review all equipment and submit a repair or punch list of all items that are not in compliance with the documents. All items shall be completed immediately and not to exceed 14 days unless written notice is submitted and approved.

3.6 SCHEDULE OF EQUIPMENT

A. The following specifications refer to items of food service equipment on the drawings which shall form a part of these specifications and are binding as written herein, and will indicate the required quantity, size, etc. of each item.

Item Specifications:

Item #101 – Walk-in Cooler & Freezer - Qty. of 1

Base Manufacturer:	Kolpak Co.	Base Model: R-Series
Alternate Manufacturer:	Norlake Co.	
Alternate Manufacturer:	Bally Co.	
Alternate Manufacturer:	American Panel Co.	
Alternate Manufacturer:	Imperial/Brown Co.	

Minimum specifications:

1. NSF walk-in sized approximately 20’-2.5” by 9’-8” and shape as shown on plan by 8'-4" high with aluminum interior and stainless steel exposed exterior finish, aluminum interior ceilings, door heaters, gaskets, pressure relief port, heated door threshold, etc. for all compartments. Provide digital thermometer with audio / visual alarm system with dry contactors to connect to building management system for all compartments.
2. Trades to furnish and install insulated sub-floor and vapor barrier as shown on plans. Minimum insulation value of the floor shall be R-28.
3. Provide standard 34" wide flush mount doors with 18” by 24’ heated triple pane viewport, stainless steel front, 24" high aluminum tread-plate interior kick-plate, two cam lift hinges, chrome plated hardware, and have same 4" thick foamed in place UL-25 flame spread rated urethane insulation as walls and ceiling. Provide Curtron Co. Polar Pro USDA Polar Grade self-closing hinged vinyl door curtain with .120” clear door panels and stainless-steel mounting hardware.
4. Furnish one LED light mounted over the door and extra 48” LED lights inter-wired to switch per plan. All lighting shall have a 40 Lumens per Watt efficacy or more including ballast loss.
5. Joints between walk-in and building walls and ceiling shall be closed with filler strips of same appearance as exterior of box with service access panels as required.
6. Provide one UL listed 208 Volt 3 Phase system for the cooler and one 208 Volt 3 Phase system for the freezer. Provide Copeland compressors piped to BTU matched Bohn low profile end mount coils. The freezer section shall have 208 Volt 1 Phase timed electric defrost coil. The Cooler section shall have 120 Volt air defrost coil. Both coils shall be furnished with electronically commutated motors, remote mounted (shipped loose) weather proof time clock for timed defrost, thermostat, solenoid, “P”-trap and expansion valves mounted and wired.

7. The air-cooled compressors shall be factory assembled and mounted on heavy duty steel base and be placed on roof with outdoor package in aluminum housing with hinged shroud, head pressure control with flood back, crankcase heater, sight glass, frame mounted dual pressure control, oversize condenser, drier, suction line filter, suction vibration eliminator, oversize receiver with total pump down capacity and king and queen service valves. Provide a pre-wired NEMA-3 control panel with industrial grade fused disconnect, terminal block, magnetic starters, circuit breakers and contactors, defrost timer and pump down switch.
8. Provide approximately 40’-0" of field piped and pressure tested insulated refrigeration lines per compartment to connect compressors to coils. Provide refrigeration with piping, controls, drain lines and heat tape, etc.
9. Provide a 5 Year warranty on compressors and 1 Year free service plan as per G.S.
10. Final connections, structural support, etc. are by Trades.

Item #102 - Utility Cart - Qty. of 2

Base Manufacturer:	Lakeside Co.	Base Model: 744
Alternate Manufacturer:	Eagle Metalmasters Co.	
Alternate Manufacturer:	Metro Co.	

Minimum specifications:
1. Unit to be fully welded and constructed of stainless steel.
2. Shelf mounted bumper strip.
3. Three shelves.
4. Heavy duty locking swivel casters.
5. 700 lbs. capacity.

Item #103 - Shelving - Qty. of 29

Base Manufacturer:	Cambro Co.	Base Model: CPU-72-V4
Alternate Manufacturer:	Inter-Metro Co.	

Minimum specifications:
1. Provide polymer unit size and shape as per plan.
2. Units in the cooler & freezer shall have 64” posts, all remaining units shall have 72” posts.
3. Post connectors, traverses and four vented shelf plates.
4. Two swivel and two locking casters.

Item #104 – Lockers – Not in Kitchen Equipment Contract.

Item #105 - Pan Rack - Qty. of 1

Base Manufacturer:	New Age Co.	Base Model: 1335
Alternate Manufacturer:	Channel Co.	
Alternate Manufacturer:	Lakeside Co.	
Alternate Manufacturer:	Advance Tabco Co.	

Minimum specifications:
1. Provide fully welded universal angle 64" high aluminum rack.
2. Two 5” heavy duty swivel casters and two 5” heavy duty locking swivel casters.

Item #106 – Mop Sink Cabinet – Qty. of 1

Base Manufacturer:	Eagle Metal-masters Co.	Base Model: F1916-VSCS-DL
Alternate Manufacturer:	Approved Manufacturer as listed in Section 2.03 of the General Specifications	

Minimum specifications:
1. Provide cabinet style 430 series stainless steel unit with open back, louvered sides and sloped top.
2. Double pan locking doors
3. Integral mop sink.
4. T&S Co. B-0655-BSTP service faucet with vacuum breaker, hose, and support bracket.
5. Four fixed interior shelves and two pole mop holder.

Item #107 - Fire Protection System - Qty. of 1

Base Manufacturer:	Pyro-Chem Co.	Base Model: Kitchen Knight II
Alternate Manufacturer:	Ansul Co.	
Alternate Manufacturer:	Range Guard Co.	
Alternate Manufacturer:	Kidde Co.	
Alternate Manufacturer:	Amerex Co.	

Minimum specifications:
1. Furnish and install a pre-engineered wet chemical fire detection and suppression system, properly sized, to protect the hood, duct, plenum, and surface appliances. The system shall be installed in accordance with NFPA Standard 17A and 96 and meet UL 300. The installation shall also comply with all local and/or state codes and standards.
2. The cylinder and controls shall be housed in approved stainless steel cabinet and be mounted as shown on plans. The system shall be capable of both automatic and manual operation with a remote mechanical manual pull station (54" above floor) located in the path of egress, a minimum of 10 feet and a maximum of 20 feet from the hood. Provide fusible link detectors properly located and temperature rated per manufacturer’s specifications for automatic detection.
3. Provide and locate piping and required nozzles for duct, plenum, and surface appliance protection as per manufacturer’s specifications. Provide concealed piping where possible with non-exposed piping and fittings shall be black pipe and stainless-steel or chrome-plated or chrome sleeved where exposed (no galvanized piping). No horizontal supply piping greater than 6 inches from a T is allowed under the hood. All hood penetrations to be accomplished by UL listed seal-tite fittings.

4. Provide a mechanical gas shut-off valve of approximately 2" - VIF. The valve shall be installed in an accessible location within 20 feet of the hood by the mechanical trades - verify in field.
5. Provide 2 double pull double throw micro-switches in the control head and an approved electrical box mounted to Stainless Steel Cabinet for connections. No wire connections are to be made inside control cabinet. Upon activation of system the following shall occur: All electrical under the hood, including wall outlets, are de-activated. The hood exhaust fan shall continue to operate, and the hood make up air unit shall shut down.
6. Provide a 120 Volt horn/strobe mounted on fire cabinet to activate upon discharge or wire into building fire alarm system as required. Complete all required pressure/puff tests, and system documentation as required by the local Fire Marshall.
7. Provide and install 1 Class K portable fire extinguisher for the kitchen. Mount in location coordinated with the Owner and/or Contractor.

Item #201 – Trash Bin – By Owner

Item #202 – Prep Table - Qty. of 1

Base Manufacturer:	Eagle Metalmasters Co.	Base Model: YJRAN30-SEM-BS
Alternate Manufacturer:	Approved Manufacturer as listed in Section 2.03 of the General Specifications	

Minimum specifications:
1. 14 Gauge 304 stainless steel table as per G.S. size and shape as per plan by 34" high with 6” backsplash.
2. Stainless steel legs, gussets, and adjustable bullet feet.
3. Marine edge and sound deadened top.
4. 16 Gauge stainless steel under shelf.
5. One 20" by 20" by 5" deep roller bearing drawer assembly with stainless-steel or plastic insert and an 18” by 24” white poly cutting board mounted below drawer.
6. One 18" by 24" by 14" deep coved corner sink with T&S Co. B-3990-01 modular waste drain with connected overflow, and T&S Co. 5F-8WLS12 faucet with rear connector kit.
7. 10" deep stainless steel over shelf mounted 24" above table surface as shown on plan.

Item #203 – Can Rack – Qty. of 1

Base Manufacturer:	New Age Co.	Base Model: 1250CK
Alternate Manufacturer:	Channel Co.	
Alternate Manufacturer:	Lakeside Co.	

Minimum specifications:
1. Provide fully welded aluminum unit.
2. Heavy duty locking casters.

Item #204 – Pass Thru Worktable - Qty. of 1

Base Manufacturer:	Eagle Metalmasters Co.	Base Model: CBH30-SE
Alternate Manufacturer:	Approved Manufacturer as listed in Section 2.03 of the General Specifications.	

Minimum specifications:

1. Furnish and install 14 Gauge 304 enclosed base stainless steel table as per G.S. size and shape as per plan by 34" high.
2. Stainless steel legs and gussets.
3. Flat sound deadened top.
4. Sliding locking doors at front and rear.
5. 16 Gauge stainless steel adjustable intermediate shelf and bottom.
6. 6” stainless-steel legs with adjustable bullet feet.

Item #301 - Hood & Ventilation System - Qty. of 1

Base Manufacturer:	Captive Aire Co.	Base Model: NDFP
Alternate Manufacturer:	Z-Vent Co.	
Alternate Manufacturer:	Accurex Co.	

Minimum specifications:

1. Furnish and install 24" high single shell 18 Gauge 430 series stainless steel (where exposed) hood per the General Specifications size and shape per plan to cover all cooking equipment and be mounted 6'-8" above floor with open capture ends, duct collars, grease cups and gutter, recessed 3K LED lights factory wired to junction box, hanger rods and brackets and insulated rear standoff. FSEC shall furnish and install a 20 Gauge stainless steel wall panel mounted from bottom edge of hood to top of coved base wall tile with concealed fasteners and trim strips.
2. System shall be built in accordance with and bear the seal of NFPA, NSF, and UL with 20" high UL listed Captrate Solo stainless-steel filters running full length of hood.
3. Provide remote wall mounted variable volume control panel and HMI interface (two gang electrical junction box provided by the Trades) with fan and light switch, variable frequency drives, CAT 5 cable (installed by Trades), room temperature sensor and cellular on-line monitoring capability. Control panel to be variable volume and shall modulate exhaust fan and MUA speed during the cooking operation to maximize energy savings. Controls to include CASLink cloud-based building management system with or without BMS interlock capabilities.
4. Provide stainless steel closure panels from top of hood to ceiling and insulated full height vertical stainless steel end panels with floor mounting legs and gas line cutout.
6. Hood shall be designed to automatically activate exhaust fan whenever cooking operation occurs. The activation of the exhaust fan shall occur through an interlock with cooking appliances, by means of heat sensors or by means of other approved methods.
7. The Trades shall provide wiring to inter-wire lights, control panel, HMI interface, heat sensor, exhaust fan and makeup air unit to hood control panel to interlock as required by code. This wiring shall be installed by the trades in conduit as required.
8. System is to be factory commissioned, tested, and balanced as required for proper operation by Trades with written report to Consultant, Architect and/or Owner.

9. Roof openings, 2 Hour fire rated exhaust ductwork, exhaust fan, make-up air ductwork, make-up air unit, fire rated walls within 18" of hood, structural support, and final connections shall be by the trades.

Item #302 - Range - Qty. of 1

Base Manufacturer:	Southbend Co.	Base Model: 4241E
Alternate Manufacturer:	Vulcan Co.	
Alternate Manufacturer:	Garland Co.	
Alternate Manufacturer:	Montague Co.	

Minimum specifications:
1. Furnish and install unit with four non-clog burners 33,000 BTU burners.
2. Standard oven.
3. Stainless steel flue riser with removable slotted over shelf.
4. Stainless steel front and sides.
5. 5" heavy duty locking casters.
6. 3/4" rear gas connection.
7. Dormont Co. or T&S Co.1675-KIT-S-PS swivel gas hose with quick disconnect, gas valve, posi-sets, and restraint line.

Item #303 - Convection Oven - Qty. of 1

Base Manufacturer:	Southbend Co.	Base Model: GS-25-SC
Alternate Manufacturer:	Vulcan Co.	
Alternate Manufacturer:	Garland Co.	
Alternate Manufacturer:	Montague Co.	

Minimum specifications:
1. Double deck standard depth.
2. Gas fired unit that operates on 120 Volt with cords and plugs.
3. Stainless steel front and sides.
4. Door windows.
5. Flue deflector.
6. 5" heavy duty locking casters.
7. Two speed motors with solid state control panel with standard controls.
8. Two Dormont Co. or T&S Co. 1675-KIT-S-PS swivel gas hose with quick disconnect, gas valve, posi-sets and restraint line. A single gas hose can be provided if the unit is factory inter-piped or manifolded to a single point gas connection.

Item #304 – Steamer – Qty. of 1

Base Manufacturer:	Cleveland Range Co.	Base Model: 24-CGA-10
Alternate Manufacturer:	Vulcan Co.	
Alternate Manufacturer:	Accu-Temp Co.	
Alternate Manufacturer:	Groen Co.	

Minimum specifications:

1. Furnish and install a gas fired double compartment convection steamer that operates on 120 Volt.
2. Generator cleaning light and exterior deliming port.
3. Pressure type vacuum breaker, automatic water fill and drain, low water cutoff.
4. 60 Minute electro-mechanical timer with LED indicator lights with timed and manual bypass switch. Steam generator stand-by mode.
5. Steam and fan shut off controls.
6. Provide self-contained point of use Everpure Co. or 3M Co. Reverse Osmosis System (model # EZ RO 375/50ATM) mounted in location as shown on the plan.
7. Prior to ordering equipment, the FSEC shall perform a water test. If the water levels are within acceptable standards, the Reverse Osmosis system will be replaced with a steam acceptable filtration system as recommended by the manufacturer. The contract will be adjusted as required.
8. 4" legs with flanged feet.
9. Left hinged door.
10. Ten 12” by 20” by 2.5” deep pan capacity.
11. One Dormont Co. or T&S Co. 1675-KIT-S swivel gas hose with quick disconnect, gas valve, and restraint line.
12. DWT-1 drain water tempering kit and all associated hardware.
13. Dormont Co. or T&S Co. W50B2Q-36 uncoated flexible water hose with 2-way quick disconnect.

Item #304A – Reverse Osmosis System – Included in Item #304.

Item #304B – Drain Water Tempering Kit – Included in Item #304.

Item #305 – Freezer - Qty. of 1

Base Manufacturer:	Traulsen Co.	Base Model: G22010
Alternate Manufacturer:	Continental Co.	
Alternate Manufacturer:	True Co.	
Alternate Manufacturer:	Victory Co.	

Minimum specifications:

1. Unit to operate on 120 Volt with cord and plug and have top mount expansion valve style of refrigeration system.
2. Stainless steel exterior front and standard door hinging.
3. Digital thermometer.
4. Five coated shelves per door.
5. 5” heavy duty locking casters.

6. Provide a 5 Year warranty on compressor and 1 Year free service plan as per G.S.

Item #306 - Refrigerator - Qty. of 1

Base Manufacturer:	Traulsen Co.	Base Model: G10010
Alternate Manufacturer:	Continental Co.	
Alternate Manufacturer:	True Co.	
Alternate Manufacturer:	Victory Co.	

Minimum specifications:
1. Unit to operate on 120 Volt with cord and plug and have top mount expansion valve style of refrigeration system.
2. Stainless steel exterior front and right door hinging.
3. Digital thermometer.
4. Five coated shelves.
5. 5” heavy duty locking casters.
6. Provide a 5 Year warranty on compressor and 1 Year free service plan as per G.S.

Item #401 – Hot Food Table – Qty. of 1

Base Manufacturer:	LTI Co.	Base Model: EF4-CPA Modified
Alternate Manufacturer:	Randell Co.	
Alternate Manufacturer:	Delfield Co.	
Alternate Manufacturer:	Duke Co.	

Minimum specifications:
1. Provide 34” high unit size and shape per plan that operates on 208 Volt 1 Phase.
2. Stainless-steel top, latching assembly, and stainless-steel undershelf.
3. Wet or dry hot food wells with drains, drain manifold with individual and master valves. Drain valves to be easily accessible from the employee side of the counter.
4. Open rear with plastic laminate front and end panels in color as selected by the Architect.
5. One 12” solid folding inverted “V” style stainless steel tray slide mounted 32” above finished floor and one 8” stainless steel solid folding work shelf mounted on rear.
6. 5” heavy duty locking casters.
7. Furnish and install BSI Co. PMG Co. or Vollrath-ACS Model #ZG9930 sneeze guard with brushed aluminum uprights and surface mounted hardware, slim/stealth heat lamp, LED light, glass top, ends, and adjustable front. Unit shall meet current NSF standards. Posts in front of food wells or food display shall not be acceptable.
8. Sneeze guard assembly and hot food table to be inter-wired to a common point to provide one electrical connection for entire unit and be supplied with a cord and plug.
9. Dormont Co. or T&S Co. W50B2Q-36 uncoated flexible water hose with two LFW50QD 2-way quick disconnects.
10. T&S Co. B-0208 Hot water fill faucet with red index ring.
11. A garden hose style of drain connection is not acceptable.

Item #401A – Hot Food Table w/ Heated Base – Qty. of 1

Base Manufacturer:	LTI Co.	Base Model: EF4-CPA Modified
Alternate Manufacturer:	Randell Co.	
Alternate Manufacturer:	Delfield Co.	
Alternate Manufacturer:	Duke Co.	

Minimum specifications:

1. Provide 34” high unit size and shape per plan with heated base that operates on 208 Volt 1 Phase.
2. Stainless-steel top, latching assembly, and stainless-steel undershelf.
3. Wet or dry hot food wells with drains, drain manifold with individual and master valves. Drain valves to be easily accessible from the employee side of the counter.
4. Open rear with plastic laminate front and end panels in color as selected by the Architect.
5. One 12” solid folding inverted “V” style stainless steel tray slide mounted 32” above finished floor and one 8” stainless steel solid folding work shelf mounted flush at rear.
6. 5” heavy duty locking casters.
7. Furnish and install BSI Co. PMG Co. or Vollrath-ACS Model #ZG9930 sneeze guard with brushed aluminum uprights and surface mounted hardware, slim/stealth heat lamp, LED light, glass top, ends, and adjustable front. Unit shall meet current NSF standards. Posts in front of food wells or food display shall not be acceptable.
8. Sneeze guard assembly and hot food table to be inter-wired to a common point to provide one electrical connection for entire unit and be supplied with a cord and plug.
9. Dormont Co. or T&S Co. W50B2Q-36 uncoated flexible water hose with two LFW50QD 2-way quick disconnects.
10. T&S Co. B-0208 Hot water fill faucet with red index ring.
11. A garden hose style of drain connection is not acceptable.

Item #402 – Utility Counter – Qty. of 1

Base Manufacturer:	LTI Co.	Base Model: Flex Line
Alternate Manufacturer:	Randell Co.	
Alternate Manufacturer:	Delfield Co.	
Alternate Manufacturer:	Duke Co.	

Minimum specifications:

1. Provide 34” high unit as per plan.
2. Stainless-steel top, latching assembly, and stainless-steel undershelf.
3. Open rear with plastic laminate front and end panels in color as selected by the Architect.
4. One 12” solid folding inverted “V” style stainless steel tray slide mounted 32” above finished floor.
5. 5” heavy duty locking casters.

Item #402A – Utility Counter – Qty. of 1
Base Manufacturer: LTI Co. Base Model: Flex Line
Alternate Manufacturer: Randell Co.
Alternate Manufacturer: Delfield Co.
Alternate Manufacturer: Duke Co.

Minimum specifications:
1. Provide 34” high unit as per plan.
2. Stainless-steel top and latching assembly.
3. Open rear with plastic laminate front and end panels in color as selected by the Architect.
4. One 12” solid folding inverted “V” style stainless steel tray slide mounted 32” above finished floor.
5. 5” heavy duty locking casters.
6. Provide open area to accommodate under counter refrigerator with adequate ventilation louvers in counter front panel if required.

Item #402B – Portable Condiment Counter – Qty. of 1
Base Manufacturer: LTI Co. Base Model: Flex Line
Alternate Manufacturer: Randell Co.
Alternate Manufacturer: Delfield Co.
Alternate Manufacturer: Duke Co.

Minimum specifications:
1. Provide 34” high unit as per plan.
2. Stainless-steel top and stainless-steel undershelf.
3. Enclosed base with sliding doors at front and plastic laminate front, rear, and end panels in color as selected by the Architect.
4. Two 12” solid folding inverted “V” style stainless steel tray slides mounted 32” above finished floor.
5. 5” heavy duty locking casters.

Item #403 – Cold Food Table – Qty. of 2
Base Manufacturer: LTI Co. Base Model: 60-CFMA Modified
Alternate Manufacturer: Randell Co.
Alternate Manufacturer: Delfield Co.
Alternate Manufacturer: Duke Co.

Minimum specifications:
1. Provide 34” high unit as per plan with NSF-7 drop-in self-contained refrigerated cold pan with drain and shut off valve, on/off switch, and pan adapter bars. Unit shall operate on 120 Volt.
2. Stainless-steel top, latching assembly, and stainless-steel undershelf.
3. Open rear with plastic laminate front and end panels in color as selected by the Architect.

4. One 12” solid folding inverted “V” style stainless steel tray slide as shown on plan mounted 34” above finished floor.
5. 5” heavy duty locking casters.
7. Furnish and install BSI Co. PMG Co. or Vollrath-ACS Model #ZG9930 sneeze guard with brushed aluminum uprights and surface mounted hardware, LED light, glass top, ends, and adjustable front. Unit shall meet current NSF standards. Posts in front of food wells or food display shall not be acceptable.
8. Sneeze guard assembly and hot food table to be inter-wired to a common point to provide one electrical connection for entire unit and be supplied with a cord and plug.
8. Garden hose hook style of drain connection is not acceptable.

Item #404 – Condiment Dispenser – Qty. of 2
Base Manufacturer: Server Products Co. Base Model: 07060
Alternate Manufacturer: None

Minimum specifications:
1. Provide countertop units with five pumps.
2. Unit to hold 1.5 Gallon or 6 Liter pouches with a 16mm fitment.
3. Adjustable portion control.
4. Discharge tube fittings.
5. 07299 Quintuple drip tray assembly.

Item #405 - Milk Cooler - Qty. of 1
Base Manufacturer: Beverage Air Co. Base Model: SMF49HC-1-S
Alternate Manufacturer: True Co.
Alternate Manufacturer: Continental Co.

Minimum specifications:
1. Self-contained forced air unit that operates on 120 Volt with cord and plug.
2. Dial thermometer.
3. Lid locking device.
4. Stainless steel exterior.
5. Heavy duty locking casters.

Item #405A - Milk Cooler - Qty. of 1
Base Manufacturer: Beverage Air Co. Base Model: SMF49HC-1-S
Alternate Manufacturer: True Co.
Alternate Manufacturer: Continental Co.

Minimum specifications:
1. Self-contained forced air unit that operates on 120 Volt with cord and plug.
2. Dial thermometer.
3. Lid locking device.
4. Stainless steel exterior.
5. Heavy duty locking casters.

Item #406 – Cashier Counter – Qty. of 2

Base Manufacturer:	LTI Co.	Base Model: Flex Line
Alternate Manufacturer:	Randell Co.	
Alternate Manufacturer:	Delfield Co.	
Alternate Manufacturer:	Duke Co.	

Minimum specifications:
1. Counter to be 34" high, size and shape as per plan.
2. Stainless-steel top, latching assembly, and stainless-steel undershelf.
3. Plastic laminate front, rear, and one end panel in color as selected by the Architect.
4. One 12” solid folding inverted “V” style stainless steel tray slide as shown on plan mounted 32” above finished floor.
5. Provide locking ventilated door at end, one locking cash drawer and stainless steel interior under shelf.
6. 5” heavy duty locking casters.

Item #407 – Cash Registers / POS – By Owner.

Item #408 – Pass Thru Refrigerator/Heated Cabinet - Qty. of 1

Base Manufacturer:	Traulsen Co.	Base Model: ADH132WPUT-HHS
Alternate Manufacturer:	Victory Co.	
Alternate Manufacturer:	Continental Co.	
Alternate Manufacturer:	Victory Co.	

Minimum specifications:
1. Furnish and install unit that operates on 120/208 Volt 1 Phase with cord and plug.
2. 6” stainless steel legs with adjustable bullet feet.
3. Stainless steel fronts and doors.
4. Aluminum interior, and stainless-steel interior bottom.
5. Digital thermometer.
6. 5 sets of universal angle tray slides mounted in each section.
9. Provide a 5 Year warranty on compressor and 1 Year free service plan as per G.S.

Item #409 – Portable Crowd Control Barrier – Qty. of 2

Base Manufacturer:	Lawrence Co.	Base Model: 889T2
Alternate Manufacturer:	American Metalcraft Co.	
Alternate Manufacturer:	Tensator Co.	

Minimum specifications:
1. Furnish and install unit size and shape as per plan with black double tape.
2. Locking tape receivers with 4-way connections and slow retract tape cassette.
4. Heavy weight black base with floor protectors and black or chrome uprights.

Item #410 – Under Counter Refrigerator - Qty. of 1

Base Manufacturer:	True Co.	Base Model: TUC-27-LP
Alternate Manufacturer:	Traulsen Co.	
Alternate Manufacturer:	Delfield Co.	
Alternate Manufacturer:	Randell Co.	
Alternate Manufacturer:	Victory Co.	
Alternate Manufacturer:	Continental Co.	

Minimum specifications:
1. Furnish and install one door self-contained refrigerated unit size and shape as per plan by 31-7/8" high.
2. Unit to slide under item #402A – Utility Counter and come equipped with a stainless-steel top.
3. Stainless steel exterior.
4. Locking stainless steel door.
5. Vinyl coated shelves.
6. 1.5" heavy duty casters.
7. Unit shall operate on 120 Volt with cord and plug.
8. Provide a 5 Year warranty on compressor and 1 Year free service plan as per G.S.

Item #501 – Spare Number

Item #502 - Hand Sink - Qty. of 4

Base Manufacturer:	Eagle Metalmasters Co.	Base Model: HSA-10-LRS
Alternate Manufacturer:	Approved Manufacturer as listed in Section 2.03 of the General Specifications	

Minimum specifications:
1. 10” X 14” X 5” deep stainless-steel sink with fully welded side splashes.
2. T&S Co. 5F-4WWX05 faucet.
3. Rear connector kit.
4. Wrist blades.
5. Soap and towel dispenser shall be provided and installed by the Contractor.

Item #503 - Pot Sink - Qty. of 1

Base Manufacturer:	Eagle Metalmasters Co.	Base Model: YJRAN2660-3-18
Alternate Manufacturer:	Approved Manufacturer as listed in Section 2.03 of the General Specifications	

Minimum specifications:
1. 14 Gauge 304 unit constructed per G.S. size and shape as per plan by 34" high.
2. 9" backsplash, 21" by 26.5" by 14" deep sinks.
3. Integral drain boards.
4. One T&S Co. 5F-8WLS12 faucet, and one 5PR-8W12-C + B-TEE-RGD spray hose unit and faucet.
5. T&S Co. B-3990-01-3X modular waste drains with connected overflows.

6. Stainless steel legs, gussets, and adjustable bullet feet.
7. Area below tables is to be furnished with 16 Gauge removable stainless steel under shelving where possible.
8. Provide 14" coated wire wall shelves and brackets mounted 24" above sink as shown on plans.

Item #504 - Clean Dish Table - Qty. of 1
Base Manufacturer: Eagle Metalmasters Co. Base Model: CDT-NSF
Alternate Manufacturer: Approved Manufacturer as listed in Section 2.03 of the General Specifications

Minimum specifications:
1. 14 Gauge 304 unit constructed per G.S. size and shape as per plan by 34" high with sound deadening.
2. Stainless steel legs, gussets, and adjustable bullet feet.
3. Area below tables is to be furnished with 16 Gauge removable stainless steel under shelving where possible. Provide open area for floor mounted water softener.
4. Provide 14" coated wire wall shelf and brackets mounted 24" above table as shown on plans.

Item #504A - Soiled Dish Table - Qty. of 1
Base Manufacturer: Eagle Metalmasters Co. Base Model: SDT-NSF
Alternate Manufacturer: Approved Manufacturer as listed in Section 2.03 of the General Specifications

Minimum specifications:
1. 14 Gauge 304 unit constructed per G.S. size and shape as per plan by 34" high with sound deadening.
2. Stainless steel legs, gussets, and adjustable bullet feet.
3. Drain trough with removable basket prior to dish machine.
4. Area below tables is to be furnished with 16 Gauge removable stainless steel under shelving where possible.
6. Integrally welded 18" disposer cone and switch bracket.
7. Provide 14" coated wire wall shelf and brackets mounted 24" above table as shown on plans.

Item #505 – Water Softener & Filtration – Included in Item #506.

Item #506 - Dishwasher & Booster Heater - Qty. of 1
Base Manufacturer: Hobart Co. Base Model: AM-15T-2
Alternate Manufacturer: Meiko Co.
Alternate Manufacturer: Champion Co.

Minimum specifications:
1. Provide unit with extended height chamber.

2. Unit shall operate on single point 208 Volt 3 Phase electrical connection with control panel, and disconnect switch for wall mounting by E.C.
3. Five KW tank heater with thermostat and low water cutoff.
4. Eight dish racks (two flat, six peg).
5. Unit shall be furnished with a built-in booster heater with stainless steel tank, and low water cutoff, pressure relief valve, inter-wired and inter-plumbed. Unit shall have a 70 Degree rise capability and be preset to provide 180 Degree hot water to dish machine.
6. Pressure reducing valve with line strainer and a shock stop for installation by the P.C.
7. Chemical system shall be provided by purveyor.
8. DWT-1 drain water tempering kit and all associated hardware.
9. Factory start-up & training.
10. Provide self-contained point of use Water Softening System mounted under dish table.
11. Prior to ordering equipment, the FSEC shall perform a water test. If the water levels are within acceptable standards, the Water Softening System may be removed. The contract will be adjusted as required.

Item #506A – Drain Water Tempering Kit – Included in Item #506
Item #507 - Disposer - Qty. of 1

Base Manufacturer:	Salvajor Co.	Base Model: 200-CA-18-MRSS-LD
Alternate Manufacturer:	Insinkerator Co.	

Minimum specifications:
1. 18" stainless steel cone assembly with silver saver.
2. Solenoid valve.
3. Flow control.
4. T&S Co. B-0455 vacuum breaker assembly.
5. Unit shall operate on 208 Volt 3 Phase 2 HP.
6. Provide a MRSS-LD series NEMA-4X stainless steel control panel with 24 Volt circuitry, run light, interlocked line-disconnect, manual reversing switch, start-stop buttons, and magnetic contactors.
7. Provide T&S Co. 5PR-8W00-C + B-TEE-RGD spray hose unit with rear connector kit.

Item #508 - Dishwasher Hood – Qty. of 1

Base Manufacturer:	Eagle Metalmasters Co.	Base Model: HDC
Alternate Manufacturer:	Approved Manufacturer as listed in Section 2.03 of the General Specifications	

Minimum specifications:
1. Provide 18 Gauge stainless steel hood 4'-0" deep by 5’-0” wide by 24" high as per plan with hanger rods.
2. All equipment shall be sized for CFM as shown on plan and, shall conform to all applicable codes.
3. Wiring from exhaust fan to dishwasher fan vent control contactor (located in the dishwasher control panel) shall be furnished and installed by the trades.
4. System is to be tested and balanced as required for proper operation by the Mechanical Trades.

5. Wall openings, exhaust ductwork, exhaust fan, structural support, and final connections shall be by the trades.

END OF SECTION 114000

SECTION 116001 - BROADCAST, THEATER AND STAGE EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Acoustic room components including the following:
   1. Acoustical wall and ceiling panels. (Traditional Acoustic Panel Series)

1.2 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International (ASTM):
   1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. ASTM E 413 - Classification for Rating Sound Transmission.
   4. ASTM E795 - Practices for Mounting Test Specimens during Sound Absorption Tests.

C. Underwriter's Laboratory (UL):
   1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Maintenance instructions and recommendations.

B. Shop Drawings:
   1. Submit component and project specific installation drawings, cut sheets, and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. Submit for approval before beginning any fabrication, installation, or erection.
   2. Include fabrication and installation details. Distinguish between factory and field work.
   3. Include plans, elevations, sections, attachments and work by other trades.
   4. Include wiring diagrams when applicable.
   5. Indicate seismic bracing and fastening requirements as applicable.
   6. For theater seating, develop sightline plan and sections through seating areas using sightlines program and sightline rules. Include options placement, electrical schematic for aisle lighting and placement of seating with table arms as applicable.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain all products from a single manufacturer through one source providing a comprehensive material and installation package:

B. Manufacturer Qualifications: Minimum 5 years' experience in design and manufacturing of similar products on projects of similar size, scope and complexity, and with the production capacity to meet the construction and installation schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened containers with manufacturer's labels attached. Do not deliver material until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.

B. Handle and install materials to avoid damage.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, HVAC system is operating and maintaining ambient temperature at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
   1. Coordinate installation and location of blocking and supports as requested.
   2. Verify openings, clearances, storage requirements and other dimensions relevant to the installation and final application.
   3. Where applicable, coordinate locations of electrical junction boxes.

C. Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
   1. Coordinate locations of electrical junction boxes.

D. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.7 WARRANTY

A. Special Warranty for Acoustic Room Components: Manufacturer's written warranty indicating manufacturer's intent to repair or replace panels that fail in materials or workmanship. Failures are defined to include, but are not limited to, the following:
   1. Fracturing or breaking of unit components which results from normal wear and tear and normal use other than vandalism.
   2. Warping of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.

3. Failure of unit to perform acoustically in accordance with manufacturer's published data.
4. Sound-Absorbing and Sound-Diffusing Panels Warranty Period: 5 years.

PART 2 - PRODUCTS

2.1 TRADITIONAL ACOUSTIC PANEL SERIES

A. Basis of Design: Provide a system of acoustical panels, as manufactured by Wenger Corporation, that absorb or diffuse sound in a configuration designed to reduce excess sound energy levels and improve sound distribution throughout the space.

B. Performance Requirements: Provide sound absorbing and sound-diffusing panels meeting requirements with the following characteristics:
   1. Wall Panel Mounting Types for Acoustical Performance Characteristics according to ASTM E 795, with measurements determined according to ASTM C 423:
      a. No air space.

C. Convex Ceiling Diffuser Panels: Acoustically-configured, polycylindrical convex molded thermoplastic panel, 0.125 inch (3 mm) thick, and width and length indicated.
   1. Basis of Design Product: Wenger Convex Ceiling Diffuser Panels.
   2. Finish: Manufacturer's standard textured white.
   3. Ceiling Panel Mounting Method:
      a. Lay-in ceiling grid clip. All lay-in ceiling panels include safety cable attachment to permanent ceiling grid in all four corners of ceiling panel.
   4. Acoustical Performance, Sound Absorption Coefficients, One-third Octave Band Center Frequency, Hz, for 48 by 48 inches (1219 by 1219 mm) unit, Mounting Type A.
      a. 125Hz = 0.20.
      b. 250Hz = 0.11.
      c. 500Hz = 0.17.
      d. 1000Hz = 0.04.
      e. 2000Hz = 0.09.
      f. 4000Hz = 0.21.

D. Fire-rating: The fully assembled product, as installed, shall meet Class A fire protection. Test results for flame spread and smoke developed shall be provided upon request. Individual component level fire test data is not sufficient to meet Class A fire protection requirements and shall not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Proceed with installation only after correction of unsatisfactory conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION - GENERAL

A. Install manufactured units in accordance with manufacturer's recommendations, approved submittals, and in proper relationship with adjacent construction.

B. Clean exposed surfaces. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

3.4 INSTALLATION OF ACOUSTIC ROOM COMPONENTS

A. Install housings utilizing manufacturer's supplied brackets and fasteners recommended for application. Adjust upper and lower limits individually after installation.

3.5 FIELD QUALITY CONTROL

A. Inspect installed work to verify compliance with requirements.
   1. Verify that HVAC work and electrical work complies with manufacturer's submittals and written installation requirements.
   2. Perform installation and startup checks as recommended by manufacturer.
   3. Prepare inspection reports and submit to Architect.

3.6 CLEANING AND PROTECTION

A. Repair or replace defective work as directed by Architect upon inspection.

B. Clean surfaces. Touch up marred finishes, or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.

C. Protect installed products from damage, abuse, dust, dirt, stain, or paint until completion of project. Do not permit use during construction.

END OF SECTION 116000

SECTION 116623 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basketball equipment.
   2. Volleyball equipment.
   3. Safety pads.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for installation of floor-insert sleeves to be cast in concrete slabs and footings.
   2. Section 096566 "Resilient Athletic Flooring" for game lines and markers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For gymnasium equipment.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Samples: For each color specified.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved.

B. Product Certificates: For each type of gymnasium equipment.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Basketball backstops and anchors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 BASKETBALL EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AALCO Manufacturing.
   2. ADP Lemco.
   3. Draper, Inc.
   4. Porter Athletic Equipment Company.
   5. Schelde Sports.

B. Standard Rules: Provide equipment according to the requirements of NFHS's "Basketball Rules Book." And MHSAA

C. Connections: Manufacturer's standard connections or connections recommended in writing by manufacturer and complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.

D. Overhead-Supported Backstops:
   1. Folding Type: Manufacturer's standard assembly for side-folding, braced backstop, with hardware and fittings to permit folding.

E. Wall-Mounted Backstops: Complete assembly extending from wall, including support framing to building structure, bracing, cables, support chains, pulleys, fittings, hardware, pipe anchors, equipment pads, and fasteners.
   1. Stationary Type: Manufacturer's standard assembly for stationary backstop.

F. Backstop Safety Device: Designed to limit free fall if support cable, chains, pulleys, fittings, winch, or related components fail.

G. Winch: Hoist consisting of heavy-duty, fully enclosed worm-gear; brake; cable drum; cable; and fittings, for mounting on wall with equipment-mounting board; designed to move and hold backboard in any raised or lowered position.

H. Backstop Electric Operator: Provide operating machine of size and capacity recommended in writing by manufacturer for equipment specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.
   1. Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Motor Electrical Characteristics:
      a. Horsepower: 1/2 hp.
      b. Voltage: 115 V ac, single phase, 60 hertz.
   3. Remote-Control Station(s): NEMA ICS 6, Type 1 enclosure for recessed or flush mounting and momentary-contact, three-position, switch-operated control with up, down, and off functions.
      a. Keys: Provide two keys per station.
   4. Limit Switches: Adjustable switches at each backstop, interlocked with motor controls and set to automatically stop backstop at fully retracted and fully lowered positions.

I. Basketball Backboards:
   1. Shape and Size:
      a. Rectangular, 72 by 48 inches width by height.
   2. Backboard Material: Provide with predrilled holes or preset inserts for mounting goals, and as follows:
      a. Glass: Minimum 1/2-inch-thick, transparent tempered glass according to ASTM C1048 Kind FT (fully tempered) and with impact-testing requirements in 16 CFR 1201 Category II or ANSI Z97.1 Class A for safety glazing. Provide glass and framing system manufactured according to FIBA Level 1 or Level 2 requirement that glass does not split off if broken.
         1) Rim-Restraining Device: According to NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
   3. Target Area and Border Markings: Permanently etched in white color, marked in pattern and stripe width according to referenced standard rules.

J. Goal-Mounting Assembly: Compatible with goal, backboard, and backstop.

K. Basketball Goals: Basket ring complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
   1. Single-rim basket ring competition goal.
   2. Type:
      a. Movable: pressure-release design with manufacturer's standard breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.
   3. Finish: Manufacturer's standard finish.

L. Basketball Nets: 12-loop-mesh net, between 15 and 18 inches long, sized to fit ring diameter, and as follows:
   1. Cord: Made from white cotton.

M. Backboard Safety Pads: Designed for backboard thickness and extending continuously along bottom and up sides of backboard and over backstop according to manufacturer's standard design.
   1. Color: As selected by Architect from manufacturer's full range.

2.3 VOLLEYBALL EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schelde Sports; Infinity 14 or a comparable product by one of the following:
   1. AALCO Manufacturing.
   2. ADP Lemco.
   3. Draper, Inc.
   4. Porter Athletic Equipment Company.

B. Standard Rules: Provide equipment according to the requirements of NFHS's "Volleyball Rules Book" and MHSAA

C. Floor Insert: Solid-brass floor plate and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, minimum length required, to securely anchor pipe sleeve below finished floor in concrete footing; with anchors designed for securing floor insert to floor substrate indicated; one per post standard.
   1. Flush Floor Plate: Manufacturer's standard hinged access cover, designed to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.

D. Post Standards: Removable, adjustable-height, telescoping, paired volleyball post standards, as indicated on Drawings, designed for easy removal from permanently placed floor inserts.
   1. Materials: Extruded-aluminum pipe or tubing, with nonmarking plastic or rubber end cap or floor bumper to protect permanent flooring.
   2. Nominal Pipe or Tubing Diameter: 4-inch OD at base.
   3. Finish: Manufacturer's standard factory-applied, polyester powder-coat finish.
   4. Net Height Adjuster: Manufacturer's standard mechanism for height adjustment, complete with fittings; designed for positioning net at heights indicated.
      a. Net Heights: Between tennis/pickleball net height and boys'/men's volleyball net height, 36 and 95-5/8 inches or more.
   5. Height Markers: Clearly marked at regulation play heights for elementary school, girls/women, boys/men, tennis and pickleball.

E. Net: 32 feet long; one per pair of paired post standards; and as follows:
   1. Width and Nylon Mesh: Competition volleyball net, 36 inches with 4-inch-square mesh made of black nylon string.
   2. Dowels: Minimum 1/2-inch-diameter fiberglass or 1-inch-diameter wood. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
   3. Net Antennas: 3/8-inch-diameter, high-tensile-strength, extruded-fiberglass or plastic rods, 72 inches long, extending above top hem band of net, with alternating white and red bands according to referenced standard rules. Provide two antennas per net.

4. Boundary Tape Markers: 2-inch-wide white strip with sleeve for securing net antenna, secured to net top and bottom with hook-and-loop attachment. Provide two tape markers per net for marking court boundaries.

F. Net-Tensioning System: Designed to adjust and hold tension of net. Fully enclosed, nonslip, manufacturer's standard-type winch with cable length and fittings for connecting to net lines, positive-release mechanism, and manufacturer's standard handle.

G. Bottom Net Lock Tightener: Manufacturer's standard.

H. Judges' Stands: Manufacturer's standard units designed to be freestanding, folding for storage with wheels for transporting.

I. Safety Pads: Consisting of minimum 1-inch- thick, multiple-impact-resistant manufacturer's standard foam filler covered by puncture- and tear-resistant fabric cover, manufacturer's standard; with fire-test-response characteristics indicated. Provide pads with hook-and-loop closure or attachments for the following components:
   1. Post Standards: three- or four-sided style pads, designed to totally enclose each standard to a minimum height of 72 inches; one per post.
   2. Net Lines: Four per net.
   3. Judges' Stands: Pads designed to totally enclose front and sides.
   4. Fabric Cover Flame-Resistance Ratings: Complies with NFPA 701.
   5. Fabric Color: As selected by Architect from full range of industry standard colors and color densities.

J. Storage Cart: Manufacturer's standard.

2.4 SAFETY PADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AALCO Manufacturing.
   2. ADP Lemco.
   3. Draper, Inc.
   4. Porter Athletic Equipment Company.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

C. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, minimum 14-oz./sq. yd. and treated with fungicide for mildew resistance; with surface-burning characteristics indicated.

D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board, with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
   1. Backer Board: Minimum 3/8-inch-thick plywood, mat formed, or composite panel.
   2. Fill: Multiple-impact-resistant foam, minimum 2-inch-thick polyurethane, 3.5-lb/cu. ft. density.
   3. Size: Each panel section 24 inches wide by minimum 72 inches long.
   4. Number of Modular Panel Sections: As indicated on Drawings.
   5. Installation Method: Manufacturer's standard.
   6. Fabric Covering Color(s): As selected by Architect from manufacturer's full range for color(s).

E. Cutout Trim: Manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.

2.5 MATERIALS

A. Support Cable: Manufacturer's standard galvanized-stranded-steel wire rope. Provide fittings according to the wire rope manufacturer's written instructions for size, number, and installation method.

B. Support Chain and Fittings: For chains used for overhead lifting, provide Grade 80 heat-treated alloy-steel chains, according to ASTM A391/A391M, with commercial-quality, hot-dip galvanized or zinc-plated steel connectors and hangars.

C. General-Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain, according to ASTM A413/A413M (Grade 30 proof coil chain or higher grade recommended by gymnasium equipment manufacturer). Provide coating type, chain size, number, and installation method according to manufacturer's written instructions.

D. Castings and Hangers: Malleable iron, according to ASTM A47/A47M; grade as required for structural loading.

E. Softwood Plywood: DOC PS 1, exterior.

F. Particleboard: ANSI A208.1.

G. Anchors, Fasteners, Fittings, and Hardware: Gymnasium equipment manufacturer's standard corrosion-resistant or noncorrodible units; concealed.

H. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, according to ASTM C1107/C1107M, with minimum strength recommended in writing by gymnasium-equipment manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions and competition rules for each type of gymnasium equipment.

B. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relationship to adjacent construction; and aligned with court layout.

C. Connections: Connect electric operators to building electrical system.

D. Removable Gymnasium-Equipment Components: Assemble in place to verify that equipment and components are complete and in proper working order. Disassemble removable gymnasium equipment after assembled configuration is approved by Owner, and store units in location indicated on Drawings.

E. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly; free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; and lubricate as recommended in writing by manufacturer.

3.2 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION 116623

SECTION 116643 - SCOREBOARD

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single-sided LED basketball scoreboard

1.2 REFERENCES

A. Standard for Electric Signs, UL 48

B. Standard for CSA C22.2 #207

C. Federal Communications Commission Regulation Part 15

D. National Electric Code

1.3 SUBMITTALS

A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation.

B. Shop drawings: Submit mechanical and electrical drawings.

C. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Product delivered on site

B. Scoreboard and equipment to be housed in a clean, dry environment

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install scoring equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

B. Field Measurements: Coordinate scoreboard location and height with the customer. Verify dimensions by field measurements.

C. Supply weight and mounting method for owner to verify that building structure is capable of supporting the scoreboard's weight in addition to the auxiliary equipment.

1.6 QUALITY ASSURANCE

A. For indoor use only

B. Source Limitations: Obtain each type of scoring equipment and electronic displays through one source from a single manufacturer.

C. ETL listed to UL 48

D. NEC compliant

E. FCC compliant

F. ETLC listed to CSA 22.2 #207

1.7 WARRANTY

A. Provide 5 years of no cost parts exchange including standard shipping on electronics parts and radios due to manufacturing defects

B. Provide toll-free service coordination

C. Provide technical online and phone support during Daktronics business hours

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Daktronics, Inc., 201 Daktronics Drive, P.O. Box 5128, Brookings, SD 57006-5128

B. Approved Substitutions

2.2 PRODUCT

A. Daktronics BB-2155 single-sided basketball scoreboard displays period time to 99:59, HOME and GUEST scores to 199, PERIOD to nine, team FLS (fouls) to 19, PLYR (player) number to 99, player FOUL to nine, T.O.L. (time outs left) to nine and indicates possession and bonus. During the last minute of the period, scoreboard displays time to 1/10 of a second. Electronic captions automatically change when volleyball and wrestling modes are selected. Scoreboard can also score any sport requiring a clock, score and period function.

2.3 SCOREBOARD

A. General information
   1. Dimensions: 6'-0" (1.83 m) high, 10'-0" (3.05 m) wide, 0'-6" (152 mm) deep
   2. Base weight: 275 lb (125 kg) – options may increase weight
   3. Base power requirement: 350 W – options may increase wattage
   4. Color: provide over 150 colors to choose from

B. Construction
   1. All-aluminum construction
   2. Scoreboard back, face, and perimeter: 0.063" (1.60 mm) thick
   3. Cabinet withstands high-velocity impact from air-filled sports balls without the need for protective screens

C. Digits & Indicators
   1. LED digit technology:
      a. UniView® (UV) – enhanced digits with diffusant lenses over the LEDs that blend the light for a uniform bar look and 140° viewing angle
   2. LED color:
      a. Amber clock/colon, PERIOD, PLYR/FOUL and T.O.L. digits and bonus indicators with Red score and FLS digits and possession indicators
   3. Clock and score digits: 13" (330 mm) high
   4. PERIOD, FLS, PLYR/FOUL and T.O.L. digits: 10" (254 mm) high
   5. Bonus indicators: 4" (102 mm) high
   6. Possession arrows: 3" (76 mm) high
   7. Seven bar segments per digit

D. Vinyl Captions
   1. Applied directly to scoreboard face
   2. HOME and GUEST captions: 6" (152 mm) high
   3. PERIOD and T.O.L. captions: 4" (102 mm) high
   4. Color: standard white or others available upon request

E. Electronic Captions
   1. FLS and PLYR/FOUL captions: 6" (152 mm) high
   2. Color: amber LEDs

F. Horn
   1. Vibrating horn mounted inside the scoreboard cabinet behind the face
   2. Sounds automatically when period clock counts down to zero
   3. Sounds manually as directed by operator

G. Power Cord

H. Cord is 11' (3.35 m) long
   1. Cord plugs into a standard grounded outlet

I. Accessory Equipment
   Custom team name caption in place of HOME
   1. Two 17" (432 mm) high, 21" (533 mm) wide aluminum panels in upper corners with vinyl logo/sponsor decoration
   2. Advantage time option for wrestling mode – PLYR and FOUL digits reversed
   3. Hinged metal mesh protective screen – painted to match scoreboard

2.4 SCORING CONSOLE

A. Console is an All Sport® 5000 controller

B. Scores multiple sports using changeable keyboard inserts

C. Controls multiple scoreboards, stats displays and shot clocks, including other All Sport 5000 controlled displays currently owned by customer

D. Recalls clock, score, and period information if power is lost

E. Runs Time of Day and Segment Timer modes

F. Console includes:
   1. Rugged aluminum enclosure to house electronics
   2. Sealed membrane water-resistant keyboard
   3. 32-character backlit LCD to verify entries and recall information currently displayed
   4. Power cord that plugs into a standard grounded outlet; 6 watts max
   5. Control cable to connect to the control receptacle junction box (wired system only)
   6. Hand-held switch for main clock start/stop and horn
   7. Soft-sided carrying case

G. Accessory Equipment
   1. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console and a receiver installed inside the scoreboard(s)
   2. Hard carrying case
   3. Battery pack

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that mounting surface is ready to receive scoreboard. Verify that placement of conduit and junction boxes are as specified and indicated in plans and shop drawings.

3.2 INSTALLATION

A. Power conduit, cables and outlet boxes to be provided and installed by the electrical contractor. Signal raceways, conduit and boxes to be provided by the electrical contractor. Electrical contractor is also responsible for any required wire and terminators between each scoreboard and control location.

B. Mount scoreboards and interior displays to wall in location detailed and in accordance with manufacturer's instructions. Unit to be plumb and level.

3.3 INSTALLATION - CONTROL CENTER

A. Provide boxes, cover plates and jacks as required to meet control specification requirements. Control cables to control panels shall be concealed.

B. Test the operation of the scoreboard, controller and all control jacks; leave control unit in carrying case and other loose items with owner's designated representative.

C. Conduct operator training on the scoreboard/controller operation.

END OF SECTION 116643

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manually operated roller shades with single rollers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Draper, Inc.
   2. Hunter Douglas Architectural.
   3. Lutron Electronics Co., Inc.
   4. MechoShade Systems, LLC.
   5. Silent Gliss Inc.; Silent Gliss International Ltd.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Chain-Retainer Type: Clip, jamb mount.
   2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
   1. Roller Drive-End Location: Right and left side of interior face of shade as required to have chain be accessible.
   2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Shadebands:
   1. Shadeband Material: Light-filtering fabric.
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      a. Type: Enclosed in sealed pocket of shadeband material.
      b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
   2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
   3. Endcap Covers: To cover exposed endcaps.
   4. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
   5. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.2 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
   1. Type: PVC-coated fiberglass.
   2. Weave: Basketweave.
   3. Orientation on Shadeband: Up the bolt.
   4. Color: As indicated on Drawings.

2.3 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
   2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
   1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
   2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
   3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plastic-laminate-clad casework.
   2. Hardware and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plastic-laminate-clad casework.

C. Samples: For casework and hardware finishes.

1.3 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CampbellRhea.
   2. Case Systems Inc.
   3. Flairwood.
   4. Stevens Industries, Inc.
   5. TMI Systems Design Corporation.

2.2 GENERAL REQUIREMENTS FOR CASEWORK

A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
   1. Grade: Premium.

B. Product Designations:
Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-clad casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered.
1. Drawings indicate configurations of manufactured plastic-laminate-clad casework by referencing designations of Casework Design Series numbering system in the Appendix of the AWI/AWMAC/WI's "Architectural Woodwork Standards."

2.3 PLASTIC-LAMINATED-FACED CABINETS

A. Design: Frameless cabinet construction with the following door and drawer-front style:
1. Flush overlay.

B. Grain Direction for Wood-Grain Plastic Laminate:
1. Doors: Vertical with continuous vertical matching.
2. Drawer Fronts: Vertical with continuous vertical matching.
3. Face Frame Members: Lengthwise.
4. End Panels: Vertical.
5. Bottoms and Tops of Units: Side to side.
6. Knee Space Panels: Vertical.
7. Aprons: Horizontal.

C. Exposed Materials:
1. Plastic-Laminate Grade: HGS.
   a. Colors and Patterns: Match Architect's samples.
2. Edgebanding: PVC.
   a. PVC Edgebanding Color: As selected by Architect from casework manufacturer's full range.

D. Semiexposed Materials:
1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
   a. Colors and Patterns: As selected by Architect from manufacturer's full range.
   b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
2. Thermally Fused Laminate (TFL) Panels: Provide thermally fused laminate panels for semiexposed surfaces unless otherwise indicated.
   a. Colors and Patterns: As selected by Architect from manufacturer's full range.
   b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
3. Metal for Steel Drawer Pans: Not Allowed. Provide four sided box plus front.
4. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.

E. Concealed Materials:
   1. Solid Wood: With no defects affecting strength or utility.
   2. Plywood: Hardwood plywood.
   3. Plastic Laminate: Grade VGS.
   4. Particleboard.
   5. MDF.

2.4 MATERIALS

A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2.

E. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.

F. Hardboard: ANSI A135.4, Class 1 tempered.

G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Formica Corporation.
      b. Nevamar; a Panolam Industries International, Inc. brand.
      c. Pionite, a Panolam Industries International, Inc. brand.
      d. Wilsonart LLC.

H. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.

I. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paperand complying with requirements of ISO 4586.
   1. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC or polyester edgebanding matching thermally fused laminate panels.

J. Glass for Glazed Doors:
   1. Clear tempered glass complying with ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.5 HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
   1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, Type B01602, self-closing.

C. Wire Pulls: Solid wire pulls, fastened from back with two screws.
   1. Provide Mockett DP128 Series round top drawer pull in satin nickel finish.

D. Door Catches: Zinc-plated, dual, self-aligning, permanent magnet catch.

E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.

F. Drawer Slides: Manufacturer's standard; complying with ANSI/BHMA A156.9. Provide full extension

G. Drawer and Hinged-Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with ANSI/BHMA A156.11, Grade 1.
   1. Provide a minimum of two keys per lock and six master keys.
   2. Provide locks where indicated.
      a. Master key for up to 500 key changes.

H. Adjustable Shelf Supports:
   1. Adjustable Shelf Supports: Pin-type, single-pin metal shelf rests complying with ANSI/BHMA A156.9, Type B04013.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grade: Install casework to comply with same quality standard grade as item to be installed.

B. Install casework level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

E. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

H. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid surface material countertops.
   2. Solid surface material backsplashes.
   3. Solid surface material end splashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
   1. Colors and Patterns: Match Architect's samples.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Premium.

B. Configuration:
   1. Front: Beveled 1-inch laminated bullnose.
   2. Backsplash: Beveled.
   3. End Splash: Matching backsplash.

C. Countertops:
   1. 1/2-inch- thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, solid surface material.

E. Joints:
   1. Fabricate countertops without joints.

F. Cutouts and Holes:
   1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.
   1. Verify adhesives have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 126600 - TELESCOPING STANDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Electrically operated telescoping stands.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For telescoping stands in both stacked and extended positions.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Telescoping stands to withstand the effects of gravity loads, operational loads, and other loads and stresses according to ICC 300.

B. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

2.2 TELESCOPING STANDS

A. System Description: Operable system of multiple-tiered seating on interconnected folding platforms that close for storage, without being dismantled, into a nested stack. Telescoping-stand units permit opening and closing of adjacent, individual and multiple rows, and close with vertical faces of platforms in the same vertical plane.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Telescoping-Stands Standard: ICC 300.

B. Wall-Attached Telescoping Stands: Forward-folding system, in which the bleachers open in the forward direction by moving the front row away from the stack to the fully extended position and the rear of bleacher understructure permanently attaches to wall construction.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hussey Seating Company.
      b. Interkal LLC.
      c. Irwin Seating Company.
   2. Operation: Electrically operated, with friction-type, integral power unit.
   3. Electrical Characteristics for Each Seating Section:
      a. Horsepower: 1/2.
      b. Single-Phase Voltage: 115 V ac, 60 hertz.
   4. Electrical Controls:
      a. Control Devices: Walk-along pendant control system.
      b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.
      c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during operation.
      d. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.

2.3 COMPONENTS

A. Benches: Seats and skirts.
   1. Material: Molded plastic with contour surfaces.
      a. Color: As selected by Architect from manufacturer's standard.
   2. Bench Height: Not less than 16 inches or more than 18 inches.
   3. Bench Depth: 12 inches.

B. Wheelchair-Accessible Seating: Locate retractable truncated benches to provide wheelchair-accessible seating at locations indicated on Drawings.
   1. Equip tiers adjacent to wheelchair-accessible seating with front rails as required by ICC 300.
   2. Equip cutouts with full-width front closure panels that match decking construction and finish and that extend from underside of tiers adjacent to cutouts to 1-1/2 inches from finished floor.

C. Deck: Manufacturer's standard laminated panel.
   1. Finish: Manufacturer's standard.
      a. Color: Manufacturer's standard.

D. Risers: Steel sheet with manufacturer's standard, rust-inhibiting coating or hot-dip galvanized finish.

E. Safety Rails: Steel, finished with manufacturer's standard powder coat system.
   1. Self-storing mid-aisle handrails located at centerline of each aisle with seating on both sides.
   2. End rails (guards) that are telescoping and self-storing.
   3. Back rails (guards) along rear of units where required by ICC 300.
   4. Removable front rails (guards) along front of units where required by ICC 300.
   5. Removable rails around accessible seating cutouts and truncations.
   6. Removable, programming-support front rails to allow seating in upper rows while lower rows remain in the stored position.
   7. Color: Manufacturer's standard neutral color.

F. Understructure: Structural steel.
   1. Finish: Manufacturer's standard rust-inhibiting finish.
   2. Color: Manufacturer's standard.

G. Support Column Wheels: Nonmarring, soft, rubber-face wheel assembly under each support column.
   1. Include wheels of size, number, and design required to support stands and operate smoothly without damaging the flooring surface, but no fewer than four per column or less than 4 inches in diameter and 1-1/2 inches wide.

H. Control Devices:
   1. Walk-Along Pendant: Manufacturer's standard unit, which plugs into first row of each operating section. Provide two units.

2.4 ACCESSORIES

A. Steps:
   1. Slip-resistant, abrasive tread nosings at aisles.
   2. Intermediate aisle steps, fully enclosed, at each aisle.
   3. Transitional top step, fully enclosed, at each aisle where last row of telescoping stands is adjacent to a cross aisle.
   4. Removable front steps, fully enclosed, at each aisle, that engage with front row to prevent accidental separation or movement and are equipped with a minimum of four skid-resistant feet.

B. Closure Panels and Void Fillers:
   1. Aisle closures at foot level that produce flush vertical face at aisles when system is stored.
   2. End panels covering exposed ends of stands in the stored position.
   3. Panels at cutouts and truncations for accessible seating.

4. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.
5. Gap fillers for closing openings between stand units or between stand units and adjoining construction.

2.5 MATERIALS

A. Plywood: PS 1 as standard with manufacturer.

2.6 FABRICATION

A. Fabricate telescoping stands to operate easily without special tools or separate fasteners unless otherwise indicated.

B. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.

C. Form exposed work with flat, flush surfaces, level and true in line.

D. Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair their usefulness.
   1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install telescoping stands according to ICC 300 and manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:
   1. ICC 300 Inspection: Inspect installed telescoping stands to verify that construction, installation, and operation are according to ICC 300 requirements.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Telescoping stands will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust backrests so that they are at proper angles and aligned with each other in uniform rows.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to inspect, adjust, operate, and maintain telescoping stands.

END OF SECTION 126600

SECTION 200500 - COMMON WORK RESULTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Access Doors.
3. Transition fittings.
4. Dielectric fittings.
5. Mechanical sleeve seals.
6. Sleeves.
7. Escutcheons.
8. Grout.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.
13. Coordination drawings.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.
   5. EPDM: Ethylene-propylene-diene terpolymer rubber.
   6. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.
   5. Coordination drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 SUBMITTALS

A. Welding certificates.

B. Shop drawings: Submit for all major equipment including, but not limited to the items listed in Division 20, 21, 22, 23. Submittals shall be provided in electronic format.

C. As-built Drawings: Submit as-built drawings that include accurate dimensioned record drawings of all underground work, above ground piping, and ductwork systems. As-built drawings shall be submitted in electronic format.

D. Operation and Maintenance Manuals: When the building is substantially complete and before the building is taken over by the Owner for maintenance purposes, the contractor shall provide four sets of complete operation and maintenance manuals. The manual shall consist of an indexed loose-leaf binder containing the equipment data, manufacturer's installation, operating, and maintenance, repair parts manual for each system component, test reports, and as-built temperature control diagrams. Refer to Divisions 20, 21, 22, and 23 for additional submittal requirements. Provide an electronic copy of the operation and maintenance manual in addition to three (3) sets of loose-leaf hard copy binders. Preliminary copy of O&M manuals shall be submitted to commissioning agent for review. Schedule of preliminary submittal will be reviewed with Commissioning Agent at the commissioning kick off meeting.

E. Substitutions: The contractors' base bid must be in accordance with the materials or products specified. Any exceptions to this must be approved in writing by the Architect/Engineer, 10 days or more prior to bidding. Voluntary alternates may be submitted for consideration on the proposal, with listed addition or deductions to the base bid, but will not affect the awarding of the contract.

F. Coordination Drawings: Contractor shall prepare above ceiling coordination drawings for efficient installation of different components and coordination for installation of products and materials fabricated by each trade.
   1. Content: Project-specific information, drawn accurately to scale, 1/4 inch per foot. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
      a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate required installation sequences.
      c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   2. Sheet Size: 30 by 42 inches**.**
   3. Number of Copies: Electronic submissions are preferred. Where not feasible, provide the following.
      a. Submit two opaque copies of each submittal. Architect will return one copy.
      b. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.
   4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Perform all Work in accordance with applicable Federal, State and local codes rules, ordinances and regulations. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standards, Rules and Regulations of NFPA, UL, and as follows unless otherwise indicated.
   1. Boiler Code
   2. ASHRAE 55
   3. ASHRAE 62.1
   4. ASHRAE 90.1

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. Electrical Characteristics for Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

E. Permits and inspections: Obtain and pay for all permits (temporary and permanent), fees, and inspections as required by any applicable laws and ordinances. Post such permits and inspection Certificates in a prominent place adjacent to the work. Deliver all certificates of final inspection or approval to the Architect/Engineer. Do not cover any concealed work until final inspection has been made and approval certificates obtained.

1.8 DELIVERY, STORAGE, HANDLING, AND INSTALLATION

A. Deliver ductwork, pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent ductwork and pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. During installation, provide temporary caps of sufficient material to prevent entrance of dirt, debris, and moisture.

1.9 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Under provisions of commissioning documentation; testing of mechanical equipment, as well as training of owner's operation and maintenance personnel, shall be required in cooperation with the commissioning agent.

E. Refer to the Owner/Utility tie-in schedule.

F. Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work.

G. Each contractor shall coordinate its operations with operations, included in different sections, which depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.10 WARRANTIES

A. In the event that any part of the work or equipment fails (abuse and causes beyond control of the contractor excepted), within this period of guarantee, it shall be replaced by the contractor at no cost to the owner.

B. All mechanical system components and controls shall be provided with a minimum 1-year warranty. Specific mechanical components may have longer warranty periods. Warranty shall be unconditional and include material, labor and response with 24 hours of notification. All warranties to begin at substantial completion and extend for period indicated in the contract documents.

1.11 SYSTEM STARTUP

A. Activation of the heating, ventilating and air conditioning equipment for testing and balancing will be allowed only after the construction is substantially complete, or by permission of the owner's construction representative.

B. Air handling systems used prior to final acceptance shall have specified filters installed during temporary use. Replace the temporary filters if the filters become loaded to capacity during system activation. Install replacement filters upon completion of the work and prior to final acceptance. Record the dates when the filters are changed for system start-up and when spare filters are provided with the commissioning agent documents.

1.12 MAINTENANCE

A. Contractor shall be responsible for maintenance of equipment and systems installed until final acceptance by Owner.

B. Lubricate rotating equipment in accordance with manufacturer's recommendations before activation. Re-lubricate as required during activation and prior to final acceptance.

C. Provide readily accessible and secured copper extensions to bearing lubrication fittings on equipment bearings.

1.13 SITE INSPECTION

A. Contractor shall visit the site prior to submitting Proposal and examine and verify existing conditions. Additional charges will not be allowed due to failure to complete site visit or to include necessary materials and labor to complete the work. Proposal being submitted implies site visit has occurred and contractor understands the conditions which the work will be conducted.

1.14 CONSTRUCTION DOCUMENT INTERPRETATION

A. Any conflict within the documents shall be included with the highest cost.

1.15 TESTING, ADJUSTING AND BALANCING MOTOR PULLEY REQUIREMENTS

A. For all constant speed belt driven fans greater than 5 hp, Contractor shall provide and install two sets of fixed motor pulleys. First set shall be installed for initial start-up and shall be based on scheduled data. Factory provided motor pulley may be used if properly sized. The second set shall be installed after system balance is complete and shall be based on actual field conditions as determined by the TAB contractor.

B. For all constant speed belt driven fans through 5 hp, Contractor shall provide and install two sets of adjustable motor pulleys. First set shall be installed for initial start-up and shall be based on scheduled data. Factory provided motor pulley may be used if properly sized. The second set shall be installed after the balance is complete and shall be based on actual field conditions as determined by the TAB contractor. Select motor pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

C. For all belt driven variable frequency drive operated fans, contractor shall provide and install one set of fixed motor pulleys sized to allow full utilization of fan motor horsepower provided, with VFD at 100 percent of fan motor RPM

D. Furnish motor pulleys of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Larson.
   2. Milcor.
   3. Nystrom.

B. Access doors in walls or ceilings shall be of 24”X24” in size, unless specified otherwise or space restricted.

C. Non-labeled door shall be 16-gauge prime painted steel frame; 14-gauge prime painted steel panel; concealed spring type hinges; and flush, screwdriver operated metal cam lock.

D. Labeled doors shall be UL listed; 16-gauge, prime painted steel frame; sandwich type with 20-gauge face sheets, flush design with filler panels; continuous hinges with stainless steel pins and flush, self-latching cylinder locks with two keys per lock. Coordinate doors and accessories with Division 08 Section 083113 “ACCESS DOORS AND FRAMES”.

E. All access doors shall have flush mounted handles.

2.3 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21, 22, and 23 piping sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.4 JOINING MATERIALS

A. Refer to individual Division 21, 22, and 23 piping sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inchmaximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8-inchthick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.5 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser Industries.
      c. Ford Meter Box Company.
      d. JCM Industries.

e. Smith-Blair.
f. Viking Johnson.
2. Underground Piping NPS 1-1/2and smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2and larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
a. Thompson Plastics.

D. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
1. Manufacturers:
a. Nibco.

2.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psigminimum working pressure at 180 deg F.
1. Manufacturers:
a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse.
d. Epco Sales.
e. Hart Industries.
f. Watts.
g. Zurn Industries.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psigworking pressure as required to suit system pressures.
1. Manufacturers:
a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales.
d. Watts.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers:
      a. Advance Products & Systems.
      b. Calpico.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator.
   2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psigminimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psigminimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Calpico.
      b. Lochinvar.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psigminimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products.
      c. Sioux Chief Manufacturing Co.
      d. Victaulic Company.

2.7 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. Advance Products & Systems.
   2. Flexicraft Pipeseal.
   3. Calpico.
   4. Metraflex.
   5. Pipeline Seal and Insulator.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Glass reinforced plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.

3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.9 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems.
2. Airex Manufacturing.
3. CALPICO.
4. GPT; an EnPro Industries company.
5. Metraflex Company.
6. Proco Products.

B. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
2. Pressure Plates: Stainless steel
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.10 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Presealed Systems.
6. Proco Products, Inc.

B. Description:
1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
2. Plastic or rubber waterstop collar with center opening to match piping OD.

2.11 ESCUTCHEONS

A. Description: Manufactured chrome plated wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

D. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

E. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

F. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.12 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.13 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.14 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
      d. Polymeric Systems, Inc.
      e. Sherwin-Williams Company (The).

f. The Dow Chemical Company.
2. Sealant shall have a VOC content of 250 g/L or less.
3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
5. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. May National Associates, Inc.; a subsidiary of Sika Corporation.
2. Sealant shall have a VOC content of 250 g/L or less.
3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
5. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Smooth-On.
2. Sealant shall have a VOC content of 250 g/L or less.

3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
5. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21, 22, 23 sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping indicated to be exposed in finished areas as high as possible unless noted otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing. Valves shall be located not more than 24 inches above the suspended ceiling grid.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends. Piping shall be installed level and plumb where piping slopes are not required.

J. Install fittings for changes in direction and branch connections.

K. Install piping to allow application of insulation.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Install escutcheons for penetrations of walls, ceilings, and floors:
   1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   3. Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
   4. Insulated Piping: One-piece, stamped-steel type with spring clips.
   5. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
   6. Bare Piping in Unfinished Service Spaces and Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.
   7. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces of walls.
      a. Exception: Extend sleeves installed in floors 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inchannular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Schedule 40 Black Steel Sleeves: For pipes penetrating interior walls.
      b. Schedule 40 Galvanized Steel Sleeves: For pipes penetrating floors.
   4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
   5. Seal sleeves in plaster/gypsum board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
   6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
   7. Sleeves through floors and walls shall be sized so that the required pipe insulation is continuous through the sleeve.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

U. Contractor shall maintain adequate clearances (per the latest edition of the national electric code) above and around any new electrical panels, equipment, and transformers when routing overhead piping.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

J. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
1. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
2. PVC Non-pressure Piping: Join according to ASTM D 2855.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each control valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to each control valve and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated or coordination with other services dictates different mounting heights.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC, Plumbing, and Fire Protection equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 ACCESS DOOR INSTALLATION

A. Access doors shall be provided in all pipe chases, soffits, walls, ceilings, and ductwork to give access to valves, dampers, both sides of booster coils in ductwork or VAV terminals, control devices, etc.

B. All access doors shall be within 24 inches of any fire damper.

C. Coordinate the exact location with other trades.

D. Verify the exact quantity, size and location of the required access panels after the installation of systems and equipment requiring access, and prior to the closure of affected ceilings and building assemblies.

3.6 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09 Section 099124 "Interior Painting (MPI Standards)."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section 033000 "Cast-in-Place Concrete."

B. Provide concrete bases where specified within individual products' specifications and/or where indicated on the drawings and details.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
   1. Provide all supplementary steel to provide proper drainage for gravity flow systems.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

3.10 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 200500

SECTION 200513 - COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Section does not include motors for fire pumps, elevators, centrifugal chillers, sealed refrigeration equipment, submersible sump pumps, and vertical hollow or solid shaft motors used with vertical turbine pumps.

C. Related Sections include the following:
   1. Section 20 Section 200514 "Variable Frequency Drives".
   2. Section 26 Section 262813 "Fuses".
   3. Section 26 Section 262816 "Enclosed Switches".
   4. Section 26 Section 262913 "Enclosed Controllers".

1.3 DEFINITIONS

A. ABMA: American Bearing Manufacturers Association.

B. IEEE: Institute of Electrical and Electronics Engineers.

C. NEMA: National Electrical Manufacturers Association.

D. MG 1: (NEMA) Motors and Generators Standard.

E. VFD: Variable frequency drive.

1.4 SUBMITTALS

A. Submit the following product data for approval:
   1. Manufacturer information.

2. Dimensions and elevations.
3. Complete NEMA nameplate electrical data including design type, insulation, service factor, and efficiency.
4. Materials of construction.
   a. Bearing type, L10 bearing life, and seal construction (open, single, or double shielded).
5. Certification that VFD driven motors comply with all parts of NEMA MG-1 Part 31.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Baldor Electric Company
   2. Dayton.
   3. General Electric.
   4. Leeson Electric.
   5. Marathon Electric.
   6. Reliance Electric.
   7. Toshiba Corporation.
   8. U.S. Electrical Motors.

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in Fire Protection, Plumbing or HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with ABMA 9 for bearing life calculations. For belted applications, calculations shall be based on maximum external side load limits per NEMA MG 1 Table 14-1A. L10 life calculations for vertical motors and horizontal motors mounted in the vertical position shall consider the application's thrust loading.

2.3 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level. Maximum hot spot temperature shall not exceed the insulation temperature limit, when operated in an ambient temperature of 104 deg F, except as otherwise indicated.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Noise: Motors shall not exceed dBA levels listed in NEMA MG 1 section 12.54 at all speeds.

2.4 POLYPHASE MOTORS (1/2 HP and larger)

A. Description: NEMA MG 1, Design B, squirrel cage, medium induction motor with open drip proof enclosure unless noted otherwise in equipment specifications of schedules. When totally enclosed fan cooled motors are specified or scheduled, provide external shaft slinger on drive end.

B. Efficiency: Nominal (nameplate) full load efficiency and corresponding minimum efficiency equal to or greater than that stated in NEMA MG 1 Table 12-12 – Premium Efficient Motors Nominal Full Load Efficiencies.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Manufacturer's standard starting characteristic.

J. Enclosure Material and Bearings:
   1. Motors less than 3 HP: Steel or cast iron motor frames, cast aluminum, cast iron, or steel end plates, steel or cast iron terminal box, copper windings.
      a. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings, selected for a minimum L10 bearing life of 26,280 hours, for belted and direct drive.
   2. Motors 3 HP and above: Cast iron motor frames and mounting feet, cast iron end plates (bells), steel or cast iron terminal box, copper windings.
      a. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings. Rated for a minimum L10 bearing life of 40,000 hours for belted or 130,000 hours for direct drive.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers:
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Inverter-Duty Motors: Class B temperature rise; Class H insulation.
   3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
   4. For VFD driven motors, provide a maintenance free, circumferential conductive micro-fiber ground ring installed on the motor to discharge stray shaft currents to ground. Grounding ring shall be AEGIS SGR (shaft grounding ring). Motors protected by AEGIS SGR shall be warranted for the term of the manufacturer's motor warranty from induced current bearing damage.
   5. Motors protected by AEGIS SGR shall be warranted for the term of the manufacturer's motor warranty from induced current bearing damage.

2.6 SINGLE-PHASE MOTORS (less than 1/2 HP)

A. Motors larger than 1/20 HP shall be one permanent-split-capacitor type, to suit starting torque and requirements of specific motor application:

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

F. Furnish with sliding base/slotted mounting holes adequate for proper belt tensioning and alignment of motor or motor/load.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and align motors in accordance with the equipment manufacturer's recommendations.

B. For VFD driven motors using a shaft grounding ring: Install grounding ring in accordance with the manufacturer's recommendations, including application of a colloidal silver shaft coating on the motor shaft.

3.2 COMMISSIONING

A. Perform commissioning activities as outlined in Division 1 Section, Commissioning Requirements, and other requirements of the Contract Documents.

3.3 ADJUSTING, CLEANING, PROTECTION

A. Assure motor nameplate is legible and properly affixed.

B. Verify bearings are factory lubricated before starting motors. Lubricate per manufacturer's instructions. Do not over lubricate bearings.

C. Check motors for unusual heating, noise, or excessive vibration during operation. Correct any such deficiencies.
   1. Any motors with vibration exceeding specified limits, as noted in the Testing, Adjusting, and Balancing Section, or manufacturer's recommendations, whichever is more stringent, shall be corrected, at no cost to the Owner, until reduced below those limits.

D. Clean the motor prior to start-up and immediately prior to final turn-over to the Owner.

END OF SECTION 200513

SECTION 200514 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 DEFINITIONS

A. ANSI: American National Standards Institute.

B. FCC: Federal Communications Commission.

C. IEEE: Institute of Electrical and Electronics Engineers.

D. NEMA: National Electrical Manufacturer's Association.

E. UL: Underwriters Laboratory.

F. VFD: Variable Frequency Drive.

1.3 SUBMITTALS

A. Product Data: Include dimensions and elevations, complete product data listing all included features, electrical rating for each VFD, matched to each piece of driven equipment, and fault current rating.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.
      a. Line/load connection points.
      b. Main input and inverter input disconnect switches.
      c. VFD/bypass switch circuit.
      d. Fusing/circuit breakers.
      e. Auxiliary control transformer.
      f. Local/remote circuit.
      g. Hand-off-auto circuit.
      h. Safety interlock, run permissive, and drive initiated external circuits.
      i. Analog inputs and outputs.
      j. Pilot lights.

k. Each wire on the wiring diagram shall be labeled with a distinct wire identifier.

2. VFD panel face diagram indicating the location of the main and inverter disconnect switches, local/remote and H-O-A switches, VFD/bypass switch, pilot lights, digital display, keypad, programmable carrier frequency limitations (4-5 kHz or 2-14 kHz) and any other face mounted device, along with the panel face labeling.

C. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. VFD shall comply with NFPA 90 (National Electrical Code), IEEE 519, UL 508, and FCC compliance for Radio Frequency Interference (RFI) and Electro-Mechanical Interference (EMI).

B. Unit shall be UL listed, as an entire assembly, and bear the UL label.

C. All circuit boards shall be completely tested and burned-in prior to assembly into the completed VFD.

D. Factory test complete VFD to ANSI/UL Standard 508. Functionally test all options, perform dynamometer test at full load, cycle load and speed during factory test.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. A.B.B.
   2. Danfoss.
   3. Yaskawa Electric America.

2.2 GENERAL

A. Unit shall be dead front construction.

B. All relays shall be a plug-in style base.

C. All fuses shall be mounted in fuse blocks with insulated covers. Covers shall shield fuse ends and wire terminations.

D. The VFD shall be marked with its short circuit current rating in compliance with UL.

E. The unit, including all specified accessories, shall have a minimum efficiency of 85% at any speed from 50 to 100%. The unit shall have a power factor of 0.9 or higher when operating at any speed from 50 to 100%.

F. The VFD shall be a variable torque type and shall provide full motor torque at any operating speed from 40 to 100%.

G. The VFD shall provide variable torque V/Hz control when operating at speeds less than 100%.

H. The VFD must be capable of operating in the following service conditions:
   1. Ambient Temperature: 0º to 40ºC (32º to 104ºF).
   2. Relative Humidity: 0 to 95%, non-condensing.
   3. Elevation: 0 to 3300 ft. (100 meters) above mean sea level (MSL).
   4. AC line voltage variation:
      a. 480 V: 440 - 10% to 500 + 10%; 45-65 Hz
      b. 230 V: 200 - 10% to 230 + 10%; 45-65 Hz

I. Provide the drive with a main input disconnect switch, accessible without opening the drive cabinet, equipped with current limiting fuses and fuse rejection clips, or circuit breakers. All other fuse blocks with current limiting fuses installed shall be equipped with fuse rejection clips. It shall be possible to padlock the disconnect in the “off” position.

J. Provide minimum 6 pulse-width modulation (PWM) type drives.

K. Provide the necessary electronics to avoid audible noise generated from the motor due to frequency change. The unit shall not increase the motor audible noise by more than 3 dB above the motor’s across-the-line noise at any motor speed from 50 to 100%.

L. The unit shall include self-diagnostics with a digital display that identifies fault conditions and trouble shooting. Fault indication shall be retained even after a power outage or an input over-current protective device trip.

M. Unit shall be provided with RFI/EMI filters.

N. VFD shall include current sensors on all three output phases to accurately measure motor current.

O. Provide minimum 3% AC input line reactors and/or minimum 5% DC link reactors to limit the maximum current total harmonic distortion (THD) to not more than 100% of the variable frequency drive (VFD) input current waveform at any VSD operating speed from 20 to 100%. Reactors shall be integral to the VFD. The reactors shall not be active when the drive is in the bypass mode. If testing reveals the maximum THD is exceeded, the manufacturer shall provide and install additional reactors at no cost to reduce the THD to within these specified limits.

P. The unit shall have a dedicated terminal block for all external inputs and outputs.

Q. Provide a factory mounted and wired 115 V, 1 Ph, 60 Hz control power transformer sized for handling an additional 30 VA inductive load. Limit fuse size for the control transformer to 3 amps maximum.

R. The VFD input and output shall be rated at 480-volt, 3 phase or 208-volt, 3 phase.

S. The VFD shall have a minimum short circuit current rating (SCCR) of 100 kA.

T. Provide a factory mounted and wired manual bypass device.
   1. Manual Bypass
      a. Manual transfer to line power shall be via three (3) contactors sized for applicable voltage and motor current. One (1) contactor shall be between the VFD output and the motor. The second shall be between the bypass power line and the motor, providing across-the-line starting. The third contactor shall be between the line voltage and VFD input. Transferring load via contactors shall disconnect VFD inputs from line voltage and outputs from the motor, thus providing the ability to safely trouble shoot and test the VFD while operating in the bypass mode. A fused disconnect switch shall be required. Bypass and VFD output contactors shall be electrically and mechanically interlocked to prevent both being closed at the same time. Include motor thermal overload protection in bypass and VFD modes.
   2. Provide two (2) 3-position selector switches to control bypass contactor and the VFD input and output contactors: 1) Normal-Off-Test and 2) Drive-Off-Bypass. Selector switches shall have padlockable switch covers.
   3. Door mounted status lights shall include power on, drive, bypass, and safety.
   4. Provide terminal strip for connection of fire, smoke contacts, external start command, and VFD control signal. All external interlocks shall function in hand, auto, or bypass. External start/stop signal shall be functional in auto and bypass modes.
   5. The 120-volt ac control power shall be supplied by the fused transformer.
   6. Provide a NEMA 1 enclosure for bypass components and a NEMA 4 enclosure is required for outdoor applications. Bypass and VFD enclosures shall be factory wired and assembled on a common backplate.
   7. Manual bypass and accessories shall be furnished and mounted by the VFD manufacturer.
   8. Two (2) contactor bypasses and knife switches are not acceptable.
   9. The bypass device shall allow the load to run across-the-line while electrically isolating the VFD so that maintenance can be performed on the drive components.

2.3 CONTROL FEATURES

A. The VFD shall be provided with the following control features:
   1. Factory mounted and wired Hand-Off-Auto selector switch that allows local or remote starting or stopping of the drive. Separate start and stop buttons, electronic circuits that "virtually" provide this capability or other alternative devices are not acceptable.
   2. Factory mounted and wired VFD-Bypass switch.
   3. Factory mounted and wired Local-Remote speed control switch, that allows either local or remote control of the drive speed. Key pad buttons are also acceptable provided that permanently labeled, dedicated buttons are provided for the local and the remote speed control functions.
   4. Main input disconnect switch.
   5. Inverter input and output disconnect switch, accessible without opening the drive cabinet, if a bypass device is provided.
   6. Manual speed potentiometer or keypad control, for local speed control with the Local-Remote speed control switch in the Local position.
   7. VFD shall accept an input reference (feedback) signal, 4-20 mA analog input, for remote speed control with the Local-Remote speed control switch in the Remote position. Provide input signal; isolation to isolate input signal ground from the VFD internal ground control. Coordinate required 4-20 mA analog input with DDC control system supplier.
   8. A remote start/stop contact input that functions in the automatic mode only.
   9. A safety interlock circuit that functions in drive and bypass modes. All safety and limit controls must function in both automatic and manual operating modes.
   10. A run permissive circuit, separate from the safety interlock circuit, which prevents motor operation whether in drive or bypass mode. This circuit, via the customer's external contact device, signals the motor may run, provided the safety interlock contact(s) is made. A typical application would be for a time delay before motor start to allow some external event to occur. The run permissive circuit shall be jumpered from the factory.
   11. Provide the following drive initiated external circuits:
      a. Powered run mode: A circuit that is powered after the motor is started in drive or bypass modes.
      b. Powered run request: A circuit that is powered whenever the drive safety interlock contact(s) are closed, and the drive H-O-A is in hand, or the drive H-O-A is in auto and the remote start/stop contact is closed.
   12. A standard USB port for direct connection of a Personal Computer (PC) to the VFD. The manufacturer shall provide PC software to allow complete setup and access to the VFD through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the Building Management System (BMS).
   13. An integral proportional-integral-derivative (PID) controller that, when activated, controls drive speed to maintain a programmed set point based on a remote analog input feedback signal.
      a. The VFD shall be able to apply a scaling factor to the feedback signal.
      b. The VFD shall be able to calculate the square root of the feedback signal so that a pressure sensor can be used to measure flow.

c. The analog feedback signal must be linear in nature when inputting to the on-board (PID) controller using this feature.

14. A real-time clock shall be an integral part of the VFD.
    a. It shall be possible to use this to display the current date and time on the VFD's display.
    b. The clock shall include a time clock function with 7-day programmability and a minimum of four (4) programmable time periods per day, with individually selectable ON and OFF functions. The time clock function shall be programmable to control start/stop functions, constant speeds, PID parameter set points and output relays. The time clock function shall be programmable through the controller display and keypad, or by included software that allows programming via a PC and a USB connection.
15. VFD shall be capable of starting a coasting load. Provide a bi-directional auto speed search to allow starting into rotating loads spinning in either direction.
16. VFD shall automatically attempt to restart a minimum of three (3) times during an adjustable time period of no less than 30 seconds after shutting off for any reason, except for a short circuit or motor overload.
17. The VFD shall have adjustable motor acceleration and deceleration rates from 0.1 to 1,800 seconds. Provide maximum Hz speed settings. Provide current limiting feature.
18. The VFD shall have the ability to lock-out a minimum of four (4) critical frequency ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment.
19. The VFD shall be configured as required to meet system operational requirements including:
    a. Provide one (1) normally open and one (1) normally closed auxiliary contacts to actuate when the motor is started in any mode.
    b. Provide an additional set of N.O. contacts on the VFD-bypass switch that close when the switch is set to bypass.
    c. Provide a minimum of one (1) 4-20 mA analog output signal selectable to proportionally indicate drive output frequency, current, or power, or to indicate the VFD input reference/feedback signal, for monitoring by the DDC control system or the Building Management System.
    d. Provide remote communication to the building DDC/BMS control system.
        1) The drive shall be configured to communicate with several different fieldbuses, making it easy to communicate with a variety of control systems. Fieldbus options are as follows:
            a) BACnet
            b) N2 / Modbus
            c) LonWorks
        2) The DDC system shall be capable of receiving all VFD fault and trips, current, voltage, and power consumption through the communication interface. The communication capabilities shall include but not be limited to the following:
            a) Output Frequency / Speed
            b) Motor Current
            c) Output voltage
            d) Motor Power (kW)
            e) Analog Input Valves

f) Drive Status
g) Motor Speed / Torque
h) Run Time
i) Accel / Decel Time Adjustments
j) VFD Fault Status
k) Start / Stop Control (if not required to be hardwired)

2.4 INDICATORS

A. Provide an indicating lamp for “POWER AVAILABLE” and for “MOTOR ON BYPASS”. Lights shall be LED type.

B. A motor RPM and AMP display shall be factory mounted on the face of the unit, either as a separate indicator or via the controller display.

2.5 SAFETIES

A. Provide LED type status lights or digital display indication of the cause of any shutdown.

B. The VFD shall be provided with the following safety features:
1. VFD over voltage and under voltage protection and protection against temporary power outages.
2. VFD over temperature protection.
3. Motor over temperature protection per NEC 430.126(A) (2).
4. Short circuit and ground fault protection.
5. Separate motor overload protection functional in bypass and normal operation. For VFD’s controlling multiple motors, provide overload protection for each motor.
6. Integral phase-loss protection
7. Adjustable current limiter.

2.6 LABELING

A. Provide engraved plastic labels permanently attached to the VFD panel face indicating the unction of all switches and indicators, and the equipment served.

B. Tag all wiring in the drive. Tag nomenclature shall match the corresponding wire identification nomenclature indicated on the approved drive submittal.

C. For VFD’s serving smoke purge, stair pressurization, or other smoke control systems, include an engraved permanently attached red faced label, minimum 8” x 8”, with the following nomenclature: “CAUTION: THIS VFD IS PART OF A LIFE SAFETY SMOKE CONTROL SYSTEM. NOTIFY THE OWNER PRIOR TO ANY CHANGE OR MAINTENANCE ACTIVITY TO THIS DRIVE”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unit installation, including mounting, supports, and wiring to motor, shall be by the Electrical Trades, in compliance with Division 26. Coordinate with the Mechanical Trades and the Control Trades, as required.

B. Install the VFD as close as possible to the motor. The load side power cables to the motor shall be kept as short as possible and shall not be run in the same conduit as the line side power cables. Control wiring shall be in separate conduit from power wiring. Where applicable, control wires from the motor disconnect early break contacts may be installed with the motor power wiring.

C. Provide “shaft grounding” since modern AC or DC variable speed motors develop an electrical potential between the shaft and the frame of the motor. It has been found that shaft-to-frame voltages above three (3) volts generally cause current flow across the bearings. When current flows across a bearing, metal is transferred causing frosting, pitting, and fluting of the bearing races resulting in premature failure of the bearings. Grounding the shaft to the frame provides a path for the current to flow around the bearings eliminating the bearing damage caused by shaft potentials. Therefore, all installed VFD’s shall include a shaft grounding brush as manufactured by “Shaft Grounding Systems, Inc.” (SGS) on all fan and pump motors. The products manufactured by SGS contain only stable materials and are not believed to constitute a hazardous material as defined under the Office of Safety and Health Act (OSHA) regulations. Specifically developed proprietary carbon compounds are used by SGS to ensure sustained performance. At present, the brush wear life expectancy is from 3 to 5 years based upon data obtained from running these brushes for over two (2) years in continuous industrial applications. In systems designed for wet or severe environment applications, the brush contact area shall be sealed to keep contaminants from entering the shaft grounding system. The shaft grounding system shall be designed to reduce shaft voltage levels to less than the three (3) volts typically required for current to pass through bearings. Shaft voltages without a shaft grounding system typically range from 3 to 30 volts, or higher.

D. Protect the unit from dirt, dust, water, and physical damage prior to and during construction. If the inside of the unit becomes dirty or dusty before acceptance by the Owner, it shall be thoroughly cleaned by the unit manufacturer at the contractor’s expense.

3.2 QUALITY ASSURANCE

A. Upon completion of manufacturing, each VFD unit shall be inspected and load tested prior to shipment. The Owner’s representative may be present for factory-acceptance tests. Tests to be conducted shall include but are not limited to simulating system logic. All associated costs for said tests shall be included in the manufacturers bid. Certification that the factory inspections and load tests have been successfully performed shall be submitted to the Owner after completion of the tests.

3.3 CHECK, TEST AND START

A. After installation of the system at the site a field acceptance test shall be performed by the Mechanical trades in conjunction with the manufacturer of the drive equipment, who will provide the services of a factory trained and certified technician to supervise the check, test and start.

B. The mechanical contractor shall notify the Owner's representative five (5) days prior to the start-up procedure.

C. The field acceptance test shall consist of a repeat of the factory test. Functional tests shall demonstrate satisfactory operation of all interlocks, alarms, and normal operational sequences. The drive manufacturer shall use suitable test equipment to locate and correct all malfunctions. Repeated failure of any component will cause the test to be terminated and restarted when the equipment has been fixed. Harmonic distortion tests shall be run on the drives and the bus to determine the voltage and current distortion. IEEE 519-1992 standards shall be used as the guide to test results. Measurements shall be made utilizing a Dranetz analyzer or a BMI analyzer capable of indicating snapshots of the current and voltage distortions. Measurements shall include phase to phase, phase to neutral, and neutral to ground. The test shall be run the full range of the drive operation. The graphs of the test results shall be submitted for speed values of 60%, 80%, and 100%. Also, test shall be done with no units running, then one unit, then two units, etc. Tests shall be conducted by a qualified technician acceptable to the Owner. Included in the scope of this specification shall be an allowance for a factory-trained service engineer, other than sales representatives, to inspect, perform final adjustments and operational checks, perform functional checks, and prepare a final report for record purposes. A minimum of one day shall be allowed for this start-up service.

D. The "Capacity Test" to insure that energy use is minimized, the HVAC system must be balanced at design conditions at the lowest possible static pressure (SP). This requires that the lowest possible SP be found at the sensor that will allow full design flow at the Terminal Air Unit (TAU) most difficult to satisfy. This system minimum SP found is what the VFD should control to. To accomplish this verify that the TAU on the critical leg has its damper 90% or more open when all TAU's taking off upstream of the static pressure sensor are in full cooling. The "Capacity Test" to minimize energy usage in the hydronic system, it must be balanced at design conditions at the lowest differential pressure (DP) possible. This requires that the lowest possible DP at the sensor be found that will allow the delivery of design flow through the valve most difficult to satisfy. This system minimum DP found is what the VFD should control to. This is accomplished by changing the temperature setpoint for all zones to 55ºF for cooling or 85ºF for heating coils, causing all AHU coil valves to be calling for full cooling or heating, as applicable. Each coil's flow is then measured against the design flow. The coil that is receiving the lowest the lowest fraction of design is identified. The current DP at the controlling sensor is noted. A calculation is made, giving the DP required at the sensor to allow the identified most critical coil to meet its design flow.

E. The Mechanical trades shall submit a “Certificate of Proper Installation” to the Owner confirming that all equipment was inspected, operation checked, and installation approved in writing by the manufacturer’s representative.

F. UNDER NO CIRCUMSTANCES ARE ANY PORTIONS OF THE VARIABLE FREQUENCY DRIVE SYSTEM TO BE ENERGIZED WITHOUT AUTHORIZATION FROM THE MANUFACTURER’S REPRESENTATIVE.

3.4 TRAINING

A. Conduct a minimum of four (4) hours training for maintenance staff on operation, programming, and service of VFD’s. Training shall be conducted by a factory trained service technician.

B. Training shall not be performed until system is operational and functional and two (2) weeks after receiving approved job specific technical manuals.

END OF SECTION 200514

SECTION 200516 - EXPANSION FITTINGS AND LOOPS FOR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Flexible-hose packless expansion joints.
2. Metal-bellows packless expansion joints.
3. Alignment guides and anchors.

B. Related Sections include the following:
1. Division 20 Section 200529 Section "Hangers and Supports" for hangers and supports.

1.3 DEFINITIONS

A. BR: Butyl rubber.

B. Buna-N: Nitrile rubber.

C. CR: Chlorosulfonated polyethylene synthetic rubber.

D. CSM: Chlorosulfonyl-polyethylene rubber.

E. EPDM: Ethylene-propylene-diene terpolymer rubber.

F. NR: Natural rubber.

G. PTFE: Polytetrafluoroethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

C. Maintenance Data: For pipe expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
   2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flex Pression Ltd.
      b. Flex-Hose Co.
      c. Flexicraft Industries.
      d. Mason Industries.
      e. Metraflex Company.
      f. Unisource Manufacturing.
   2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
   3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
   4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
      a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
      b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
   5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
   6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 4: Stainless-steel fittings with flanged end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

B. Metal-Bellows Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Adsco Manufacturing.
   b. American BOA.
   c. Badger Industries.
   d. Expansion Joint Systems.
   e. Flex Pression Ltd.
   f. Flex-Hose Co.
   g. Flex-Weld.
   h. Flexicraft Industries.
   i. Flo Fab.
   j. Hyspan Precision Products.
   k. Mason Industries.
   l. Metraflex Company.
   m. Proco Products.
   n. Senior Flexonics Pathway.
   o. Tozen Corporation.
   p. U.S. Bellows.
   q. Unaflex.
   r. Unisource Manufacturing.
   s. Universal Metal Hose.
   t. Wahlco Metroflex.
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 200 psig unless otherwise indicated.
5. Configuration: Single- or double-joint with base class(es) unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
   a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
   b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded
7. Expansion Joints for Steel Piping: Single- or multi ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
   a. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged or welded

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Adsco Manufacturing.
   b. Advanced Thermal Systems.

c. Flex-Hose Co.
d. Flex-Weld.
e. Flexicraft Industries.
f. Hyspan Precision Products.
g. Mason Industries.
h. Metraflex Company.
i. Senior Flexonics Pathway.
j. U.S. Bellows.
k. Unisource Manufacturing.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland Cement Concrete, with tension and shear capacities appropriate for application.
   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened Portland Cement Concrete, with tension and shear capacities appropriate for application.
   a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
   c. Washer and Nut: Zinc-coated steel.
6. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section 033000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
7. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
   a. Properties: Nonstaining, noncorrosive, and nongaseous.
   b. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

D. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:
   1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
   1. Anchor Attachment to Steel Structural Members: Attach by welding.
   2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

H. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

I. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 200516

SECTION 200519 - METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Test plugs.
7. Sight flow indicators.
8. Orifice flowmeters.
9. Pitot-tube flowmeters.
10. Ultrasonic, thermal-energy meters.

B. Related Sections:
1. Division 21 Section 211313 "Wet-Pipe Sprinkler Systems"
2. Division 21 Section 211316 "Dry-Pipe Sprinkler Systems" for fire protection pressure gages.
3. Division 22 Section 221116 "Domestic Water Piping" for water meters inside the building.
4. Division 23 Section 231123 Section "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, include performance curves.

B. Shop Drawings: Schedule for thermometers, gages, flowmeters, and thermal-energy meters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of product listed above, signed by product manufacturer.

D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ashcroft.
   2. Miljoco Corporation.
   3. Trerice.
   4. Watts.
   5. Weiss Instruments.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle rigid, back, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass or plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Miljoco Corporation.
      b. Trerice.
   2. Standard: ASME B40.200.
   3. Case: Cast aluminum; 6-inch nominal size.
   4. Case Form: Back angle unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue or red organic liquid.
   6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
   7. Window: Glass or plastic.
   8. Stem: Aluminum and of length to suit installation.
      a. Design for Air-Duct Installation: With ventilated shroud.
      b. Design for Thermowell Installation: Bare stem.
   9. Connector: 3/4 inch, with ASME B1.1 screw threads.
   10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 THERMOWELLS

A. Thermowells:
   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: CNR or CUNI.
   4. Material for Use with Steel Piping: CRES.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Manufacturers: Same as manufacturer of thermometer being used.

2.5 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMETEK.
      b. Ashcroft.
      c. Miljoco Corporation.
      d. Trerice.
      e. Watts.
      f. Weiss Instruments.
   2. Standard: ASME B40.100.
   3. Case: Indicating type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
   4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   6. Movement: Mechanical, with link to pressure element and connection to pointer.
   7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
   8. Pointer: Dark-colored metal.
   9. Window: Glass or plastic.
   10. Ring: Metal.
   11. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
   12. Range for Fluids under Pressure: Two times operating pressure.
   13. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal -type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flow Design.
   2. Peterson Equipment Co.
   3. Miljoco Corporation.
   4. Trerice.
   5. Watts.
   6. Weiss Instruments.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Corrosion-resistant brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: One or two self-sealing rubber valves.
   1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
   2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

2.8 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dwyer Instruments.
   2. Emerson Process Management.
   3. Ernst Co.
   4. Ernst Flow Industries.
   5. Penberthy.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.9 FLOWMETERS

A. Orifice Flowmeters:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB
      b. Bell & Gossett
      c. Meriam Process Technologies.
      d. Preso Meters.
      e. S. A. Armstrong Limited.
   2. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
   3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.
   a. Design: Differential-pressure-type measurement for water.
   b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
   c. Minimum Pressure Rating: 300 psig.
   d. Minimum Temperature Rating: 250 deg F.
5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor and having 6-inch diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.
   a. Scale: Gallons per minute.
   b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two 12-foot hoses, with carrying case.
   a. Scale: Gallons per minute.
   b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
7. Display: Visual instantaneous rate of flow.
8. Conversion Chart: Flow rate data compatible with sensor and indicator.
9. Operating Instructions: Include complete instructions with each flowmeter.

B. Pitot-Tube Flowmeters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB.
   b. Emerson Process Management
   c. Meriam Process Technologies.
   d. Preso Meters.
   e. Taco.
   f. Veris Industries.
2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute.
   a. Design: Differential-pressure-type measurement for water.
   b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
   c. Minimum Pressure Rating: 150 psig (1035 kPa).
   d. Minimum Temperature Rating: 250 deg F (121 deg C).
   e. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
5. Integral Transformer: For low-voltage power connection.
6. Accuracy: Plus or minus 3 percent.
7. Display: Visual instantaneous rate of flow.
8. Operating Instructions: Include complete instructions with each flowmeter.

2.10 THERMAL-ENERGY METERS

A. Ultrasonic, Thermal-Energy Meters:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. EMCO Flow Systems.
   3. Siemens Energy & Automation.
   4. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
   5. Flow Sensor: Transit-time ultrasonic type with transmitter.
   6. Temperature Sensors: Insertion-type or strap-on transducer.
   7. Indicator: Solid-state, integrating-type meter with integral battery pack.
   8. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
   9. Battery Pack: Five-year lithium battery.
   10. Accuracy: Plus or minus 1 percent.
   11. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
   12. Operating Instructions: Include complete instructions with each thermal-energy meter system.
   13. Strainer: Full size of main line piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

U. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

V. Assemble components and install thermal-energy meters.

W. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

X. Install thermometers in the following locations:
   1. Plumbing Systems:
      a. Inlet and outlet of each water heater.
      b. Two inlets of each mixing valve.
   2. HVAC Systems:
      a. Inlet and outlet of each hydronic zone.
      b. Inlet and outlet of each hydronic boiler.

Y. Install pressure gages in the following locations:
   1. Plumbing Systems:
      a. Building water service entrance into building.
      b. Inlet and outlet of each pressure-reducing valve.

c. Suction and discharge of each domestic water pump.
2. HVAC Systems:
a. Inlet and outlet of each pressure-reducing valve.
b. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
1. Compact-style, liquid-in-glass type.
2. Test plug with EDPM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic zone shall be the following:
1. Compact-style, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
1. Compact-style, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

D. Install liquid-filled-case-type, bimetallic -actuated dial thermometers at suction and discharge of each pump.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg.

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

C. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.

D. Scale Range for Air Ducts: 0 to 150 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
   2. Test plug with EDPM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
   2. Test plug with EDPM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Liquid-filled, direct -mounted, metal case.
   2. Test plug with EDPM self-sealing rubber inserts.

D. Pressure gages at discharge of each hydronic pressure-reducing valve shall be the following:
   1. Liquid-filled, direct -mounted, metal case.
   2. Test plug with EDPM self-sealing rubber inserts.

E. Pressure gages at suction and discharge of each HVAC pump shall be the following:
   1. Liquid-filled, direct -mounted, metal case.
   2. Test plug with EDPM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi

C. Scale Range for Heating, Hot-Water Piping: 0 to 160psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Heating, Hot-Water Piping: Orifice or Pitot-tube type.

3.9 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters for Heating, Hot-Water Piping: Ultrasonic type.

END OF SECTION 200519

SECTION 200523 - GENERAL-DUTY VALVES FOR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Section 200500 Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron swing check valves with closure control.
8. Iron, center-guided check valves.
9. Iron gate valves.
10. Bronze globe valves.
11. Iron globe valves.
12. Drain Valves.
13. Chainwheels.

B. Related Sections:
1. Division 20 Section 200553 "Mechanical Identification" for valve tags and schedules.
2. Division 22 Section 220523 "Valves for Plumbing Piping" for valves applicable only to this piping.
3. Division 22 Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

A. ASME: American Society of Mechanical Engineers.

B. ASTM: American Society for Testing and Materials.

C. AWWA: American Water Works Association.

D. CWP: Cold working pressure.

E. EPDM: Ethylene propylene copolymer rubber.

F. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

G. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

H. NRS: Nonrising stem.

I. OS&Y: Outside screw and yoke.

J. PTFE: Polytetrafluoroethylene plastic.

K. RS: Rising stem.

L. SWP: Steam working pressure.

M. TFE: Tetrafluorethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

G. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

H. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
   a. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
4. Threaded: With threads according to ASME B1.20.1.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Nonmetallic Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Valve Group; Crane Valves.
      b. Crane Valve Group; Jenkins Valves.
      c. Crane Valve Group; Stockham Division.
      d. Hammond Valve.
      e. Milwaukee Valve Company.
      f. Nibco.
      g. Powell Valves.
   2. Description:
      a. Standard: MSS SP-80, Type 2.
      b. CWP Rating: 300 psig.
      c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
      d. Ends: Threaded.
      e. Stem: Bronze.
      f. Disc: PTFE or TFE.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries.; Apollo Valves.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Hammond Valve.
      d. Lance Valves.
      e. Milwaukee Valve Company.
      f. Nibco.
      g. Watts.
   2. Description:
      a. Standard: MSS SP-110.
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABZ Valve and Controls; a division of ABZ Manufacturing.
      b. Conbraco Industries; Apollo Valves.
      c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
      d. Crane Valve Group; Jenkins Valves.
      e. Crane Valve Group; Stockham Division.
      f. DeZurik Water Controls.
      g. Flo Fab.
      h. Hammond Valve.
      i. Kitz Corporation.
      j. Legend Valve.
      k. Milwaukee Valve Company.
      l. Nibco.
      m. Norriseal; a Dover Corporation company.
      n. Red-White Valve Corporation.
      o. Spence Strainers International; a division of CIRCOR International.
      p. Watts Regulator Co.; a division of Watts Water Technologies.
   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
      d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
      e. Seat: EPDM.
      f. Stem: One- or two-piece stainless steel.
      g. Disc: Aluminum bronze.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flo Fab Inc.
      b. Hammond Valve.
      c. Kitz Corporation.
      d. Milwaukee Valve Company.
      e. Mueller Steam Specialty; a division of SPX Corporation.
      f. NIBCO INC.
      g. Red-White Valve Corporation.
      h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 2.
      b. CWP Rating: 200 psig.
      c. Body Design: Vertical flow.

d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Red-White Valve Corporation.
   i. Zy-Tech Global Industries, Inc.
2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Valve Group; Crane Valves.
   b. Crane Valve Group; Jenkins Valves.
   c. Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Kitz Corporation.
   f. Legend Valve.
   g. Milwaukee Valve Company.
   h. Nibco.
   i. Powell Valves.
   j. Red-White Valve Corporation.
   k. Sure Flow Equipment.
   l. Watts Regulator Co.; a division of Watts Water Technologies.
   m. Zy-Tech Global Industries.
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.

e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.8 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.
   i. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever and Weight-Closure Control:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves. Crane Co.; Crane Valve Group; Jenkins Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.
   i. Closure Control: Factory-installed, exterior lever and weight.

2.9 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.

b. APCO Willamette Valve and Primer Corporation.
c. Crispin Valve.
d. DFT Inc.
e. Flo Fab Inc.
f. GA Industries, Inc.
g. Hammond Valve.
h. Metraflex, Inc.
i. Milwaukee Valve Company.
j. Mueller Steam Specialty; a division of SPX Corporation.
k. NIBCO INC.
l. Spence Strainers International; a division of CIRCOR International.
m. Sure Flow Equipment Inc.
n. Val-Matic Valve & Manufacturing Corp.

2. Description:
a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer.
f. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. Mueller Steam Specialty; a division of SPX Corporation.
i. NIBCO INC.
j. Spence Strainers International; a division of CIRCOR International.
k. Sure Flow Equipment Inc.
l. Val-Matic Valve & Manufacturing Corp.
m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

C. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. APCO Willamette Valve and Primer Corporation.
      b. Crispin Valve.
      c. DFT Inc.
      d. Flo Fab Inc.
      e. Hammond Valve.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Spence Strainers International; a division of CIRCOR International.
      i. Sure Flow Equipment Inc.
      j. Val-Matic Valve & Manufacturing Corp.
   2. Description:
      a. Standard: MSS SP-125.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A 126, gray iron.
      e. Style: Compact wafer.
      f. Seat: EPDM.

D. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. APCO Willamette Valve and Primer Corporation.
      c. Crispin Valve.
      d. DFT Inc.
      e. GA Industries, Inc.
      f. Hammond Valve.
      g. Milwaukee Valve Company.
      h. NIBCO INC.
      i. Sure Flow Equipment Inc.
      j. Val-Matic Valve & Manufacturing Corp.
   2. Description:
      a. Standard: MSS SP-125.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A 126, gray iron.
      e. Style: Globe, spring loaded.
      f. Ends: Flanged.
      g. Seat: EPDM.

2.10 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve.

b. Crane Valve Group; Crane Valves.
c. Crane Valve Group; Jenkins Valves.
d. Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. Nibco.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies.
l. Zy-Tech Global Industries.

2. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

B. Class 125, RS Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.
i. Disc: Solid wedge; bronze.
j. Packing: Asbestos free.
k. Handwheel: Malleable iron.

2.11 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Flo Fab Inc.
      e. Hammond Valve.
      f. Kitz Corporation.
      g. Legend Valve.
      h. Milwaukee Valve Company.
      i. NIBCO INC.
      j. Powell Valves.
      k. Red-White Valve Corporation.
      l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      m. Zy-Tech Global Industries, Inc.
   2. Description:
      a. Standard: MSS SP-70, Type I.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A 126, gray iron with bolted bonnet.
      e. Ends: Flanged.
      f. Trim: Bronze.
      g. Disc: Solid wedge.
      h. Packing and Gasket: Asbestos free.

2.12 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Valve Group; Crane Valves.
      b. Hammond Valve.
      c. Kitz Corporation.
      d. Milwaukee Valve Company.
      e. Nibco.
      f. Powell Valves.
      g. Red-White Valve Corporation.
      h. Watts Regulator Co.; a division of Watts Water Technologies.
      i. Zy-Tech Global Industries.
   2. Description:
      a. Standard: MSS SP-80, Type 2.
      b. CWP Rating: 300 psig.
      c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
      d. Ends: Threaded.
      e. Stem: Bronze.

f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.13 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Powell Valves.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.
2. Description:
a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.14 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Bronze ball valve as specified in this Section.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.15 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly, gate, and globe valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly, gate, globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, or butterfly valves.
   2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service: Globe or angle valves.
4. Pump-Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 and Larger for Hydronic: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.

B. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two-piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 4: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron Swing Check Valves: Class 125 metal seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 4: Class 125, lever and spring.
5. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.
6. Iron Gate Valves: Class 125, NRS.
7. Iron Globe Valves, NPS 2-1/2 to NPS 4: Class 125.

END OF SECTION 200523

SECTION 200529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Section 200500 Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. This Section includes the following hangers and supports for fire protection system, plumbing system, and HVAC system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Fastener systems.
   5. Pipe stands.
   6. Pipe positioning systems.
   7. Equipment supports.

B. Related Sections include the following:
   1. Division 05 Section 050000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 20 Section 200548 "Vibration Controls" for vibration isolation devices.
   3. Division 20 Section 200516 "Expansion Fittings and Loops for Piping" for pipe expansion joints, pipe expansion loops, pipe guides and pipe anchors.
   4. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
   5. Division 23 Section Metal Ducts for duct hangers and supports.

1.3 DEFINITIONS

A. ASCE: American Society of Civil Engineers.

B. ASME: American Society of Mechanical Engineers.

C. ASTM: American Society for Testing and Materials.

D. AWS: American Welding Society.

E. IAPMO: International Association of Plumbing and Mechanical Officials.

F. MFMA: Metal Framing Manufacturers Association.

G. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

H. SSPC: Steel Structures Painting Council now the Society for Protective Coatings.

I. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.

B. Shop Drawings: Show fabrication and installation details and include calculations stamped by a structural engineer licensed to perform work in the State of Michigan for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Pipe stands. Include Product Data for components.
   4. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.3, "Structural Welding Code--Sheet Steel."
   3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AAA Technology & Specialties Co., Inc.
   2. Anvil International.
   3. Bergen-Power Pipe Supports.
   4. B-Line Systems, Inc.; a division of Cooper Industries.
   5. Carpenter & Paterson, Inc.
   6. Empire Industries, Inc.
   7. ERICO/Michigan Hanger Co.
   8. Globe Pipe Hanger Products, Inc.
   9. Grinnell Corp.
   10. GS Metals Corp.
   11. National Pipe Hanger Corporation.
   12. PHD Manufacturing, Inc.
   13. PHS Industries, Inc.
   14. Piping Technology & Products, Inc.
   15. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Non-metallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, straps, clips, clamps and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel or stainless steel channels and other components with appropriate finish based on location of use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anvil International.
   2. B-Line Systems, Inc.; a division of Cooper Industries.
   3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   4. GS Metals Corp.
   5. Power-Strut Div.; Tyco International, Ltd.
   6. Thomas & Betts Corporation.
   7. Tolco Inc.
   8. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal or galvanized surfaces are indicated.

D. Non-metallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc., a subsidiary of Piping Technology & Products, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type **zinc-coated** steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-Line Systems, Inc.; a division of Cooper Industries.
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping, ductwork and equipment.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ERICO/Michigan Hanger Co.
      b. MIRO Industries.
      c. Portable Pipe Hangers.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ERICO/Michigan Hanger Co.
      b. MIRO Industries.
      c. Portable Pipe Hangers.
   2. Base: **Stainless steel.**
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Portable Pipe Hangers.
   2. Bases: One or more plastic.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.8 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. C & S Mfg. Corp.
   2. HOLDRITE Corp.; Hubbard Enterprises.
   3. Samco Stamping, Inc.
   4. Sioux Chief Manufacturing Co.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel or stainless steel shapes with appropriate finish based on location of use.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Stainless Steel: ASTM A 304, stainless steel plates, shapes, and bars.

C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and non-metallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use non-metallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts, or equipment.

G. Hangers and supports shall also be provided at every change in direction and within 12 inches of any pipe fitting and valves.

H. Pipe hangers in the boiler room shall be provided with spring hangers with elastomeric inserts to eliminate noise transmission between piping and the building structure. Refer to Division 20 “Vibration and Seismic Controls.”

I. Hanger components shall not be used for purposes other than for which they were designed.

J. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

K. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, braces, brackets or structural cross members may be used.

L. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roll carriages shall be used.

M. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring cushion hangers may be used where vertical movement does not exceed 1/4 inches.

N. Pipe attachments for insulated pipe shall be outside the insulation. Insulation protection shields and high density insulation inserts shall be provided to protect the insulation.

O. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 8, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 8, requiring clamp flexibility and up to 4 inches of insulation.
   4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
   8. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
   9. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
   10. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 3 and larger.

11. Clips (MSS Type 26): For support of insulated pipes, not subject to expansion or contraction.
12. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 3 to NPS 8, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
13. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 3 to NPS 8, from single rod if horizontal movement caused by expansion and contraction might occur.
14. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 3 to NPS 8, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
15. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 3 to NPS 8, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
16. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 3 to NPS 8, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

P. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 8.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 8, if longer ends are required for riser clamps.

Q. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

R. Building Attachments: Use of “C” clamps and beam clamps of “C” pattern and any modification thereof for pipe sizes 2-1/2 inches and larger is prohibited unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
9. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
10. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

S. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length indicated in specifications and details to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: To provide rigid insulation at location of pipe hangers.

T. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

U. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

V. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

W. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

X. Use pipe positioning systems (Sioux Chief or approved equal) in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Provide necessary piping and equipment supporting elements including building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, or other pipes, ducts, or equipment.

B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation: Install within pipe hanger and shield for insulated piping.

F. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Bases shall have sufficient footprint direct contact area to limit loading on roof membrane to be within roofing manufacturer's limitations so as to not void the roofing warranty.

H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Use thermal-hanger shield insert with clamp sized to match OD of insert for all piping 2" and larger
      b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles for all insulated piping 4" and larger. Fill interior voids with insulation that matches adjoining insulation.
   3. Install MSS SP-58, Type 40, protective shields on all insulated piping without saddles. Shields shall span an arc of 180 degrees.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 4: 12 inches long and 0.048 inch thick.
      b. NPS 5 to NPS 6: 18 inches long and 0.06 inch thick.
   5. Pipes NPS 8 and Larger: Include wood inserts.
   6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 SUPPLEMENTARY STEEL

A. Where it is necessary to frame structural members between existing structural steel members or where structural steel members are used in lieu of commercially rated supports, install such supplementary steel in accordance with American Institute of Steel Construction Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. Connection to the existing steel shall be with clamps unless otherwise approved by the Engineer.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches**.

3.7 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 200529

SECTION 200533 - HEAT TRACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. This Section includes heat tracing with the following electric heating cables:
   1. Self-regulating, parallel resistance.

B. Related Sections include the following:
   1. Division 20 Section 200553 Section "Mechanical Identification."
   2. Division 20 Section 200700 Section "Mechanical Insulation".
   3. Division 26 Section 260526 Section "Grounding and Bonding for Electrical Systems."
   4. Division 26 Section 260519 Section "Low-Voltage Electrical Power Conductors and Cables."

1.3 DEFINITIONS

A. IEEE: Institute of Electrical and Electronics Engineers.

B. NFPA: National Fire Protection Association.

C. NPS: Nominal Pipe Size.

D. OD: Outside Diameter.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chromalox.
   2. Delta-Therm Corporation.
   3. Pyrotenax; a brand of Tyco Thermal Controls LLC.
   4. Raychem; a brand of Tyco Thermal Controls LLC.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of parallel No. 16 AWG, nickel-coated stranded copper bus wires embedded in cross-linked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned-copper braid, and polyolefin outer jacket with UV inhibitor.

F. Maximum Operating Temperature (Power On): 150 deg F.

G. Maximum Exposure Temperature (Power Off): 185 deg F.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Capacities and Characteristics:
   1. Maximum Heat Output 5 W/ft.
   2. Piping Diameter: Refer to drawings.
   3. Number of Parallel Cables: As required for application.
   4. Volts: Coordinate with available dedicated circuit and electrical contractor.

2.2 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:
   1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F
   2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
   3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
   4. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Division 20 Section 200553 "Mechanical Identification."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Install the following types of electric heating cable for the applications described:
   1. Freeze Protection of Pipes: Self-regulating, parallel-resistance.

3.3 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables according to Division 20 Section 200700 "Mechanical Insulation."
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

D. Protect installed heating cables, including non-heating leads, from damage.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section 260526 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section 260519 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   2. Test cables for electrical continuity and insulation integrity before energizing.
   3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed heating cables, including non-heating leads, from damage during construction.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 200533

SECTION 20 05 48 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Open-spring isolators.
3. Spring hangers.
4. Vibration isolation equipment bases.

1.3 SUBMITTALS

A. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation device.
1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

D. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

E. Qualification Data: For testing agency.

F. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control.
   2. Mason Industries.
   3. Virbo-Acoustics.
   4. Vibration Eliminator Co.
   5. Vibration Mountings & Controls.

B. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

C. Size: Factory or field cut to match requirements of supported equipment.

D. Pad Material: Oil and water resistant with elastomeric properties.

E. Surface Pattern: Waffle pattern.

F. Infused nonwoven cotton or synthetic fibers.

G. Load-bearing metal plates adhered to pads.

H. Sandwich-Core Material: elastomeric.

2.2 OPEN-SPRING ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control.
   2. Mason Industries.
   3. Virbo-Acoustics.
   4. Vibration Eliminator Co.
   5. Vibration Mountings & Controls.

B. Freestanding, Laterally Stable, Open-Spring Isolators.

C. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

D. Minimum Additional Travel: 50 percent of the required deflection at rated load.

E. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

F. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.

H. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.3 SPRING HANGERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control.
   2. Mason Industries.
   3. Virbo-Acoustics.
   4. Vibration Eliminator Co.
   5. Vibration Mountings & Controls.

B. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

C. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

D. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

E. Minimum Additional Travel: 50 percent of the required deflection at rated load.

F. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

G. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

H. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

I. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

J. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control.
   2. Mason Industries.
   3. Virbo-Acoustics.
   4. Vibration Eliminator Co.
   5. Vibration Mountings & Controls.

B. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Section 033000 "Cast-in-Place Concrete."

END OF SECTION 200548

SECTION 200553 – MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Brady Co.
   2. Bramer.
   3. Craftmark.
   4. Emed.
   5. Marking Services, Inc.
   6. Seton Name Plate Corp.

2.2 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
   2. Letter Color: White
   3. Background Color: Black
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel self-tapping screws.

B. Label Content: Include equipment's unique equipment number from the plans.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black

C. Background Color: Yellow

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 DUCT LABELS

A. Material and Thickness: Outdoor Grade 3.2 mil thick high gloss adhesive backed vinyl film, printed using UV and chemical resistant inks,

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches minimum
   2. Fasteners: Brass grommet and wire
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:
   1. Fire Protection:
      a. Background Color: Red.
      b. Letter Color: White.
   2. Domestic Cold Water Piping:
      a. Background Color: Blue.
      b. Letter Color: White.
   3. Domestic Hot Water Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.
   4. Storm Drainage Piping:
      a. Background Color: Blue.
      b. Letter Color: White.
   5. Natural Gas Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.
   6. Heating Water Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.
   7. Refrigerant Piping:
      a. Background Color: Green
      b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
   1. Green: For supply ducts.
   2. Yellow: For return ducts.
   3. Blue: For exhaust-, outside-, relief-, ducts.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape: 1 ½ inches, round
   2. Valve-Tag Color: Natural
   3. Letter Color: Black

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 200553

SECTION 200593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
   2. Hydronic Piping Systems:
      a. Constant-flow systems.
      b. Variable-flow systems.
      c. Primary-secondary systems.
   3. Domestic hot water recirculation systems.
   4. Kitchen hood airflow balancing.
   5. Verifying that automatic control devices are functioning properly.
   6. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit electronic copy of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit electronic copy of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit electronic copy of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, NEBB, or TABB.

B. Acceptable TAB Firms: Subject to compliance with requirements, select from one of the following TAB firms:
   1. Absolut Balance Co.
   2. Air Flow Testing, Inc.
   3. Barmatic Inspecting Co.
   4. Ener-Tech.
   5. EnviroAire – Total Balance, Inc.
   6. International Test & Balance, Inc

C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives; HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
   1. Agenda Items: Include at least the following:
      a. Submittal distribution requirements.
      b. The Contract Documents examination report.
      c. TAB plan.
      d. Work schedule and Project-site access requirements.
      e. Coordination and cooperation of trades and subcontractors.
      f. Coordination of documentation and communication flow.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.", or TABB "Contractors Certification Manual."

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

H. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

I. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of Contract.

2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of systems and equipment.

C. Examine Project Record Documents.

D. Examine design data, including system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Interlocked systems are operating.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
   1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set outside-air dampers at minimum and return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.
   4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
   6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
   7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
   8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, and then balance the secondary system.

3.11 PROCEDURES FOR DOMESTIC HOT WATER RECIRCULATION PLUMBING SYSTEMS

A. Set calibrated balancing valves at calculated presettings.

B. Measure flow at all stations and adjust, where necessary, to obtain first balance

C. Adjust balancing stations to within specified tolerances of indicated recirculation flow rate.

D. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

E. Record settings and mark balancing devices.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR BOILERS

A. If hydronic, measure entering- and leaving-water temperatures and water flow.

B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.14 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
   1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.

B. After balancing is complete, do the following:
   1. Measure and record the static pressure at the hood exhaust-duct connection.
   2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
   3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
   1. Check duct slopes as required.
   2. Verify that duct access is installed as required.
   3. Verify that point of termination is as required.
   4. Verify that duct air velocity is within the range required.
   5. Verify that duct is within a fire-rated enclosure.

D. Report deficiencies.

3.15 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to +10%.
   2. Air Outlets and Inlets: -5% to +5%.
   3. Heating-Water Flow Rate: 0 to +10%.
   4. Cooling-Water Flow Rate: 0 to +5%.
   5. Domestic Hot Water Recirculation Flow Rate: 0 to +10%.

3.16 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.

4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems and domestic hot water recirculation systems. Present each system with single-line diagram and include the following as applicable:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Rooftop Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.

i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.

2. Motor Data:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat coil static-pressure differential in inches wg.
   g. Cooling coil static-pressure differential in inches wg.
   h. Heating coil static-pressure differential in inches wg.
   i. Outside airflow in cfm.
   j. Return airflow in cfm.
   k. Outside-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btuh.
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
   k. Motor volts, phase, and hertz.
   l. Motor full-load amperage and service factor.
   m. Sheave make, size in inches, and bore.
   n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Entering-air temperature in deg F.
   c. Leaving-air temperature in deg F.

d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.

g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.

e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

M. Boiler Test Reports:
1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and type.
   e. Model and serial numbers.
   f. Fuel type and input in Btuh.
   g. Number of passes.
   h. Ignition type.
   i. Burner-control types.
   j. Voltage at each connection.
   k. Amperage for each phase.
2. Test Data (Indicated and Actual Values):
   a. Operating pressure in psig.
   b. Operating temperature in deg F.
   c. Entering-water temperature in deg F.
   d. Leaving-water temperature in deg F.
   e. Number of safety valves and sizes in NPS.
   f. Safety valve settings in psig.
   g. High-limit setting in psig.
   h. Operating-control setting.
   i. High-fire set point.
   j. Low-fire set point.

k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig.

N. Air-to-Air Energy-Recovery Unit Reports:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. If fans are an integral part of the unit, include the following for each fan:
a. Make and type.
b. Arrangement and size.
c. Sheave make, size in inches, and bore.
d. Sheave dimensions, center-to-center, and amount of adjustments in inches.
4. Test Data (Indicated and Actual Values):
a. Total exhaust airflow rate in cfm.
b. Purge exhaust airflow rate in cfm.
c. Outside airflow rate in cfm.
d. Total exhaust fan static pressure in inches wg.
e. Total outside-air fan static pressure in inches wg.
f. Pressure drop on each side of recovery wheel in inches wg.
g. Exhaust air temperature entering in deg F.
h. Exhaust air temperature leaving in deg F.
i. Outside-air temperature entering in deg F.
j. Outside-air temperature leaving in deg F.
k. Calculate sensible and total heat capacity of each airstream in MBh.

O. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.18 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
   2. Randomly check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Measure sound levels at two locations.
      e. Measure space pressure of at least 10 percent of locations.
      f. Verify that balancing devices are marked with final balance position.
      g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
   1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
   2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
   3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
   6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
   7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.19 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 200593

SECTION 200700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Section 019113 General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Calcium silicate.
      b. Cellular glass.
      c. Flexible elastomeric.
      d. Mineral fiber.
      e. Polystyrene.
   2. Fire-rated insulation systems.
   3. Insulating cements.
   4. Adhesives.
   5. Mastics.
   6. Lagging adhesives.
   7. Sealants.
   8. Factory-applied jackets.
   9. Field-applied fabric-reinforcing mesh.
   10. Field-applied cloths.
   11. Field-applied jackets.
   12. Tapes.
   13. Securements.
   14. Corner angles.
   15. Protective shielding guards

B. Related Sections:
   1. Division 23 Section 233113 "Metal Ducts" for duct liners.

1.3 DEFINITIONS

A. ASHRAE/IESNA: American Society of Heating, Refrigeration, Air Conditioning Engineers/Illuminating Engineering Society of North America.

B. ASTM: American Society for Testing and Materials.

C. CFC: Chlorinated Fluorocarbon.

D. HCFC: Hydrogenated Chlorofluorocarbon.

E. LEED: Leadership in Energy and Environmental Design.

F. MIL: Military.

G. NPS: Nominal Pipe Size.

H. VOC: Volatile Organic Compound.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
   8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft-training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 20 Section 200529 "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Industrial Insulation Group (The); Thermo-12 Gold.
   2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
   3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
   4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Pittsburgh Corning Corporation; Foamglas.
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Board Insulation: ASTM C 552, Type IV.
   5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
   7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK or PSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; SOFTR All-Service Duct Wrap.

J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
      b. Johns Manville; HTB 26 Spin-Glas.
      c. Roxul Inc.; Roxul RW.

K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJor FSK jacket (see duct application schedule on plans. For equipment applications, provide insulation with factory-applied ASJ jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; CertaPro Commercial Board.
      b. Fibrex Insulations Inc.; FBX.
      c. Johns Manville; 800 Series Spin-Glas.
      d. Knauf Insulation; Insulation Board.
      e. Manson Insulation Inc.; AK Board.
      f. Owens Corning; Fiberglas 700 Series.

L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; FBX.Industrial Insulation Group (IIG); MinWool-1200 Industrial Board.
      b. Rock Wool; Delta Board.
      c. Roxul Inc.; RHT and RockBoard.
      d. Thermafiber, Inc.; Thermafiber Industrial Felt.

M. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Knauf Insulation; 1000-Degree Pipe Insulation.
      d. Manson Insulation Inc.; Alley-K.

e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

N. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb./cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

O. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Chemical Company (The); Styrofoam.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
      b. Eagle Bridges - Marathon Industries; 290.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
      d. Mon-Eco Industries, Inc.; 22-30.
      e. Vimasco Corporation; 760.
   2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
      d. K-Flex USA; R-373 Contact Adhesive.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 739, Dow Silicone.
      b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
      c. P.I.C. Plastics, Inc.; Welding Adhesive.
      d. Speedline Corporation; Polyco VP Adhesive.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
      b. Eagle Bridges - Marathon Industries; 570.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
   5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
      b. Eagle Bridges - Marathon Industries; 550.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
      d. Mon-Eco Industries, Inc.; 55-50.
      e. Vimasco Corporation; WC-1/WC-5.
   2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: 60 percent by volume and 66 percent by weight.
   5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
   c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:
   1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
      b. Eagle Bridges - Marathon Industries; 405.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
      d. Mon-Eco Industries, Inc.; 44-05.
      e. Pittsburgh Corning Corporation; Pittseal 444.
   2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
      b. Eagle Bridges - Marathon Industries; 405.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
      d. Mon-Eco Industries, Inc.; 44-05.
   3. Materials shall be compatible with insulation materials, jackets, and substrates.
   4. Permanently flexible, elastomeric sealant.
   5. Service Temperature Range: Minus 100 to plus 300 deg F.
   6. Color: White or gray.
   7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
      b. Eagle Bridges - Marathon Industries; 405.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.
4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
   5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
      b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      c. RPR Products, Inc.; Insul-Mate.
   2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
      a. Finish and thickness are indicated in field-applied jacket schedules.
      b. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and Kraft paper.
      c. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015-inch-thick, 1/2-inch-wide with wing seal.
   3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 1/2-inch-wide with wing seal.
   4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; CWP-1.
         2) GEMCO; CD.
         3) Midwest Fasteners, Inc.; CD.
         4) Nelson Stud Welding; TPA, TPC, and TPS.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; CHP-1.
         2) GEMCO; Cupped Head Weld Pin.
         3) Midwest Fasteners, Inc.; Cupped Head.
         4) Nelson Stud Welding; CHP.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
         2) GEMCO; Perforated Base.
         3) Midwest Fasteners, Inc.; Spindle.
      b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
      c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
      d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
    b. Baseplate: Perforated, nylon sheet, 0.030-inch-thick by 1-1/2 inches in diameter.
    c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
        2) GEMCO; Peel & Press.
        3) Midwest Fasteners, Inc.; Self Stick.
    b. Baseplate: Galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
    c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, Aluminum or Stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) AGM Industries, Inc.; RC-150.
        2) GEMCO; R-150.
        3) Midwest Fasteners, Inc.; WA-150.
        4) Nelson Stud Welding; Speed Clips.
    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040-inch-thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Truebro; a brand of IPS Corporation.
      b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
   2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Truebro; a brand of IPS Corporation.
      b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
   2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation (Conditioned Spaces): Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation (Unconditioned Spaces and Exposed to Weather): Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Division 07 "Penetration Firestopping" and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Pipe: Install insulation continuously through floor penetrations.
   3. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
   2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
   3. Protect exposed corners with secured corner angles.
   4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
      a. Do not weld anchor pins to ASME-labeled pressure vessels.
      b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
      c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
      d. Do not overcompress insulation during installation.
      e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
      f. Impale insulation over anchor pins and attach speed washers.
      g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
   5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
   6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
   7. Stagger joints between insulation layers at least 3 inches.
   8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
   9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
   10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
   1. Apply 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
   2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:
   1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
   2. Fabricate boxes from stainless steel, at least 0.050 inch thick.
   3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Provide protective shielding guards on exposed piping serving barrier free sinks and lavatories.

D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

E. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings and Ducts:
   1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
   2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
   3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:
   1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
   2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
   3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
   4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:
1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.11 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
    1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
    2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
    3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
    1. Install preformed pipe insulation to outer diameter of pipe flange.
    2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
    3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
    1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed section of polystyrene insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.12 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.13 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
   2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
   3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.15 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in nonconditioned space.
   4. Indoor, exposed return located in nonconditioned space.
   5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
   6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
   7. Outdoor, concealed supply and return.
   8. Outdoor, exposed supply and return.

B. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums and casings.

5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.16 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Refer to “Duct Application Schedule” in the drawings.

3.17 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Refer to “Duct Application Schedule” in the drawings.

3.18 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic hot-water pump insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.
2. Mineral-Fiber Blanket: 1-inch-thick and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1-inch-thick and 3-lb/cu. ft. nominal density.

D. Heating-hot-water pump insulation shall be one of the following:
1. Calcium Silicate: 3 inches thick.
2. Cellular Glass: 3 inches thick.
3. Mineral-Fiber Board: 2 inches thick and 3-lb./cu. ft. nominal density.

E. Heating-hot-water expansion/compression tank insulation shall be one of the following:
1. Calcium Silicate: 2 inches thick.
2. Cellular Glass: 1-1/2 inches thick.
3. Mineral-Fiber Board: 1-inch-thick and 3-lb./cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch thick.

F. Heating-hot-water air-separator insulation shall be one of the following:
1. Calcium Silicate: 3 inches thick.
2. Cellular Glass: 3 inches thick.
3. Mineral-Fiber Board: 2 inches thick and 3-lb./cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.19 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.20 INDOOR PIPING INSULATION SCHEDULE

A. Refer to “Piping Application Schedule” and “Plumbing Application Schedule” in the drawings.

B. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 1-1/2 inches thick.
      b. Flexible Elastomeric: 1 inch thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.

3.21 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refer to “Piping Application Schedule” and “Plumbing Application Schedule” in the drawings.

B. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 2 inches thick.
      b. Flexible Elastomeric: 2 inches thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 2 inches thick.
      b. Polyolefin: 2 inches thick.

3.22 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Refer to “Piping Application Schedule” and “Plumbing Application Schedule” in the drawings.

3.23 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Refer to “Duct Application Schedule”, “Piping Application Schedule” and “Plumbing Application Schedule” in the drawings.

B. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

C. If more than one material is listed, selection from materials listed is Contractor's option.

END OF SECTION 200700

SECTION 200800 - COMMISSIONING OF MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes Commissioning of Building Systems incorporating the following:
   1. HVAC Systems and Associated Controls.
   2. General requirements for coordinating and scheduling commissioning.
   3. Commissioning meetings.
   4. Commissioning reports.
   5. Use of test equipment, instrumentation, and tools for commissioning.
   6. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
   7. Commissioning tests and commissioning test demonstration.
   8. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:
   1. Division 01 "Submittal Procedures" for submittal procedures requirements for general commissioning.
   2. Division 01 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.
   3. Division 20 Sections – Common Mechanical.
   4. Division 22 Sections – Plumbing.
   5. Division 23 Sections – Heating, Ventilating, and Air Conditioning.
   6. Division 26 Sections – Electrical.

C. Certain building systems on this Project are to be commissioned using a team approach lead by the designated Commissioning Authority (CxA). The intent of this commissioning program is to provide documentation, testing, verification, and training facilitation to help ensure that the Project satisfies the needs of the Owner and the designer's intent. The scope of the commissioning program includes:
   1. Start up and testing of specified equipment and systems in accordance with the approved and updated Commissioning Authority commissioning plan, Field Installation Verification, Operational Performance Test, and Functional Performance Test approved forms.
   2. Identification of and documentation of equipment and system deficiencies and normal operating parameters.
   3. Corrective actions and acceptance of corrected equipment and systems.
   4. Review Operation and Maintenance manuals for completeness.
   5. Preventative maintenance equipment and system data collection.

6. Verify and Document Equipment and systems use and maintenance training is completed.

D. The Commissioning Authority (CxA) shall furnish labor and materials to facilitate, accomplish, and coordinate Building Commissioning as specified herein.

E. Schedule of Values: Contractor will delineate the cost of supporting the Commissioning Authority activities as a separate line item on their schedule of values.

F. Project Schedule: Contractor shall include the Commissioning Authority systems commissioning support in the total Project schedule as required by other specification Sections.

1.3 REFERENCE STANDARDS

A. The following referenced Industry Standards and Project Manual Specification Sections shall be used by the Commissioning Authority for developing the commissioning plan and all forms:
1. ASHRAE Guideline 0-2013, The Commissioning Process.
2. ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for The Commissioning Process.
3. ASHRAE Guideline 4-2008, Preparation of Operation and Maintenance Documentation for Building Systems.
4. Building Commissioning Guidelines, 2nd Edition, Bonneville Power Administration.
5. NEBB Procedural Standards for Building Systems Commissioning, 2009 - 3rd Edition.
6. PECI Commissioning Guidelines and Templates

1.4 DEFINITIONS

A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occur.

B. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the contract documents.

C. Architect / Engineer (A/E): The prime consultant (Architect) and sub-consultants who comprise the design team, generally the mechanical engineer and the electrical engineer.

D. Basis of Design (BoD): The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included.

E. Commissioning: A systematic process of ensuring that all building systems perform interactively according to the contract documents, design intent and the owner's operational needs through the construction, acceptance and the warranty period with actual verification of performance. The commissioning process encompasses and coordinates the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives in accordance with the contract documents:
   1. Verify that applicable equipment and systems are installed in accordance with the contract documents, manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors. The details on the drawings will take precedence over industry accepted minimum standards, unless the specifications make specific references (i.e. ASME 31.1 for piping).
   2. Verify and document proper performance of equipment and systems.
   3. Verify the testing, adjusting and balancing report.
      a. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

F. Commissioning Authority: (CxA): The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the CM. The CxA is part of the Architect/Engineer's team or shall report directly to the owner.

G. Commissioning Plan: An overall plan, developed before or after bidding that provides the structure, schedule and coordination planning for the commissioning process.

H. Contract Documents: The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).

I. Control System: The central building energy management control system.

J. Construction Manager (CM): Generally refers to all the CM's subcontractors as well. Also referred to as the contractor, in some contexts. The CM is hired by the owner and is contracted to oversee the fulfillment of all requirements of the contract documents.

K. Data logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

L. Deferred Functional Tests: FT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

M. Deficiency (also referred to as "Identified Issue"): A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the contract documents (that is, does not perform properly or is not complying with the design intent).

N. Design Intent: A dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

O. Design Narrative or Design Documentation: Sections of either the Design Intent or Basis of Design.

P. Factory Testing: Testing of equipment at the factory with an owner's representative present.

Q. Functional Test (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying what has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FT's are performed after prefunctional checklists and start-up are complete.

R. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed.

S. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

T. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

U. Non-Compliance: See Deficiency.

V. Non-Conformance: See Deficiency.

W. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50 to 75 degrees F to verify economizer operation). See also "Simulated Signal."

X. Owner-Contracted Tests: Tests paid for by the owner outside the CM's contract and for which the CxA does not oversee. These tests will not be repeated during functional tests if properly documented.

Y. Phased Commissioning: Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

Z. Pre-functional Checklists (PFC's): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the CM and Sub. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word pre-functional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The CxA only requires that the procedures be documented in writing, and does not witness much of the pre-functional check listing, except for larger or more critical pieces of equipment.

AA. Project Manager (PM): The individual employed by the owner to be responsible for the overall management and oversight of the Project.

BB. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.

CC. Seasonal Performance Tests: FT's that are deferred until the system(s) will experience conditions closer to their design conditions.

DD. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

EE. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

FF. Startup: The initial starting or activating of dynamic equipment, including executing pre-functional checklists.

GG. Subs: The subcontractors to the CM who provide and install building components and systems.

HH. Test Procedures: The step-by-step process that must be executed to fulfill the test requirements. The test procedures are developed by the CxA.

II. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures.

JJ. Trending: Monitoring using the building control system.

KK. Vendor: Supplier of equipment.

LL. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at substantial completion and extends for a period indicated in the contract documents and accepted submittals. As may be amended by owner requirements (i.e. beneficial use of the chiller plant).

1.5 ABBREVIATIONS

A. Abbreviations: The following are common abbreviations used in the Project Manual and in the commissioning plan.

A/E -	Architect and Design Engineers	FT -	Functional Test
CxA -	Commissioning Authority	MC -	Mechanical Contractor
CC -	Controls Contractor	PFT -	Pre-Functional Checklist
CM -	Construction Manager	PM -	Project Manager (of the owner)
Cx -	Commissioning	Subs -	Subcontractors to CM
Cx Plan -	Commissioning Plan Document	TAB -	Test, Adjusting & Balancing Contractor
EC -	Electrical Contractor		

1.6 COORDINATION

A. Commissioning Team: The members of the commissioning team consist of the following:
1. Owner's project manager (PM);
2. Commissioning authority (CxA);
3. Designee of the owner's construction management firm (CM);
4. Architect and/or design engineers (A/E) (particularly the mechanical engineer);
5. Mechanical contractor (MC);
6. Electrical contractor (EC);
7. Representative of TAB subcontractor (TAB);
8. Controls contractor (CC);
9. Any other installing subcontractors or suppliers of equipment;
10. The building or plant operator/engineer.

B. Management: The CxA is hired by the owner. The CxA directs and coordinates the commissioning activities and reports to the owner, A/E, and CM. All members work together to fulfill their respective contracted responsibilities and to meet the objectives of the contract documents.

C. Scheduling: The CxA will work with the CM and associated contractors according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the CM and contractors for scheduling commissioning activities. The CM will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
   1. The CxA will provide the initial schedule of commissioning milestones at the commissioning kick-off meeting. The “Commissioning Plan” provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA in coordination with the Commissioning Team.

1.7 COMMISSIONING PROCESS

A. Commissioning Plan: The “Commissioning Plan” provides guidance in the execution of the commissioning process. After the initial commissioning coordination meeting, the CxA will update the plan, which will continue to evolve as the project progresses.

B. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
   1. Commissioning during construction begins with a kick-off meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
   2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, and schedule future activities and resolve problems.
   3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.
   4. CxA works with the CM and Subs in developing startup plans and pre-functional documentation formats.
   5. In general, the checkout and performance verification proceeds from simple to complex, from component level to equipment to systems and intersystem levels with pre-functional checklists being completed before functional testing.
   6. The Subs, under the direction of the CM, execute and document the pre-functional checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.
   7. The CxA develops specific equipment and system functional test procedures. The CM and Subs review the procedures and provide comments to CxA.
   8. The procedures are executed by the Subs, under the direction of the CM, and documented by the CxA.
   9. Items of non-compliance in material, installation or setup are corrected and the system retested.
   10. Commissioning is intended to be completed before substantial completion.

1.8 SUBMITTALS

A. Submit under provisions of Divisions 20, 22, 23 and 26.

B. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At a minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation (as applicable), O&M data, performance data, any performance test procedures, control drawings (as applicable) and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.

C. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the contractor.

1.9 COMMISSIONING RECORD

A. Documentation of Commissioning Process:
   1. The CxA is responsible to compile, and organize the following commissioning data, by system, into indexed and bound for delivery to the owner. The commissioning record shall include 4 main sections:
      a. Commissioning Plan
      b. Final Commissioning Report
      c. Commissioning Testing Record
      d. Issues and Deficiencies Record
   2. The Final Commissioning Report shall include:
      a. Executive Summary
      b. List of participants and roles
      c. Brief building description
      d. Overview of commissioning and testing scope
      e. General description of testing and verification methods.
   3. The Commissioning Testing Record shall include:
      a. Completed pre-functional checklists and system startup forms
      b. Completed functional testing forms for each system
   4. The Cx Issues Tracking List shall include:
      a. All open items listing
      b. All closed items listing

1.10 COMMISSIONING RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this section. Additional responsibilities of the Mechanical, Temperature Controls and TAB Contractors are in Division 23. Additional responsibilities of the Plumbing Contractor are in Division 22 and for the Electrical Contractor in Division 26. The services of the Project Manager, Architect, Mechanical and Electrical Designers/Engineers, and Commissioning Authority are not provided for in the contract and CM is not responsible for providing their services. Their responsibilities of the PM, A/E and CxA are listed here to clarify the commissioning process.

B. All Parties:
   1. Follow the commissioning plan.
   2. Attend the commissioning kick-off meeting and additional meetings, as necessary.

C. Architect (or A/E):
   1. Construction and Acceptance Phase:
      a. The CM coordinates with the CxA contract for the owner.
      b. Attend the commissioning kick-off meeting and selected commissioning team meetings.
      c. Perform normal submittal review, construction observation, record drawing preparation, O&M manual preparation, etc., as contracted.
      d. Accept and review request made by the CxA for supplemental design narrative documentation.
      e. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
   2. Warranty Period:
      a. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. Mechanical and Electrical Designers/Engineers (of the A/E):
   1. Construction and Acceptance Phase:
      a. Perform normal submittal review, construction observation, record drawing preparation, etc., as contracted with the Architect. One (1) site observation at discretion of the A/E should be completed just prior to system startup.
      b. Accept and review report made by the CxA for supplemental design narrative and sequence documentation. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
      c. Attend commissioning kick-off meeting and other selected commissioning team meetings per A/E contract.
      d. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
      e. Review the final copies of the O&M manuals and submit to owner.

f. From the contractor's red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the chilled and hot water, domestic water, steam and condensate systems; supply, return and exhaust air systems as outlined in A/E contract. Provide these drawings, electronically, to the CxA. Provide electronic versions of the as-built sequences of operations, control drawings and original set points.
g. Provide system overviews at the training sessions for the owner's personnel.

2. Warranty Period:
   a. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during warranty-period commissioning.

E. Commissioning Authority (CxA):
1. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem solving, non-conformance issues or deficiencies, but ultimately that responsibility resides with the CM and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance to verify that systems are functioning in accordance with the contract documents. The contractors and subcontractors shall provide all tools or the use of tools to start, check out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CxA.
2. Design Phase:
   a. Develop and utilize a commissioning plan.
   b. Incorporate commissioning requirements into the contract documents.
3. Construction and Acceptance Phase:
   a. Coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consult with all necessary parties, frequently updated timelines and schedules and provide technical expertise.
   b. Coordinate the commissioning work and, with the CM, verify that commissioning activities are being scheduled into the master schedule.
   c. Update the commissioning plan as the project progresses.
   d. Plan and conduct a commissioning kick-off meeting and other commissioning meetings as required.
   e. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures. Review contractor's shop drawings and submittals for items being commissioned and provide comments back to CM.
   f. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
   g. Perform site visits, as necessary, to observe component and system installations.

h. Write the pre-functional checklists for commissioned equipment. Pre-functional checklists are to be completed by Subs.
i. Review and approve completed pre-functional checklists.
j. Review completed air and water balancing reports. Verify approximately 10-15% of the TAB contractors air balancing work through physical measurements.
k. Write the functional test procedures for commissioned equipment and systems with assistance from installing contractors.
l. Coordinate and witness functional tests on commissioned systems. Review controls graphics for completeness and accuracy.
m. Analyze sufficient functional performance trend logs and monitoring data to verify performance.
n. Assist in scheduling Owner's maintenance personnel, as required, to attend training classes conducted by the contractors. Collect sign-in sheets and training records to include in final Commissioning Record Book. Commissioning agent does not need to attend training sessions, demonstration of facilities or warranty orientation.
o. Maintain issue's tracking list separate from the testing record.
p. Provide the CM and owner with written progress reports noting substantive issues with recommended actions.
q. Provide a final commissioning report as described in part 1 Commissioning Record.

F. Construction Manager (CM):
1. Construction and Acceptance Phase:
a. Include the cost of commissioning (CM's and Sub's content) in the total contract price.
b. Furnish in a timely manner a copy of all construction documents, addenda, change orders and accepted submittals and shop drawings related to commissioned systems and equipment to the CxA.
c. Verify that all Subs execute their commissioning responsibilities according to the contract documents and schedule.
d. Facilitate the coordination of the commissioning work by the CxA, and, with the CxA, verify that commissioning activities are being scheduled into the master schedule.
e. Attend a commissioning kick-off meeting and other commissioning team meetings.
f. Perform the normal review of contractor submittals.
g. Review the functional performance test procedures submitted by the CxA, prior to testing.
h. Observe and witness pre-functional checkout, startup and functional testing of selected equipment.
i. Review commissioning progress and Cx issues tracking list.
j. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
k. Coordinate the training of owner personnel.
l. Prepare O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to as-built conditions.

2. Warranty Period:
   a. Assist the CxA as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.
   b. Verify that subs execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
   c. Verify that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

G. Owner's Project Manager (PM):
1. Construction and Acceptance Phase:
   a. Manage and enforce the contract of the A/E, CM, and CxA.
   b. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
   c. Review occupancy complaints and determine corrective action to be provided by owner or appropriate subcontractor.
2. Warranty Period:
   a. Verify that any seasonal or deferred testing and any deficiency issues are addressed.
   b. Review occupancy complaints and determine corrective action to be provided by owner or appropriate subcontractor.

H. Trade Contractors (Divisions 22, 23 and 26):
1. Construction and Acceptance Phase:
   a. Include cost for work associated with commissioning in contract price.
   b. Attend commissioning kick-off meeting and other meetings necessary to facilitate commissioning process.
   c. Provide CxA, thru CM, with normal cut sheets and shop drawing submittals of commissioned equipment.
   d. Provide additional requested documentation to CxA for development of start-up and functional testing procedures. This data will be requested prior to the initial submittal and will become part of the submittal package.
   e. Assist in clarifying operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
   f. Provide assistance to the CxA in preparing the specific functional testing procedures. Review test procedures to verify feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
   g. Develop full start-up and initial checkout plan using manufacturer's start-up procedures and pre-functional checklists from CxA for commissioned equipment. Submit to CxA for review and approval prior to startup.
   h. Perform and document pre-functional checks, startup, and initial checkout for commissioned equipment. Provide a copy of all checklists and startup forms to the CxA.
   i. Address punch list items before functional testing.
   j. Verify that air and water TAB is complete with discrepancies and problems remedied before performing functional testing of respective systems. TAB contractors should provide support to the CxA to verify, the TAB readings.

k. Provide skilled technicians to assist the CxA during the functional performance testing procedure. Verify that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving. The primary subcontractor for this task is the controls contractor with involvement from the mechanical and electrical sub-contractors.
l. Correct issues and deficiencies and retest equipment.
m. Prepare O&M manuals in accordance with Divisions 22, 23 and 26, including clarifying and updating original sequences of operation to as-built conditions.
n. During construction, maintain as-built drawings. Update and submit after completion of commissioning.
o. Provide a training plan and training of owner's operating staff using qualified personnel familiar with the project.
p. Coordinate with equipment manufacturers to determine specific requirements to maintain warranty.

2. Warranty Period:
   a. Execute seasonal or deferred functional performance testing, witnessed by CxA in accordance with the specifications.
   b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.11 SYSTEMS TO BE COMMISSIONED

A. Mechanical, Plumbing, HVAC, and Electrical Systems to be Commissioned for this Project include the following:
   1. Packaged rooftop units
   2. Air terminal units
   3. Boilers.
   4. Building piping, valves, expansion joints, and loops.
   5. Domestic water heaters.
   6. Exhaust air systems.
   7. Fans.
   8. Generators and transfer switches.
   9. Heat trace systems.
   10. Hot and cold domestic water systems.
   11. Hot water heating systems.
   12. Kitchen exhaust systems.
   13. Lighting control systems.
   14. Mechanical systems controls.
   15. Meters and gauges.
   16. Motors, motor controllers, and variable speed drives.
   17. Piping and plumbing specialties.
   18. Pumps.
   19. Terminal heating devices.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All testing equipment required to perform startup, initial checkout, and functional performance testing shall be provided by the CxA or Division Contractor.

B. Two-way radios shall be provided by the Division Contractor during functional testing activities.

C. Include special tools and instruments required for testing, according to the contract documents. Refer to Trade Divisions for details.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the project specifications.

PART 3 - EXECUTION

3.1 MEETINGS

A. Commissioning Kick-Off Meeting: Within 30 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning coordination meeting with the entire commissioning team in attendance. Meeting minutes and updated test plans will be distributed to all parties by the CxA.

B. Routine Commissioning Meetings: Periodic meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings to minimize time spent by Subs. These meetings will be held monthly and will increase in frequency as the project draws closer to completion. Meeting minutes and updated test plans will be distributed to all parties by the CxA.

3.2 REPORTING

A. The CxA will provide regular reports to the owner, A/E, and CM, with increasing frequency as construction and commissioning progresses.

B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress, issues and deficiencies, and scheduling changes through memos, progress reports, etc.

C. The CxA will provide a Final Commissioning Report to the owner and CM as described in Part 1, Commissioning Record.

3.3 PREFUNCTIONAL CHECKLISTS AND START-UP

A. The following procedures apply to all systems and equipment to be commissioned.

B. General: Pre-functional checklists (PFC's) are important to verify that the equipment and systems are connected properly and are operational. PFC's verify that functional testing may proceed without unnecessary delays. The contractor shall be responsible for performing pre-functional checks. EVERY piece of equipment, as outlined in Part 1, "Systems To Be Commissioned" receives a full pre-functional checkout.

C. The primary role of the CxA in this process is to verify that there is written documentation and that each of the manufacturer-recommended procedures has been completed.
   1. The CxA prepares pre-functional checklists for the selected systems. These checklists are provided to the CM for distribution to the responsible trade(s). Each form will have more than one trade responsible for its execution.
   2. The CM is responsible that ALL Subs complete the pre-functional checklist as identified by BIC "body-in-charge" designations.

D. Execution of Pre-functional Checklists and Startup:
   1. Subs and vendors schedule startup and checkout with the CM and CxA.
   2. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and pre-functional checklists. Only individuals that have direct knowledge and have witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check off that item.
   3. The CxA may observe selected pre-functional tests and startup procedures.
   4. The CxA will review ALL pre-functional checklists furnished by Subs and vendors and compile in the commissioning record.

E. Issues and Deficiency Resolution:
   1. The Subs shall clearly list any issues and deficiencies identified in the initial start-up and PFC procedures and return the completed test form to the CxA within two days.
   2. Problem Solving: The CxA may recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.
   3. The installing Subs or vendors shall correct all areas that are deficient in a timely manner and notify the CxA as soon as outstanding items have been corrected. An updated PFC form shall be submitted to CxA when complete.
   4. Upon completion of all associated PFC's, the system will then be scheduled for functional testing by the commissioning team.

3.4 FUNCTIONAL TESTING

A. This article applies to all commissioning functional testing for all divisions.

B. A detailed list of systems to be commissioned is referenced in Article 1.11, "Systems To Be Commissioned."

C. The CxA will identify Subs responsible to execute and/or assist in functional testing.

D. Objectives and Scope: The objective of functional testing is to demonstrate that each system is operating according to the design intent and contract documents.

E. In general, each system will be tested in all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, etc.).

F. Development of Test Procedures:
   1. Subs and their vendors provide CM and CxA with documents describing final approved equipment, configuration and control sequences.
   2. The CxA develops specific test procedures and forms to verify and document proper operation of each system.
   3. Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection.
   4. The CM will provide the CxA with copies of owner-contracted, factory testing or acceptance tests that the CxA is not responsible to oversee. The CxA shall include these tests in the commissioning record.

G. Forms:
   1. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:
      a. System and equipment or component name(s)
      b. Equipment location and ID number
      c. Pre-functional checklist and start-up documentation ID numbers for the piece of equipment
      d. Date
      e. Project name
      f. Participating parties
      g. A copy of the specification section describing the test requirements
      h. A copy of the specific sequence of operations or other specified parameters being verified
      i. Formulas used in any calculations
      j. Required pre-test field measurements
      k. Instructions for setting up the test
      l. Special cautions, alarm limits, etc.
      m. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable forma.
      n. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved
      o. A section for comments
      p. Signatures and date block for the CxA

H. Test Methods:
   1. Functional performance testing will generally be achieved by manipulating the control systems or equipment and observing system response. Means by which manipulation may occur include:
      a. Simulated conditions
      b. Overwritten values

c. Simulated signals
d. Altering set points

2. Setup: Each test shall be performed under conditions that simulate actual conditions as close as practically possible.
3. Trend logging or data loggers may be used to confirm short or long term system response and performance.
4. At completion of a test, the Sub shall return all affected building equipment and systems to their pre-test conditions.
5. Sampling: Multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested using a sampling strategy. Systems to be tested by sampling methods, if any, are identified in Section 1.11 “Systems To Be Commissioned.” If sampling strategy is applied, the CxA shall define systems appropriate for sampling and specify sampling population. Note: No sampling will be allowed in pre-functional checklist execution.
   a. The following strategy (“xx% Sampling—yy% Failure Rule”) shall be utilized when functional performance testing is applied to a sample of the project systems:
      1) xx = the percent of the group of identical equipment to be included in each sample.
      2) yy = the percent of the sample that if failing, will require another sample to be tested.
   b. The example below describes a 20% Sampling—10% Failure Rule.
      1) Randomly test at least 20 percent (xx) of each group of identical equipment. In no case test less than three units in each group. This 20 percent, or three, constitute the “first sample.”
      2) If 10 percent (yy) of the units in the first sample fail the functional performance tests, test another 20 percent of the group (the second sample).
      3) If 10 percent of the units in the second sample fail, test all remaining units in the whole group.
      4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

I. Coordination and Scheduling:
   1. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the CM and related Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

2. Functional testing is conducted after pre-functional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for functional testing or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

J. Test Equipment: Refer to Article 2.1, “TEST EQUIPMENT” for test equipment requirements.

K. Issues and Deficiency Resolution: (See Article 3.5, “ISSUES, DEFICIENCIES AND COST OF RETESTING”)

3.5 ISSUES, DEFICIENCIES AND COST OF RETESTING

A. Issues and Deficiencies:
1. All issues and deficiencies shall be noted in the Cx Issues Tracking List by the CxA.
2. The CxA shall work with the CM and Subs to correct issues or deficiencies identified during functional testing. The CxA will involve the PM, and request the A/E and others, as necessary. The CxA may recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E. The PM should assist in the resolution of issues.
3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM and PM.
5. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
   a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it and notifies the CxA of completion.
      1) The CxA reschedules the test and the test is repeated.
   b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
      1) Once the interpretation and resolution have been decided, in cooperation with the CM, the appropriate party corrects the deficiency and notifies the CxA of completion.
      2) The CxA reschedules the test and the test is repeated.
6. The CxA retains the original Cx Issues Tracking List until the end of the project.

B. Cost of Retesting:
   1. The cost for the Sub to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, all cost recovery for retesting shall be negotiated with the CM.
   2. For a deficiency related to functional testing, the following shall apply: The CxA and CM to direct any retesting on systems or equipment reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged by the CM to the Sub responsible for necessitating the retesting.
   3. Refer to the sampling paragraph of this article for requirements for testing and retesting identical equipment.
   4. Any required retesting shall not be considered a justified reason for a claim of delay or for a time extension by any contractor.

3.6 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the Project Manual. The commissioning plan lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

	Product	**Developed By**
1.	Commissioning Plan	CxA
2.	Cx Kick-off Meeting & Minutes	CxA
3.	Commissioning Schedules	CxA with CM
4.	Equipment Submittals	Subs
5.	Sequence Clarifications	Subs and A/E as needed
6.	Pre-functional Checklist Forms	CxA with assistance of Subs
7.	Pre-functional Checklist and Contractor/Vendor Startup Forms (filled out)	Subs
8.	Final TAB Reports	TAB
9.	Cx Issues Tracking List	CxA
10.	Commissioning Field Trip Reports	CxA
11.	Functional Test Forms	CxA
12.	Functional Test Forms (filled out)	CxA with assistance of Subs

END OF SECTION 200800

SECTION 210523 - GENERAL-DUTY VALVES FOR FIRE PROTECTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01, General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Indicator posts.
9. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and weld ends.
   3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
   1. Main Level: HAMV - Fire Main Equipment.
      a. Level 1: HCBZ - Indicator Posts, Gate Valve.
      b. Level 1: HLOT - Valves.
         1) Level 3: HLUG - Ball Valves, System Control.
         2) Level 3: HLXS - Butterfly Valves.
         3) Level 3: HMER - Check Valves.
         4) Level 3: HMRZ - Gate Valves.
   2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
      a. Level 1: VQGU - Valves, Trim and Drain.

B. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

C. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B1.20.1 for threads for threaded-end valves.
   3. ASME B31.9 for building services piping valves.

D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

E. NFPA Compliance: Comply with NFPA 24 for valves.

F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Actuator Types:
1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. NIBCO INC.
2. Victaulic Company.

B. Description:
1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fivalco Inc.
2. Globe Fire Sprinkler Corporation.
3. Milwaukee Valve Company.

B. Description:
1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Stainless steel.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.

10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anvil International.
   2. Kennedy Valve Company; a division of McWane, Inc.
   3. NIBCO INC.
   4. Tyco Fire Products LP.
   5. Victaulic Company.
   6. Zurn Industries, LLC.

B. Description:
   1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
   2. Minimum Pressure Rating: 175 psig.
   3. Body Material: Cast or ductile iron.
   4. Seat Material: EPDM.
   5. Stem: Stainless steel.
   6. Disc: Ductile iron.
   7. Actuator: Worm gear or traveling nut.
   8. Supervisory Switch: Internal or external.
   9. Body Design: Grooved-end connections.

2.5 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anvil International.
   2. Fire Protection Products, Inc.
   3. Kennedy Valve Company; a division of McWane, Inc.
   4. Mueller Co.
   5. NIBCO INC.
   6. Reliable Automatic Sprinkler Co., Inc. (The).
   7. Tyco Fire Products LP.
   8. United Brass Works, Inc.
   9. Victaulic Company.
   10. Viking Corporation.
   11. WATTS.
   12. Zurn Industries, LLC.

B. Description:
   1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
   2. Minimum Pressure Rating: 175 psig.
   3. Type: Single swing check.
   4. Body Material: Cast iron, ductile iron, or bronze.
   5. Clapper: Bronze, ductile iron, or stainless steel.

6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Milwaukee Valve Company.
   2. NIBCO INC.
   3. United Brass Works, Inc.
   4. Zurn Industries, LLC.

B. Description:
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
   2. Minimum Pressure Rating: 175 psig.
   3. Body and Bonnet Material: Bronze or brass.
   4. Wedge: One-piece bronze or brass.
   5. Wedge Seat: Bronze.
   6. Stem: Bronze or brass.
   7. Packing: Non-asbestos PTFE.
   8. Supervisory Switch: External.
   9. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hammond Valve.
   2. Kennedy Valve Company; a division of McWane, Inc.
   3. Mueller Co.
   4. NIBCO INC.
   5. Victaulic Company.
   6. WATTS.
   7. Zurn Industries, LLC.

B. Description:
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
   2. Minimum Pressure Rating: 175 psig.
   3. Body and Bonnet Material: Cast or ductile iron.
   4. Wedge: Cast or ductile iron, or bronze.
   5. Wedge Seat: Cast or ductile iron, or bronze.
   6. Stem: Brass or bronze.
   7. Packing: Non-asbestos PTFE.
   8. Supervisory Switch: External.
   9. End Connections: Flanged or Grooved.

2.8 NRS GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kennedy Valve Company; a division of McWane, Inc.
   2. Mueller Co.
   3. NIBCO INC.
   4. Victaulic Company.
   5. Zurn Industries, LLC.

B. Description:
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
   2. Minimum Pressure Rating: 175 psig.
   3. Body and Bonnet Material: Cast or ductile iron.
   4. Wedge: Cast or ductile iron.
   5. Wedge Seat: Cast or ductile iron, or bronze.
   6. Stem: Brass or bronze.
   7. Packing: Non-asbestos PTFE.
   8. Supervisory Switch: External.
   9. End Connections: Flanged or Grooved.

2.9 TRIM AND DRAIN VALVES

A. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; Conbraco Industries, Inc.
      b. Fire Protection Products, Inc.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Potter Roemer LLC.
      f. Red White Valve Corp.
      g. Tyco Fire Products LP.
      h. Victaulic Company.
      i. WATTS.
      j. Zurn Industries, LLC.
   2. Description:
      a. Pressure Rating: 175 psig minimum.
      b. Body Design: Two piece.
      c. Body Material: Forged brass or bronze.
      d. Port size: Full or standard.
      e. Seats: PTFE.
      f. Stem: Bronze or stainless steel.
      g. Ball: Chrome-plated brass.
      h. Actuator: Handlever.
      i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
      j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire Protection Products, Inc.
      b. NIBCO INC.
      c. United Brass Works, Inc.
   2. Description:
      a. Pressure Rating: 175 psig minimum.
      b. Body Material: Brass or bronze.
      c. Ends: Threaded.
      d. Stem: Bronze.
      e. Disc: Bronze.
      f. Packing: Asbestos free.
      g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire Protection Products, Inc.
      b. NIBCO INC.
      c. United Brass Works, Inc.
   2. Description:
      a. Pressure Rating: 175 psig minimum.
      b. Body Material: Bronze with integral seat and screw-in bonnet.
      c. Ends: Threaded.
      d. Stem: Bronze.
      e. Disc Holder and Nut: Bronze.
      f. Disc Seat: Nitrile.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
   1. Division 21 “Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
   2. Division 21 “Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

C. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

E. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

F. Install valves in horizontal piping with stem at or above the pipe center.

G. Install valves in position to allow full stem movement.

H. Install valve tags. Comply with requirements in Division 20 "Mechanical Identification" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

I. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

J. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

SECTION 211119 – FIRE DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01, Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01, General Commissioning Requirements applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Exposed-type fire-department connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Fire Hose & Cabinet.
   2. Elkhart Brass Mfg. Co., Inc.
   3. Fire Protection Products, Inc.
   4. Fire-End & Croker Corporation.
   5. GMR International Equipment Corporation.
   6. Guardian Fire Equipment, Inc.
   7. Venus Fire Protection Ltd.
   8. Wilson & Cousins Inc.

B. Standard: UL 405.

C. Type: Exposed, projecting, for wall mounting.

D. Pressure Rating: 175 psig minimum.

E. Body Material: Corrosion-resistant metal.

F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

G. Caps: Brass, lugged type, with gasket and chain.

H. Escutcheon Plate: Round, brass, wall type.

I. Outlet: Back, with pipe threads.

J. Number of Inlets: Two.

K. Escutcheon Plate Marking: Similar to "AUTO SPKR."

L. Finish: Rough chrome plated.

M. Outlet Size: NPS 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-type fire-department connections.

B. Install two protective pipe bollards on sides of each fire-department connection.

C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01 Section General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Backflow preventers
4. Specialty valves.
5. Sprinklers.
6. Alarm devices.
7. Pressure gages.

B. Related Sections:
1. Division 20 Sections.
2. Division 21 Section 210523 "General-Duty Valves for Fire Protection Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.
3. Division 21 Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
4. Division 21 Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe fire-suppression sprinkler systems inside the building.
5. Division 28 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. ASCE/SEI: American Society of Civil Engineers/Structural Engineering Institute.

B. ASME: American Society of Mechanical Engineers.

C. ASTM: American Society for Testing and Materials.

D. AWS: American Welding Society.

E. AWWA: American Water Works Association.

F. EPDM: Ethylene-propylene-diene terpolymer rubber.

G. FDA: Food and Drug Administration.

H. FM: Factory Mutual.

I. IBC: International Building Code.

J. MSS: Manufacturers Standardization Society for the Valve and Fitting Industry Inc.

K. NFPA: National Fire Protection Association.

L. NPS: Nominal Pipe Size.

M. OS&Y: Outside Stem and Yoke.

N. PE: Polyethylene.

O. PVC: Polyvinyl Chloride.

P. UL: Underwriters Laboratories.

1.4 PRESSURE CLASSIFICATION

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.5 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm check valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.6 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer to design wet-pipe sprinkler systems.

D. Sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications:
      a. Building Service Areas: Ordinary Hazard, Group 1.
      b. Boiler Rooms: Ordinary Hazard, Group 2.
      c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      d. General Storage Areas: Ordinary Hazard, Group 1.
      e. Classroom, Office and Public Areas: Light Hazard.
   3. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
      c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
      d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
   4. Maximum Protection Area per Sprinkler: Per UL listing.
   5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
      a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
      b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

E. Sprinkler system shall be hydraulically designed to have a density of at least that required by the hazard rating of the area to be protected.

F. Materials and components shall be UL listed and labeled.

G. Pipe size shall be no less than 1 inch. The velocity of water in pipe shall not exceed 20 feet per second.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Product Data: For adhesives, indicating VOC content.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.8 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. Ductwork systems.
   5. Building structural systems.
   6. Electrical raceway systems.
   7. Electrical equipment working space and clearances.
   8. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Fire alarm devices.
      e. Audiovisual equipment.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Field Test Reports:
   1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
   2. Fire-hydrant flow test report.

F. Field quality-control reports.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.10 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.11 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of a recent summer season fire hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

E. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water. Include tapping of water mains, backflow prevention and metering.
   2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

F. Piping materials shall bear label, stamp, or other markings of specified testing agency.

G. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
   1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.12 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies. Coordinate with structural plans and architectural reflected ceiling plans for soffits, ceiling elevation changes, beam pockets, and other obstructions to the sprinkler discharge pattern.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Uncoated Steel Couplings: ASTM A 865, threaded.

D. Uncoated Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
   1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick
      a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
      b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
   2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
   1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Tyco Fire & Building Products LP.
      b. Victaulic Company.
   2. Pressure Rating: 175 psig minimum.
   3. Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 BACKFLOW PREVENTER

A. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. FEBCO; SPX Valves & Controls.
      d. Watts Water Technologies, Inc.
      e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
   2. Standards: ASSE 1047 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
   5. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved or stainless steel.
   6. End Connections: Flanged.
   7. Configuration: Designed for vertical, straight through flow.
   8. Accessories:
      a. Valves: UL 262, "Approval Guide," published by FM Global, listing; OS&Y gate type with flanged ends on inlet and outlet.
      b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
      c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

B. Backflow Preventer Test Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves.
      b. FEBCO; SPX Valves & Controls.
      c. Watts Water Technologies, Inc.
      d. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
   2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:
   1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Globe Fire Sprinkler Corporation.
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL 193.
   3. Design: For horizontal or vertical installation.
   4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
   5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
   6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Deluge Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CLA-VAL Automatic Control Valves.
      b. Kidde Fire Fighting; A UTC Business Unit.
      c. Globe Fire Sprinkler Corporation.
      d. Reliable Automatic Sprinkler Co., Inc. (The).
      e. Tyco Fire Products LP.
      f. Victaulic Company.
      g. Viking Corporation.
   2. Standard: UL 260.
   3. Design: Hydraulically operated, differential-pressure type.
   4. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
   5. Wet, Pilot-Line Trim Set: Include gage to read diaphragm-chamber pressure and manual control station for manual operation of deluge valve, and connection for actuation device.

H. Automatic (Ball Drip) Drain Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
   2. Standard: UL 1726.
   3. Pressure Rating: 175 psig minimum.
   4. Type: Automatic draining, ball check.
   5. Size: NPS 3/4.
   6. End Connections: Threaded.

2.5 AIR VENT

A. Manual Air Vent/Valve:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing, Inc.
      b. National Fittings, Inc.
      c. Shurjoint-Apollo Piping Products USA Inc.
      d. Victaulic Company.
   2. Description: Ball valve that requires human intervention to vent air.
   3. Body: Forged brass.
   4. Ends: Threaded.
   5. Minimize Size: 1/2 inch.
   6. Minimum Water Working Pressure Rating: 300 psig.

B. Automatic Air Vent:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing, Inc.
      b. CLA-VAL.
      c. Metraflex Company (The).
      d. Val-Matic Valve & Manufacturing Corp.
   2. Description: Automatic air vent that automatically vents trapped air without human intervention.
   3. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler systems.
   4. Vents oxygen continuously from system.
   5. Float valve to prevent water discharge.
   6. Minimum Water Working Pressure Rating: 175 psig.

C. Automatic Air Vent Assembly:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing, Inc.
      b. Engineered Corrosion Solutions.
      c. Potter Electric Signal Company, LLC.
      d. South-Tek Systems, LLC.
   2. Description: Automatic air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly.
   3. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.
   4. Vents oxygen continuously from system.
   5. Float valve to prevent water discharge.
   6. Minimum Water Working Pressure Rating: 175 psig.

2.6 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following**:**
      a. AGF Manufacturing, Inc
      b. Anvil International
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
   2. Standard: UL 213.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, or threaded.

B. Flow Detection and Test Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
   5. Size: Same as connected piping.
   6. Inlet and Outlet: Threaded.

C. Branch Line Testers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Elkhart Brass Mfg. Company, Inc.
      c. Fire-End & Croker Corporation.
      d. Potter Roemer.
   2. Standard: UL 199.
   3. Pressure Rating: 175 psig.
   4. Body Material: Brass.
   5. Size: Same as connected piping.
   6. Inlet: Threaded.
   7. Drain Outlet: Threaded and capped.
   8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum
   4. Body Material: Cast- or ductile-iron housing with sight glass.
   5. Size: Same as connected piping.
   6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aegis Technologies, Inc.
      b. CECA, LLC.
      c. Corcoran Piping System Co.
      d. Merit Manufacturing; a division of Anvil International, Inc.
   2. Standard: UL 1474.
   3. Pressure Rating: 250 psig minimum.
   4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
   5. Size: Same as connected piping.
   6. Length: Adjustable.
   7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. FlexHead Industries, Inc.
      b. Victaulic Company; AquaFlex Sprinkler Fittings
   2. Standard: UL 1474.
   3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
   4. Pressure Rating: 175 psig minimum.
   5. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.

B. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
   1. Early-Suppression, Fast-Response Applications: UL 1767.
   2. Nonresidential Applications: UL 199.
   3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
   1. Chrome plated.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Plastic, white finish, one piece, flat
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

F. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ADT Security Services, Inc.
      b. McDonnell & Miller; ITT Industries.
      c. Potter Electric Signal Company.
      d. System Sensor; a Honeywell company.
      e. Viking Corporation.
      f. Watts Industries (Canada) Inc.
   2. Standard: UL 346.
   3. Water-Flow Detector: Electrically supervised.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

C. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Barksdale, Inc.
   b. Detroit Switch, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Tyco Fire & Building Products LP.
   f. United Electric Controls Co.
   g. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.9 PRESSURE GAGES

A. Manufacturers: Refer to Division 20 “Meters and Gages.”

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AGF Manufacturing, Inc.
   2. AMETEK, Inc.
   3. Ashcroft Inc.
   4. Brecco Corporation.
   5. WIKA Instrument Corporation.

C. Standard: UL 393.

D. Dial Size: 3-1/2- to 4-1/2-inch diameter.

E. Pressure Gage Range: 0 to 250 psig minimum.

F. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Pressurize and check dry sprinkler system piping and air compressors.

N. Fill sprinkler system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

P. Install sleeve seals for piping penetrations of concrete walls and slabs.

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Division 03 "Cast-in-Place Concrete."

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

E. Air Vent:
   1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
   2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Where flexible sprinkler hose fittings are permitted, install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid. Provide all accessories/supports as required for a fully operational system complying with NFPA and manufacturers installation requirements.

D. Flexible sprinkler hose fittings are only for above ceiling applications. Flexible sprinkler hose fittings shall not be allowed in open ceiling applications.

E. Provide sprinkler head guards where sprinkler heads may be subject to damage (loading docks, stairways, aisles, etc.).

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves

3.12 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Refer to “Fire Protection Piping System Application Schedule” in drawings.

C. Piping between Fire-Department Connections and Check Valves: Galvanized, schedule 40 steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Concealed sprinklers
   3. Rooms with Gypsum or Special Construction (wood, metal, etc.) Ceilings: Concealed sprinklers with factory-painted custom color cover plates selected by architect.
   4. Wall Mounting: Sidewall sprinklers.
   5. Spaces Subject to Freezing: Pendent, dry sprinklers.
   6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate unless noted otherwise. Cover plate shall be flat plate.
   2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   3. Upright, pendent, and sidewall sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Control panels.
7. Pressure gages.

B. Related Sections:
1. Division 20 Sections.
2. Division 21 "General-Duty Valves for Fire Protection" for ball, butterfly, check, gate, post-indicator, and trim and drain valves
3. Division 21 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
4. Division 21 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
5. Division 28 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. ASCE/SEI: American Society of Civil Engineers/Structural Engineering Institute.

B. ASME: American Society of Mechanical Engineers.

C. ASTM: American Society for Testing and Materials.

D. AWS: American Welding Society.

E. AWWA: American Water Works Association.

F. EPDM: Ethylene-propylene-diene terpolymer rubber.

G. FDA: Food and Drug Administration.

H. FM: Factory Mutual.

I. IBC: International Building Code.

J. MSS: Manufacturers Standardization Society for the Valve and Fitting Industry Inc.

K. NFPA: National Fire Protection Association.

L. NPS: Nominal Pipe Size.

M. OS&Y: Outside Stem and Yoke.

N. PE: Polyethylene.

O. PVC: Polyvinyl Chloride.

P. UL: Underwriters Laboratories.

1.4 PRESSURE CLASSIFICATION

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.5 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air or nitrogen. Opening of sprinklers releases compressed air or nitrogen and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

1.6 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications: Per NFPA 13.
   3. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
      c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
   4. Maximum Protection Area per Sprinkler: Per UL listing.
   5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
      a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
      b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

E. Sprinkler system shall be hydraulically designed to have a density of at least that required by the hazard rating of the area to be protected.

F. Materials and components shall be UL listed and labeled.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.8 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. Ductwork systems.
   5. Building structural systems.
   6. Electrical raceway systems.
   7. Electrical equipment working space and clearances.
   8. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Fire alarm devices.

e. Audio visual equipment.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.10 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.11 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.12 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies. Coordinate with structural plans and architectural reflected ceiling plans for soffits, ceiling elevation changes, beam pockets, and other obstructions to the sprinkler discharge pattern.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized, Steel Couplings: ASTM A 865, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Tyco Fire & Building Products LP.
      b. Victaulic Company.
   2. Pressure Rating: 175 psig minimum.
   3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Victaulic Company.
   2. Standard: UL 1091 except with ball instead of disc.
   3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fivalco Inc.
      b. Global Safety Products, Inc.
      c. Milwaukee Valve Company.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig.
   4. Body Material: Bronze.
   5. End Connections: Threaded.

D. Iron Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kennedy Valve; a division of McWane, Inc.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig.

4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Potter Roemer.
   i. Reliable Automatic Sprinkler Co., Inc.
   j. Tyco Fire & Building Products LP.
   k. Victaulic Company.
   l. Viking Corporation.
   m. Watts Water Technologies, Inc.
2. Standard: UL 312
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
2. Standard: UL 262.
3. Standard: UL 262.
4. Pressure Rating: 175 psig.
5. Body Material: Bronze.
6. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Milwaukee Valve Company.
   e. Mueller Co.; Water Products Division.
   f. NIBCO INC.
   g. Tyco Fire & Building Products LP.

h. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kennedy Valve; a division of McWane, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.
6. Valve Position Monitor: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch indicating device.

I. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Stockham Division.
b. Kennedy Valve; a division of McWane, Inc.
c. Mueller Co.; Water Products Division.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

J. Indicator Posts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Stockham Division.
b. Kennedy Valve; a division of McWane, Inc.
c. Mueller Co.; Water Products Division.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.

2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Fire Protection Products, Inc.
   c. Kennedy Valve; a division of McWane, Inc.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Potter Roemer.
   g. Tyco Fire & Building Products LP.
   h. Victaulic Company.
   i. Watts Water Technologies, Inc.

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AFAC Inc.
      b. Globe Fire Sprinkler Corporation.
      c. Reliable Automatic Sprinkler Co., Inc.
      d. Tyco Fire & Building Products LP.
      e. Venus Fire Protection Ltd.
      f. Victaulic Company.
      g. Viking Corporation.
   2. Standard: UL 260
   3. Design: Differential-pressure type.
   4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
   5. Air Compressor:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Gast Manufacturing Inc.
         2) General Air Products, Inc,
         3) Viking Corporation.
      b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
      c. Motor Horsepower: Fractional.
         1) Power: 120-V ac, 60 Hz, single phase.
      d. Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA 13. Provide ASME air receiver tank as required to meet requirements on larger systems.
      e. Include filters, relief valves, coolers, automatic drains, and gauges.

C. Automatic (Ball Drip) Drain Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AFAC Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
   2. Standard: UL 1726.
   3. Pressure Rating: 175 psig minimum.
   4. Type: Automatic draining, ball check.
   5. Size: NPS 3/4.
   6. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Shurjoint Piping Products.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.
   2. Standard: UL 213.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, or threaded.

C. Flow Detection and Test Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
   5. Size: Same as connected piping.
   6. Inlet and Outlet: Threaded.

D. Branch Line Testers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkhart Brass Mfg. Company, Inc.
      b. Fire-End & Croker Corporation.
      c. Potter Roemer.
   2. Standard: UL 199.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Brass.
   5. Size: Same as connected piping.
   6. Inlet: Threaded.
   7. Drain Outlet: Threaded and capped.
   8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Triple R Specialty.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
      e. Viking Corporation.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Cast- or ductile-iron housing with sight glass.
   5. Size: Same as connected piping.
   6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CECA, LLC.
      b. Corcoran Piping System Co.
      c. Merit Manufacturing; a division of Anvil International, Inc.
   2. Standard: UL 1474.
   3. Pressure Rating: 250 psig minimum.
   4. Body Material: Steel pipe with EPDM O-ring seals.
   5. Size: Same as connected piping.
   6. Length: Adjustable.
   7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.

B. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
   3. Provide corrosion resistant coating on all sprinklers subject to elements.

C. Automatic Sprinklers with Heat-Responsive Element:
   1. Nonresidential Applications: UL 199.
   2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
   1. Chrome plated.
   2. Bronze.
   3. Painted.

E. Special Coatings:
   1. Wax.
   2. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

2.10 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
   1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

2.11 PRESSURE GAGES

A. Manufacturers: Refer to Division 20 “Meters and Gages.”

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.12 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. Refer to Division 20 “Common Work Results for Mechanical”.

2.13 SLEEVES

A. Refer to Division 20 “Common Work Results for Mechanical”.

2.14 GROUT

A. Refer to Division 20 “Common Work Results for Mechanical”.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.

J. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in Division 20 “Hangers and Supports” for hanger materials.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Drain dry-pipe sprinkler piping.

O. Pressurize and check dry-pipe sprinkler system piping and air compressors.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      a. Install air compressor and compressed-air supply piping.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Flexible sprinkler hose fittings are not permitted on the dry system.

D. Provide sprinkler head guards where sprinkler heads may be subject to damage (loading docks, stairways, aisles, etc.).

3.6 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Refer to Division 20 “Common Work Results for Mechanical”.

3.7 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Refer to Division 20 “Common Work Results for Mechanical”.

C. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Section 078413 "Penetration Firestopping" for firestop materials and installations.

D. Acoustical Wall Penetrations: Provide acoustical wall sleeves of split sheet metal design with ¾” neoprene foam in the entire annular space equal to type SWS as manufactured by Mason Industries, Inc. or other approved equal.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Division 20 “Mechanical Identification.”

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Start and run air compressors.
   6. Coordinate with fire-alarm tests. Operate as required.
   7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

A. Refer to “Fire Protection Piping System Application Schedule” in drawings.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Dry concealed sprinklers.
   3. Wall Mounting: Dry sidewall sprinklers.
   4. Spaces Subject to Freezing: Upright, dry pendent sprinklers; and dry sidewall sprinklers as indicated.
   5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate. Cover plates shall be flat plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316

SECTION 220523 - VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20 “Common Work Results for Mechanical” requirements apply to this section.

C. Division 01 “Project Management and Coordination” applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 “General Commissioning Requirements” applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Bronze ball valves.
2. Steel ball valves.
3. Iron ball valves.
4. Iron, single-flange butterfly valves.
5. Iron, grooved-end butterfly valves.
6. Bronze lift check valves.
7. Bronze swing check valves.
8. Bronze swing check valves, press ends.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end swing check valves.
12. Iron, center-guided check valves.
13. Iron, plate-type check valves.
14. Bronze gate valves.
15. Iron gate valves.
16. Chainwheels.

B. Related Sections:
1. Division 20 "Mechanical Identification" for valve tags and schedules.
2. Division 22 "Domestic Water Piping" for valves applicable only to this piping.
3. Division 22 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4. Division 22 "Storm Drainage Piping Specialties" for valves applicable only to this piping.

1.3 DEFINITIONS

A. ASME: American Society of Mechanical Engineers.

B. ASTM: American Society for Testing and Materials.

C. AWWA: American Water Works Association.

D. CWP: Cold working pressure.

E. EPDM: Ethylene propylene copolymer rubber.

F. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

G. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

H. NRS: Nonrising stem.

I. OS&Y: Outside screw and yoke.

J. PTFE: Polytetrafluoroethylene plastic.

K. RS: Rising stem.

L. SWP: Steam working pressure.

M. TFE: Tetrafluorethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and soldered ends.
   3. Set ball valves open to minimize exposure of functional surfaces.
   4. Set butterfly valves closed or slightly open.
   5. Set check valves in either closed or open position.
   6. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. RS Valves in Insulated Piping: With 2-inch stem extensions.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Ball Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

K. Butterfly Valve Actuator Types:
1. Gear Actuator: For valves NPS 8 and larger.
2. Handlever: For valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.

L. Valves in Insulated Piping:
1. Include 2-inch stem extensions.

2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Lance Valves.
   d. Milwaukee Valve Company.
   e. Nibco.
   f. Watts.
2. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded or soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

B. Two-Piece, Safety-Exhaust, Bronze Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries; Apollo Valves.
   b. Jamesbury; Metso.
   c. Nibco.
2. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze, ASTM B 584, Alloy C844.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
   i. Port: Full.

2.3 STEEL BALL VALVES

A. Class 150, Steel Ball Valves with Full Port:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries; Apollo Valves.
      b. Jamesbury; Metso.
      c. Nibco.
   2. Description:
      a. Standard: MSS SP-72.
      b. CWP Rating: 285 psig.
      c. Body Design: Split body.
      d. Body Material: Carbon steel, ASTM A 216, Type WCB.
      e. Ends: Flanged or threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Full.

2.4 IRON BALL VALVES

A. Class 125, Iron Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve.
      b. Conbraco Industries; Apollo Valves.
      c. Kitz Corporation.
      d. Sure Flow Equipment.
      e. Watts.
      f. Zurn Industries.
   2. Description:
      a. Standard: MSS SP-72.
      b. CWP Rating: 200 psig.
      c. Body Design: Split body.
      d. Body Material: ASTM A 126, gray iron.
      e. Ends: Flanged or threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel.
      i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABZ Valve and Controls
      b. American Valve.
      c. Conbraco Industries.; Apollo Valves.

d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. DeZurik
f. Flo Fab
g. FNW; Ferguson Enterprises, Inc.
h. Hammond Valve.
i. Jenkins Valves; a Crane Co. brand.
j. Kitz Corporation
k. Legend Valve
l. Milwaukee Valve Company.
m. Mueller Steam Specialty.
n. Nibco.
o. Norriseal.
p. Red-White Valve Corporation.
q. Stockham; a Crane Co. brand.
r. Sure Flow Equipment Inc.
s. Watts.

2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating, NPS 12 and Smaller: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Stainless steel.

2.6 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

A. 300 CWP, Iron, Grooved-End Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International.
      b. Kennedy Valve Company.
      c. Mueller Steam Specialty
      d. NIBCO
      e. Shurjoint Piping Products.
      f. Tyco Fire Products.
      g. Victaulic Company.
   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating, NPS 8 and Smaller: 300 psig.
      c. CWP Rating, NPS 10 and Larger: 200 psig.
      d. Body Material: Coated, ductile iron.
      e. Stem: Two-piece stainless steel.
      f. Disc: Coated, ductile iron.
      g. Seal: EPDM.

2.7 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 200 psig.
      c. Body Design: Vertical flow.
      d. Body Material: ASTM B 61 or ASTM B 62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: Bronze.

B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125, :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flo Fab Inc.
      b. Hammond Valve.
      c. Kitz Corporation.
      d. Milwaukee Valve Company.
      e. Mueller Steam Specialty; a division of SPX Corporation.
      f. NIBCO INC.
      g. Red-White Valve Corporation.
      h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 2.
      b. CWP Rating: 200 psig.
      c. Body Design: Vertical flow.
      d. Body Material: ASTM B 61 or ASTM B 62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: NBR, PTFE.

2.8 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 150:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Division.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red-White Valve Corporation.
      i. Zy-Tech Global Industries, Inc.

2. Description:
    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 300 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded or soldered. See valve schedule articles.
    f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
    a. Standard: MSS SP-80, Type 4.
    b. CWP Rating: 300 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded or soldered. See valve schedule articles.
    f. Disc: PTFE.

2.9 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Metal Seats, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Kitz Corporation.
    f. Legend Valve.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Powell Valves.
    j. Red-White Valve Corporation.
    k. Sure Flow Equipment Inc.
    l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    m. Zy-Tech Global Industries, Inc.
2. Description:
    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig.
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged or threaded. See valve schedule articles.

f. Trim: Bronze.
g. Gasket: Asbestos free.

B. Iron Swing Check Valves with Metal Seats, Class 250:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-71, Type I.
b. CWP Rating: 500 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.10 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 250:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Sure Flow Equipment Inc.
i. Val-Matic Valve & Manufacturing Corp.
2. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 400 psig.
c. Body Material: ASTM A 126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR.

B. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 250:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.

d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Val-Matic Valve & Manufacturing Corp.

2. Description:
   a. Standard: MSS SP-125.
   b. CWP Rating: 400 psig.
   c. Body Material: ASTM A 126, gray iron.
   d. Style: Globe, spring loaded.
   e. Ends: Flanged.
   f. Seat: EPDM or NBR.

2.11 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 150:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
      b. Hammond Valve.
      c. Kitz Corporation.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
      f. Powell Valves.
      g. Red-White Valve Corporation.
      h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 300 psig.
      c. Body Material: Bronze with integral seat and union-ring bonnet.
      d. Ends: Threaded.
      e. Stem: Bronze.
      f. Disc: Solid wedge; bronze.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron, bronze, or aluminum.

2.12 IRON GATE VALVES

A. Iron Gate Valves, OS&Y, Class 250:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
      b. Crane; a Crane brand.
      c. Hammond Valve.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
      f. Powell Valves.
      g. Stockham; a Crane Co. brand.
      h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-70, Type I.
   b. CWP Rating: 500 psig.
   c. Body Material: Gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Disc: Solid wedge.
   g. Packing and Gasket: Asbestos free.

2.13 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Babbitt Steam Specialty.
   2. Roto Hammer Industries.
   3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
   1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
   2. Chain: Hot-dip, galvanized steel or Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for damage or conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge, pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

G. Install valve tags. Comply with requirements in Section 20 “Mechanical Identification" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or gate valves.
   2. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal -seat check valves.

B. Use gate valves for shutoff service only.

C. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

D. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Two-piece, bronze ball valves with full port and stainless steel trim.
   3. Bronze swing check valves with bronze disc, Class 150, with soldered end connections.
   4. Bronze gate valves, NRS, Class 150 with soldered ends.

B. Pipe NPS 2-1/2 and Larger:
   1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Class 150, steel ball valves with full port.
   3. Class 150, iron ball valves.
   4. Iron, center-guided check valves with globe, resilient seat, Class 250, with threaded or flanged end connections.
   5. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y**,** Class 250 with flanged ends.

C. Butterfly Valves:
   1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
   2. Ductile-Iron, Grooved-End Butterfly Valves: 300 CWP.

END OF SECTION 220523

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Under building slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Coordination Drawings: Piping in congested areas such as mechanical rooms, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Fire suppression piping.
   2. Compressed air piping.
   3. Sanitary and vent piping.
   4. Storm drainage piping.
   5. HVAC hydronic piping.
   6. Ductwork systems.
   7. Building structural systems.
   8. Electrical raceway systems.
   9. Electrical equipment working space and clearances.
   10. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Fire alarm devices.
      e. Audiovisual equipment.

1.4 INFORMATION SUBMITTALS

A. Water Samples: Specified in "Cleaning" Article.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

D. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61 Annex G and NSF 372 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF 372 for low lead.

2.2 COPPER TUBE AND FITTINGS

A. Tube in "Hard Copper Tube" Paragraph below is available in NPS 1/8 to NPS 12 (DN 6 to DN 300).

B. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

C. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Pipe in "Mechanical-Joint, Ductile-Iron Pipe" Paragraph below is available in NPS 3 to NPS 64 (DN 80 to DN 1600).

B. Mechanical-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Standard-Pattern, Mechanical-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Compact-Pattern, Mechanical-Joint Fittings:
   1. AWWA C153/A21.53, ductile iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

E. Push-on-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51.
   2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

F. Standard-Pattern, Push-on-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Piping Specialties Products.
      c. Ford Meter Box Company, Inc. (The).
      d. Jay R. Smith Mfg. Co.
      e. JCM Industries.
      f. Romac Industries, Inc.
      g. Smith-Blair, Inc.; a Sensus company.
      h. Viking Johnson.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Comply with the requirements of Division 20 Section 200500 “Common Work Results.”

2.7 ESCUTCHEONS

A. Refer to Division 20 Section 200500 Section “Common Work Results” for requirements.

2.8 SLEEVES

A. Refer to Division 20 Section 200500 Section “Common Work Results” for requirements.

2.9 SLEEVE SEALS

A. Refer to Division 20 Section 200500 Section “Common Work Results” for requirements.

2.10 GROUT

A. Refer to Division 20 Section 200500 Section “Common Work Results” for requirements.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 20 Section 200519 "Meters and Gages” and with requirements for drain valves and strainers in Division 22 Section 221119 "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section 221119 "Domestic Water Piping Specialties."

F. Install domestic water piping level without pitch and plumb.

G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install thermometers on inlet and outlet piping from each water heater and in hot-water circulation piping. Comply with requirements for thermometers in Division 20 Section 200519 "Meters and Gages."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Install sleeve seals for piping penetrations of concrete walls and slabs.

S. Install escutcheons for piping penetrations of walls, ceilings, and floors in areas exposed to view.

T. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the top or side of the main pipe.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Comply with the requirements of Division 20 Section 200500 “Common Work Results.”

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Division 20 Section 200529 "Hangers and Supports for Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

A. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.8 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Comply with the requirements of Division 20 Section 200500 “Common Work Results.”

3.9 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. Comply with the requirements of Division 20 Section 200500 “Common Work Results.”

3.10 SLEEVE SEAL INSTALLATION

A. Sleeve seals for exterior walls and slabs-on-grade are also specified in Division 21 Sections "Wet-Pipe Sprinkler Systems," and "Dry-Pipe Sprinkler Systems." Do not specify these sleeve seals in both this Section and another fire-suppression piping Section.

B. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

C. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 20 Section 200553 "Mechanical Identification."

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
      f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.13 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
   5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
   6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
   8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Portions of disinfecting requirements in this article are taken from model plumbing codes; revise if requirements vary by authorities having jurisdiction.

B. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Refer to “Plumbing Piping System Application Schedule” in drawings.

3.16 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
   3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
   4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Provide check valve on branch piping downstream of hot water circulation balancing valve.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Air vents.
12. Trap-seal primer valves.
13. Trap-seal primer systems.
14. Flexible connectors.
15. Water meters.

B. Related Requirements:
1. Division 20 Section 200519 "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section 224700 " Electric Water Coolers" for water filters for water coolers.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
   1. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 WATER METER

A. Contractor shall carry an allowance to install new water meter as determined by the construction manager based on coordination with the local utility company.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 372

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psi gunless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
      b. Conbraco Industries, Inc.
      c. FEBCO; a division of Watts Water Technologies, Inc.
      d. Toro Company (The); Irrigation Div.
      e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
      f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
   2. Standard: ASSE 1001.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Chrome plated for exposed finished areas. Rough bronze for unfinished areas.

B. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cash Acme; a division of Reliance Worldwide Corporation.
      b. Conbraco Industries, Inc.

c. MIFAB, Inc.
d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
e. Woodford Manufacturing Company; a division of WCM Industries, Inc.
f. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated

C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Toro Company (The); Irrigation Div.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5-psig maximum, through middle third of flow range.
5. Accessories:
a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12-psig maximum, through middle third of flow range.
5. Design Flow Rate: See plans.
6. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Conbraco Industries, Inc.
    c. FEBCO; a division of Watts Water Technologies, Inc.
    d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5-psig maximum, through middle third of flow range.
5. Design Flow Rate: see plans.
6. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
    a. Valves: NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves: NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Conbraco Industries, Inc.
    b. FEBCO; a division of Watts Water Technologies, Inc.
    c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cash Acme; a division of Reliance Worldwide Corporation.
      b. Conbraco Industries, Inc.
      c. Honeywell International Inc.
      d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
      e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
   2. Standard: ASSE 1003.
   3. Pressure Rating: Initial working pressure of 150 psig.
   4. Size: See plans.
   5. See plans. Design Outlet Pressure Setting: See plans
   6. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
   7. Valves for Booster Heater Water Supply: Include integral bypass.
   8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong International, Inc.
      b. Flo Fab Inc.
      c. ITT Corporation; Bell & Gossett Div.
      d. NIBCO Inc.
      e. TAC.
      f. TACO Incorporated.
      g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
   3. Body: Brass or bronze
   4. Size: Same as connected piping, but not larger than NPS 2.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong International, Inc.
      b. Flo Fab Inc.
      c. ITT Corporation; Bell & Gossett Div.

d. NIBCO Inc.
e. TAC.
f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO Inc.
h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. Conbraco Industries, Inc.
d. Honeywell International Inc.
e. Leonard Valve Company.
f. Powers; a division of Watts Water Technologies, Inc.
g. Symmons Industries, Inc.
h. TACO Incorporated.
i. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water-mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: See plans. Retain "Tempered-Water Design Flow Rate" Subparagraph below only if flow rate is not indicated on Drawings.
9. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Lawler Manufacturing Company, Inc.
   c. Leonard Valve Company.
   d. Powers; a division of Watts Water Technologies, Inc.
   e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: See plans
9. Tempered-Water Design Flow Rate: <See plans
10. Pressure Drop at Design Flow Rate: See plans.
11. Valve Finish: Rough bronze.
12. Piping Finish: Copper.
13. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

C. Individual-Fixture, Water Tempering Valves
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cash Acme; a division of Reliance Worldwide Corporation.
   b. Conbraco Industries, Inc.
   c. Honeywell International Inc.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company.
   f. Powers; a division of Watts Water Technologies, Inc.
   g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.

4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: See plans.
9. Tempered-Water Design Flow Rate: See plans.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.020 inch >.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch
6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Engineering Company.
   b. Guy Gray Manufacturing Co., Inc.
   c. Oatey.
   d. Plastic Oddities.
   e. Symmons Industries, Inc.
   f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   g. Whitehall Manufacturing; a div. of Acorn Engineering Company.
   h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.

8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products.
      f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
      g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
      h. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
   2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
   3. Pressure Rating: 125 psig.
   4. Operation: Loose key.
   5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
   6. Inlet: NPS 3/4.
   7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
   8. Box: Deep, flush mounted with cover.
   9. Box and Cover Finish: Polished nickel bronze
   10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
   11. Nozzle and Wall-Plate Finish: polished nickel bronze
   12. Operating Keys(s): One with each wall hydrant.

B. Moderate-Climate Wall Hydrants
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products.
      f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
      g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
      h. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
   2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
   3. Pressure Rating: 125 psig.
   4. Operation: Loose key.

5. Inlet: NPS 3/4.
6. Outlet:
   a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Nozzle and Wall-Plate Finish: Polished nickel bronze.
10. Operating Keys(s): One with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
   1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
   2. Pressure Rating: 400-psig minimum CWP.
   3. Size: NPS 3/4.
   4. Body: Copper alloy.
   5. Ball: Chrome-plated brass.
   6. Seats and Seals: Replaceable.
   7. Handle: Vinyl-covered steel.
   8. Inlet: Threaded or solder joint.
   9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:
   1. Standard: MSS SP-80 for gate valves.
   2. Pressure Rating: Class 125.
   3. Size: NPS 3/4.
   4. Body: ASTM B 62 bronze.
   5. Inlet: NPS 3/4 threaded or solder joint.
   6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
   1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
   2. Pressure Rating: 200-psig minimum CWP or Class 125.
   3. Size: NPS 3/4.
   4. Body: Copper alloy or ASTM B 62 bronze.
   5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMTROL, Inc.
      b. Josam Company.
      c. MIFAB, Inc.

d. Precision Plumbing Products, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
g. Tyler Pipe; Wade Div.
h. Watts Drainage Products.
i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg. F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:
1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIFAB, Inc.
      b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      c. Zurn
   2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
   3. Size: NPS 1-1/4 minimum.
   4. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIFAB, Inc.
      b. Precision Plumbing Products, Inc.
   2. Standard: ASSE 1044.
   3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
   4. Cabinet: Recessed-mounted steel box with stainless-steel cover.
   5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
      a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   6. Vacuum Breaker: ASSE 1001.
   7. Number Outlets: See Plans
   8. Size Outlets: NPS 1/2.

2.16 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 200523 "General-Duty Valves for Piping."

B. Spring Operated, Diaphragm Assist Safety Relief Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett Domestic Pump; a division of Xylem, Inc.
      d. Conbraco Industries, Inc.
      e. Spence Engineering Company, Inc.
      f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Body: Brass.
   3. Disc: Glass and carbon-filled PTFE.
   4. Seat: Brass.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.

7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Spring: Alloy steel
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
11. Maximum Temperature Rating of 250 deg F.

2.17 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flex-Hose Co., Inc.
   2. Flexicraft Industries.
   3. Flex Pression, Ltd.
   4. Flex-Weld Incorporated.
   5. Hyspan Precision Products, Inc.
   6. Mercer Gasket & Shim, Inc.
   7. Metraflex, Inc.
   8. Proco Products, Inc.
   9. TOZEN Corporation.
   10. Unaflex.Universal Metal Hose; a Hyspan company.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig
   2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.18 WATER METERS

A. Furnished by local utility. Installed by Plumbing Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install individual fixture temperature-actuated, water mixing valves on each lavatory/sink designated for hand washing.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each pump.

G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

H. Install water-hammer arresters in water piping according to PDI-WH 201.

I. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

K. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

L. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

M. Install flexible hose connections on inlet and outlet of each pump and water service connections to vibration producing mechanical equipment,

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified elsewhere in project manual.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Intermediate atmospheric-vent backflow preventers.
   3. Reduced-pressure-principle backflow preventers.
   4. Double-check, backflow-prevention assemblies.
   5. Double-check, detector-assembly backflow preventers.
   6. Water pressure-reducing valves.
   7. Calibrated balancing valves.
   8. Primary, thermostatic, water mixing valves.
   9. Manifold, thermostatic, water mixing-valve assemblies.
   10. Primary water tempering valves.
   11. Outlet boxes.
   12. Supply-type, trap-seal primer valves.
   13. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section 200553 "Mechanical Identification."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Comply with requirements in Division 20 Section 200513 “Common Motor Requirements for Mechanical Equipment”.

C. Selection:
1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.
2. Pump speed shall be limited to 1,800 RPM except as scheduled.
3. Shaft first critical speed shall not be less than 25 percent greater than operating speed.
4. Maximum impeller diameter shall not be greater than 90 percent of “cut water” diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.
5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.
6. Select pump at a point no greater than 85 percent of end of curve flow.
7. Maximum pump suction velocity:
   a. In-line: 12 fps.
   b. End suction: 13 fps.
   c. Double suction: 15 fps.

2.2 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Corporation.
3. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
4. Pentair Pump Group; Aurora Pump.
5. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Pump Construction:
   1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
   2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
   3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
   4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
   5. Bearings: Oil-lubricated; bronze-journal or ball type.
   6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

E. Capacities and Characteristics: Refer to drawing schedule.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
   1. Type: Water-immersion temperature sensor, for installation in piping.
   2. Range: 65 to 200 deg F
   3. Enclosure: NEMA 250, Type 4X
   4. Operation of Pump: On or off.
   5. Transformer: Provide if required.
   6. Power Requirement: 24 V, ac.
   7. Settings: Start pump at 120 deg F and stop pump at 130 deg F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

E. Install continuous-thread hanger rods of size required to support pump weight.
   1. Comply with requirements for hangers and supports specified in Division 20 Section 200529 "Hangers and Supports for Piping and Equipment."

F. Install thermostats in hot-water return piping.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Horizontally mounted, in-line, close-coupled centrifugal pumps.
      b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
   2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section 220523 "Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section 221119 "Domestic Water Piping Specialties."
   3. Install pressure gage and snubber at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Division 20 Section 200519 "Meters and Gages"

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

C. Connect thermostats to pumps that they control.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 20 Section 200553 "Mechanical Identification" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Set thermostats for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   7. Start motor.
   8. Open discharge valve slowly.
   9. Adjust temperature settings on thermostats.
   10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, “Common Work Results for Mechanical”, requirements apply to this section.

C. Division 01 Section 013100 Project Management and Coordination, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Pipe, tube, and fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

D. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Coordination Drawings: Detail sanitary waste and vent piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which drainage piping will be attached or suspended from.

B. Coordination Drawings: Piping in congested areas such as mechanical rooms, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Fire suppression piping.
   2. Domestic water piping.

3. Storm drainage piping.
4. Compressed air piping.
5. HVAC hydronic piping.
6. Ductwork systems.
7. Building structural systems.
8. Electrical raceway systems.
9. Electrical equipment working space and clearances.
10. Items penetrating finished ceiling include the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Fire alarm devices.
    e. Audiovisual equipment.

C. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
    1. Soil, Waste, and Vent Piping: 10-foot head of water.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, stamped with the Cast Iron Soil Pipe Institute trademark, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 and CISPI 301 stamped with the Cast Iron Soil Pipe Institute trademark. Pipe shall be cast vertically or by centrifugal process and the inside and outside diameters shall be concentric, smooth, and free from cracks, sand holes, and other defects.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AB&I
      b. Charlotte Pipe.
      c. Tyler Pipe.

B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company
      c. Fernco Inc.
      d. Ideal Clamp Products
      e. Josam Company.
      f. MIFAB, Inc.
      g. Mission Rubber Company; a division of MCP Industries, Inc.
      h. Tyler Pipe; a subsidiary of McWane Inc.
   2. Couplings shall bear CISPI collective trademark
   3. Standards: ASTM C 1277 and CISPI 310.
   4. Description: Stainless-steel corrugated shield with a minimum of four stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:
   1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
   3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.6 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

J. Install piping to allow application of insulation.

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
   1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
   2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
      a. Straight tees, elbows, and crosses may be used on vent lines.
   3. Do not change direction of flow more than 90 degrees.
   4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of waste piping in direction of flow is prohibited.

L. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the minimum slopes required by code.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install aboveground PVC piping according to ASTM D 2665.

Q. PVC pipe shall not be exposed in return air plenums. Provide fire rated insulation as necessary for piping to comply with code required flame spread index and smoke-developed index when located within a return air plenum.

R. Install underground PVC piping according to ASTM D 2321.

S. Install engineered soil and waste drainage and vent piping systems as follows:
   1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
   2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

T. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping.
   2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section 221319 "Sanitary Waste Piping Specialties."

U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section Division 20 Section 200500 "Common Work Results for Mechanical."

W. Retain first paragraph below for piping that penetrates an exterior concrete wall or concrete slab.

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 20 Section 200500 "Common Work Results for Mechanical."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 20 Section 200500 "Common Work Results for Mechanical."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Specialty pipe fitting installation requirements are specified in Division 20 Section 200500 "Common Work Results for Mechanical."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 200529 "Hangers and Supports for Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4: 60 inches with 5/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

J. Install supports for vertical PVC piping every 48 inches.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
   6. Equipment: Connect drainage piping as indicated. Use flanges instead of unions for connections NPS 2-1/2 and larger.

C. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

D. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section 200553 "Mechanical Identification."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Refer to “Plumbing Piping System Application Schedule” in drawings.

B. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Grease interceptors.
7. Solids interceptors.

B. Related Requirements:
1. Division 22 section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.
1. Grease interceptors.

2. Solids Interceptors

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.
      d. Tyler Pipe.
      e. Watts Water Technologies, Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. Oatey.
c. Sioux Chief Manufacturing Co., Inc.
d. Smith, Jay R. Mfg. Co.
e. Tyler Pipe.
f. Watts Water Technologies, Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Required
7. Outlet Connection: Spigot
8. Closure: Brass, bronze or plastic with tapered threads
9. Adjustable Housing Material: Cast iron with threads, set-screws or other device
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy. In finished areas provide a recessed cover for finished floor material.
11. Frame and Cover Shape: Round
12. Top-Loading Classification: Medium Duty
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded brass or bronze plug with tapered threads.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Light Commercial Products Operation.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3
3. Pattern: Floor drain.
4. Body Material: Gray iron
5. Seepage Flange: Required.
6. Anchor Flange: Not required
7. Clamping Device: Required
8. Outlet: Bottom
9. Sediment Bucket: Not required
10. Top or Strainer Material: Nickel bronze
11. Top of Body and Strainer Finish: Nickel bronze
12. Top Shape: Square
13. Top Loading Classification: Medium-Duty. Drains located in Corridors and other occupied spaces shall be heavy duty loading.
14. Funnel: Not required
15. Inlet Fitting: Not required
16. Trap Material: Cast iron
17. Trap Pattern: Deep-seal P-trap
18. Trap Features: Trap-seal primer valve drain connection

2.4 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Oatey.
   b. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ProSet Systems Inc.
   2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
   6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **1 inch** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

E. Expansion Joints:
   1. Standard: ASME A112.21.2M.
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

2.7 GREASE INTERCEPTORS

A. Grease Interceptors:
   1. Cast-Iron or Steel Grease Interceptors:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Josam Company.
         2) MIFAB, Inc.
         3) Smith, Jay R. Mfg. Co.
         4) Tyler Pipe.
         5) Watts Water Technologies, Inc.
         6) Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation wastewater.
   3. Body Material: Cast iron.
   4. Interior Lining: Corrosion-resistant enamel.
   5. Exterior Coating: Corrosion-resistant enamel.
   6. Body Extension: Required.
   7. End Connections: Hub.
   8. Cleanout: field installed on outlet.
   9. Mounting: Recessed, flush with floor

2.8 SOLIDS INTERCEPTORS

A. Solids Interceptors:
   1. Cast-Iron or Steel Solids Interceptors:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Josam Company.
         2) MIFAB, Inc.
         3) Smith, Jay R. Mfg. Co.
         4) Tyler Pipe.
         5) Watts Water Technologies, Inc.
         6) Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Type: Factory-fabricated interceptor made for removing and retaining **sediment** from wastewater.
   3. Body Material: Cast iron or steel.
   4. Interior Lining: Corrosion-resistant enamel.
   5. Exterior Coating: Corrosion-resistant enamel.
   6. End Connections: Threaded.
   7. Mounting: Above floor, Inline.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install fixture air-admittance valves on fixture drain piping.

F. Install stack air-admittance valves at top of stack vent and vent stack piping.

G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations. Comply with requirements in Section 078413 "Penetration Firestopping."

H. Assemble open drain fittings and install with top of hub 1 inch above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

Q. Install grease interceptors, including trapping, and venting, according to authorities having jurisdiction and with clear space for servicing.
   1. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.

R. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

S. Install wood-blocking reinforcement for wall-mounting-type specialties.

T. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic draw off-type unit.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Grease interceptors.
2. Solids interceptors.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of metal and plastic interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:
1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
   1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of service.
   2. Do not proceed with interruption of sewer services without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

A. Cast-Iron or Steel Grease Interceptors:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. Josam Company.
      c. MIFAB, Inc.
      d. Schier Products Company.
      e. Watts; a Watts Water Technologies company.
      f. Zurn Industries, LLC.
   2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation wastewater.
   3. Body Material: Cast iron or steel.
   4. Interior Lining: Corrosion-resistant enamel
   5. Exterior Coating: Corrosion-resistant enamel

2.2 SOLIDS INTERCEPTORS

A. Cast-Iron or Steel Solids Interceptors:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. Josam Company.
      c. MIFAB, Inc.
      d. Striem (formerly Schier Products Company).
      e. Watts; a Watts Water Technologies company.
      f. Zurn Industries, LLC.
   2. Type: Factory-fabricated interceptor made for removing and retaining sediment from wastewater.
   3. Body Material: Acid resistant composite.
   4. Interior Separation Device: Screens.
   5. Interior Lining: Corrosion-resistant enamel.
   6. Exterior Coating: Not required.
   7. Mounting: Above floor

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Equipment Mounting:
   1. Install interceptors within cabinet of on floor beneath sink area as shown on plans.
   2. Comply with requirements for equipment bases and foundations specified in Division 03 Section 033000 "Cast-in-Place Concrete" For grease interceptors.

B. Set interceptors level and plumb.

C. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
   1. Flush with Floor Installation: Set unit (and extension, if required) with cover flush with finished floor.
   2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

D. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.
   1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 PROTECTION

A. Protect sanitary waste interceptors from damage during construction period.

B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION 221323

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

D. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Coordination Drawings: Piping in congested areas such as mechanical rooms, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Fire suppression piping.
2. Domestic water piping.
3. Sanitary and vent piping.
4. HVAC hydronic piping.
5. Ductwork systems.
6. Building structural systems.
7. Electrical raceway systems.
8. Electrical equipment working space and clearances.
9. Items penetrating finished ceiling include the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.

c. Speakers.
d. Fire alarm devices.
e. Audiovisual equipment.

B. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Storm Drainage Piping: 10-foot head of water

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:
1. Marked with CISPI collective trademark and NSF certification mark.
2. Class: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 and CISPI 301 stamped with the Cast Iron Soil Pipe Institute trademark. Pipe shall be cast vertically or by centrifugal process and the inside and outside diameters shall be concentric, smooth, and free from cracks, sand holes, and other defects.

B. CISPI, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Fernco Inc.

d. Ideal Clamp Products
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Tyler Pipe.

2. Couplings shall bear CISPI collective trademark and NSF certification mark.
3. Standards: ASTM C 1277 and CISPI 310.
4. Description: Stainless-steel corrugated shield with a minimum of four stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 PVC PIPE AND FITTINGS

A. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.
1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.
1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

J. Install piping to allow application of insulation.

K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

M. Install storm drainage piping at the minimum slopes required by code.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install aboveground PVC piping according to ASTM D 2665.

P. PVC pipe shall not be exposed in return air plenums. Provide fire rated insulation as necessary for piping to comply with code required flame spread index and smoke-developed index when located within a return air plenum.

Q. Install underground PVC piping according to ASTM D 2321.

R. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
      a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
      b. Comply with requirements for cleanouts specified in Division 22 Section 221423 "Storm Drainage Piping Specialties."
   2. Install drains in storm drainage gravity-flow piping.
      a. Comply with requirements for drains specified in Division 22 Section 221423 "Storm Drainage Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 20 Section 200500 "Common Work Results for Mechanical."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 20 Section 200500 "Common Work Results for Mechanical."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 20 Section 200500 "Common Work Results for Mechanical."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

D. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

E. Joint Restraints and Sway Bracing:
   1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
      a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
      c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 20 Section 200529 "Hangers and Supports for Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42 clamps.
   4. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   2. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   3. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

4. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   2. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   3. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Comply with requirements for cleanouts and drains specified in Division 22 Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 20 Section 200553 "Mechanical Identification."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Refer to “Plumbing Piping System Application Schedule” in drawings.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Section 200500 Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Roof drains.
   2. Miscellaneous storm drainage piping specialties.
   3. Cleanouts.

B. Related Requirements:
   1. Division 07 Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, General-Purpose Roof Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.
      d. Tyler Pipe.
      e. Wade; a subsidiary of McWane Inc.

f. Watts Water Technologies, Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14- to 16-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Sump Receiver Plate: Required.
11. Dome Material: Cast iron or ductile iron.
12. Vandal-Proof Dome: Required.
13. Water Dam: Required for overflow drains only. 2 inches high.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:
1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. Wade; a subsidiary of McWane Inc.
f. Watts; a Watts Water Technologies company.
g. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass or bronze plug.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. Oatey.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.

e. Tyler Pipe; a subsidiary of McWane Inc.
f. Wade; a subsidiary of McWane Inc.
g. Watts; a Watts Water Technologies company.
h. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M, for heavy-duty, adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule Material: Cast iron
6. Clamping Device: Required.
7. Outlet Connection: No hub
8. Closure: Brass, bronze or plastic with tapered threads
9. Adjustable Housing Material: Cast iron with threads, set-screws or other device
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy In finished areas provide a recessed cover for finished floor material.
11. Frame and Cover Shape: Round
12. Top-Loading Classification: Medium Duty Heavy Duty. Provide heavy duty for cleanouts located within mechanical rooms and kitchens.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. Wade; a subsidiary of McWane Inc.
f. Watts Water Technologies, Inc.
g. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded brass or bronze plug with tapered threads.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless steel cover plate with screw.

D. Test Tees:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. Watts; a Watts Water Technologies company.
f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
   3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate cleanouts at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install test tees in vertical conductors and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

H. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
   1. Comply with requirements in Section 078413 "Penetration Firestopping."

I. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section 221413 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
2. Commercial, coil-type, finned-tube, gas-fired, domestic-water heaters, domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories**.**

B. Shop Drawings:
1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, gas-fired domestic-water heater, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
   1. Comply with efficiency requirements in ASHRAE 189.1, which supersede requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Periods: From date of Substantial Completion.
      a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
         1) Storage Tank: Five years.
         2) Controls and Other Components: One [year(s).
      b. Commercial, Finned-Tube, Gas-Fired, Domestic-Water Heaters:
         1) Heat Exchanger: Five years.
         2) Controls and Other Components: One year(s).

3) Separate Hot-Water Storage Tanks: Five years.
c. Expansion Tanks: One years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bradford White Corporation.
   b. Lochinvar Corporation.
   c. PVI Industries, LLC.
   d. RBI Water Heaters; a Mestek company.
   e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
   f. State Industries.
2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
4. Storage-Tank Construction: ASME-code steel with 150-psigminimum working-pressure rating.
   a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
   b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
5. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
   e. Jacket: Steel with enameled finish.
   f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
   g. Temperature Control: Adjustable thermostat.
   h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
   i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
6. Direct Vent/sealed combustion.

B. Capacity and Characteristics: Refer to schedule on drawings.

C. Commercial, Grid-Type, Finned-Tube, Gas-Fired, Domestic-Water Heaters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bradford White Corporation.
   b. Laars Heating Systems Company; a subsidiary of Bradford White Corporation.
   c. Lochinvar Corporation.
   d. Raypak; a Rheem company.
   e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
2. Standard: ANSI Z21.13/CSA 4.9 for hot-water-supply boilers.
3. Description: Packaged unit with boiler, storage tank, pump, piping, and controls.
4. Boiler Construction: ASME code with 160-psig working-pressure rating for hot-water-boiler-type, domestic-water heater.
   a. Heat Exchanger: Horizontal, straight, finned-copper tubes with bronze headers.
   b. Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
5. Boiler Appurtenances:
   a. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire boiler except connections and controls.
   b. Jacket: Steel with enameled finish.
   c. Burner: For use with grid-type, finned-tube, gas-fired, domestic-water heaters and natural-gas fuel.
   d. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, intermittent electronic-ignition system.
   e. Temperature Control: Adjustable, storage-tank temperature-control fitting and flow switch, interlocked with circulator and burner.
   f. Safety Control: Automatic, high-temperature-limit cutoff device or system.
6. Support: Steel base or skids.
7. Hot-Water Storage Tank: Connected with piping to circulating pump and domestic-water heater.
   a. Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with 150-psig working-pressure rating.
   b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
   c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

8. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rods: Factory installed, magnesium.
   b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
   c. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
   d. Jacket: Steel with enameled finish.
   e. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
9. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, 125-psig minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.
10. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.
11. Mounting: Domestic-water heater, tank, and accessories factory mounted on skids.

D. Capacity and Characteristics: Refer to schedule on drawings.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMTROL Inc.
      b. ITT Industries; Bell & Gossett.
      c. Pentair Pump Group (The); Myers.
      d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
      e. State Industries.
      f. Taco, Inc.
      g. Wessels Co.
   2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
   3. Construction:
      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 ANNEX G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.
   4. Capacity and Characteristics: Refer to schedule on drawings.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated memory-stop balancing valves to provide balanced flow through each domestic-water heater.
   1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."
   2. Comply with requirements for balancing valves specified in Division 22 Section 221119 "Domestic Water Piping Specialties."

E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.

G. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

H. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

I. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

J. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

2.3 VENTING KITS

A. All venting material by Contractor: Refer to “Breechings, Chimneys, and Stack” Section for requirements.

B. Combustion-Air Intake: Complete system, CPVC pipe or material as specified in “Metal Ducts”, vent terminal with screen, inlet air coupling, and sealant.

C. Exhaust shall be AL29-4C stainless steel.

D. Kit: Complete system, ASTM A 959, Type AL29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections listed under section 3.4.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Division 03 Section 033000 "Cast-in-Place Concrete."
   1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Install anchor bolts to elevations required for proper attachment to supported equipment.
   8. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section 220523 "General-Duty Valves for Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.
   1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
   2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
   3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
   4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Division 23 Section 231123 "Facility Natural-Gas Piping."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section 221119 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Division 20 Section 200519 "Meters and Gages."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Division 22 Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Division 20 Section 200519 "Meters and Gages"

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water expansion tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Division 22 Section 221116 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Division 23 Section 231123 "Facility Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 20 Section 200553 "Mechanical Identification."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective and be replaced if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 223400

SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Water closets.
2. Water closet flushometer valves.
3. Toilet seats.
4. Urinals.
5. Urinal flushometer valves.
6. Lavatories.
7. Lavatory Faucets.
8. Service basins.
9. Laundry sinks
10. Counter sinks.
11. Sink faucets.
12. Supply fittings.
13. Waste fittings.
14. Shower faucets.
15. Supports.
16. Grout.

1.3 DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.5 CLOSEOUT SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

B. Operation and Maintenance Data: For flushometer valves, lavatories, faucets and electronic sensors to include in operation and maintenance manuals.
   1. Include the following: Servicing and adjustments of automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
   3. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard America.
      b. Kohler Co.
      c. Sloan Valve Company.
      d. Zurn Industries, LLC; Commercial Brass and Fixtures.
   2. Bowl:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Style: Flushometer valve.
      e. Height: ADA Handicapped/elderly, complying with ICC/ANSI A117.1
      f. Rim Contour: Elongated.
      g. Water Consumption: 1.6 gal.per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
      i. Color: White.
   3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.

2.2 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud**,** accessible.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard America.
      b. Kohler Co.
      c. Sloan Valve Company.
      d. Zurn Industries, LLC; Commercial Brass and Fixtures.
   2. Bowl:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Style: Flushometer valve.
      e. Height: Standard.
      f. Rim Contour: Elongated.
      g. Water Consumption: 1.6 gal. per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
      i. Color: White.
   3. Support: Water closet carrier.
   4. Water-Closet Mounting Height: ADA Handicapped/elderly according to ICC/ANSI A117.1 or Standard. Refer to architectural plans. WATER CLOSET FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Coyne & Delany Co.
      b. Sloan Valve Company.
      c. Zurn Industries, LLC; Commercial Brass and Fixtures.
   2. Standard: ASSE 1037.
   3. Minimum Pressure Rating: 125 psig.
   4. Features: Include integral check stop and backflow-prevention device.
   5. Material: Brass body with corrosion-resistant components.
   6. Exposed Flushometer-Valve Finish: Chrome plated.
   7. Panel Finish: Chrome plated or stainless steel.
   8. Style: Exposed.
   9. Consumption: 1.6 gal. per flush.
   10. Minimum Inlet: NPS 1.
   11. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard America.
      b. Bemis Manufacturing Company.
      c. Centoco Manufacturing Corporation.

d. Church Seats.
e. Kohler Co.
f. Olsonite Seat Co.
g. Sanderson Plumbing Products, Inc.
h. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (heavy duty).
5. Shape: Elongated rim, open front
6. Hinge: Self-sustaining, check
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required
9. Color: White.

2.5 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, siphon jet, accessible.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard America.
   b. Kohler Co.
2. Fixture:
   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
   e. Water Consumption: Water saving.
   f. Spud Size and Location: NPS 3/4; top.
   g. Outlet Size and Location: NPS 2; back.
   h. Color: White.
3. Waste Fitting:
   a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
   b. Size: NPS 2.
4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
5. Urinal Mounting Height: Standard or Handicapped/elderly according to ICC A117.1 see architectural plans for elevations.

2.6 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard.
   b. Coyne & Delany Co.
   c. Sloan Valve Company.
   d. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.

4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Consumption: 1.0 gal. per flush.
10. Minimum Inlet: NPS 1.
11. Minimum Outlet: NPS 1-1/4.

2.7 WALL-MOUNTED MULTI-STATION LAVATORIES

A. Lavatory: Rectangular, enameled, cast iron, wall mounted.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sloan
      b. Bradley
      c. Acorn
   2. Fixture:
      a. Standard: ASME A112.18.1/CSA B125.1.
      b. Type: Single piece molded cast-formed evero with no visible seams or caulk-lines.
      c. Faucet-Hole Punching: One hole, three locations.
      d. Faucet-Hole Location: Top.
      e. Mounting Material: Wall bracket.
      f. Finish: Polished quartz.
   3. Faucet: Automatic-type, hard-wired, electronic-sensor-operated, mixing, solid-brass valve.
   4. Support: ASME A112.6.1M, Type III, lavatory carrier. Include rectangular, steel uprights, or as provided by manufacturer.

2.8 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard America.
      b. Kohler Co.
      c. Sloan Valve Company.
      d. Zurn Industries, LLC; Commercial Brass and Fixtures.
   2. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: For wall hanging.
      c. Nominal Size: Oval, 20 by 18 inches.
      d. Faucet-Hole Punching: Two holes, 4-inch centers.
      e. Faucet-Hole Location: Top.
      f. Color: White.
      g. Mounting Material: Chair carrier.
   3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with escutcheon. Include rectangular, steel uprights.

4. Lavatory Mounting Height: Standard or Handicapped/elderly according to ICC A117.1 See architectural plans for elevations.

2.9 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, hard-wired, electronic-sensor-operated, mixing, solid-brass valve.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard America.
      b. Bradley Corporation.
      c. Chicago Faucets.
      d. Kohler Co.
      e. Moen Incorporated.
      f. Sloan Valve Company.
      g. T & S Brass and Bronze Works, Inc.
      h. Zurn Industries, LLC; Commercial Brass and Fixtures.
   2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
   3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
   5. Body Type: Two hole 4” centerset.
   6. Body Material: Commercial, solid brass.
   7. Finish: Polished chrome plate.
   8. Maximum Flow Rate: 0.5 gpm.
   9. Mounting Type: Deck, concealed.
   10. Spout: Rigid type.
   11. Spout Outlet: Aerator.
   12. Drain: Not part of faucet.

2.10 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Engineering Company.
      b. Florestone Products Co., Inc.
      c. Fiat Products.
      d. Stern-Williams Co., Inc.
   2. Fixture:
      a. Standard: IAPMO PS 99.
      b. Shape: Five sided.
      c. Nominal Size: 32 by 32 inches.

d. Height: 12 inches with 6” dropped front.
e. Rim Guard: On front top surfaces.
f. Color: Not applicable
g. Drain: Grid with NPS 3outlet.
3. Mounting: On floor in corner and flush to wall.
4. Faucet: Wall mounted manual faucet with 8” centers, wall support bracket and pail hook.

B. Sinks: Stainless steel, lay-in under counter mounted.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elkay Manufacturing Co.
b. Just Manufacturing.
c. Kohler
2. Fixture:
a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Undermount.
c. Number of Compartments: **One**.
d. Overall Dimensions: 23”x17.5”. See fixture schedule on plans for depth.
e. Metal Thickness: 0.050 inch.
f. Compartment:
1) Drain: NPS 1-1/2 tailpiece with strainer and stopper.
2) Drain Location: Centered in compartment
3. Faucet(s):
a. Number Required: One.
b. Mounting: Deck.
4. Supply Fittings:
a. Standard: ASME A112.18.1/CSA B125.1.
b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
1) Operation: Loose key.
2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe.
5. Waste Fittings:
a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap(s):
1) Size: NPS 1-1/2.
2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.
6. Mounting: Undermount with sealant.

2.11 LAUNDRY SINKS

A. Laundry Sinks: Freestanding.
1. Polyethylene Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Florestone Products Co., Inc.
b. Fiat Products.

2. Molded Stone Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fiat Products.
3. Polyethylene Fixture:
   a. Type: With back ledge for faucet.
   b. Number of Compartments: One.
   c. Overall Dimensions: 20-inch width x 24-inch depth.
   d. Compartment:
      1) Dimensions: 19.5”x19.5”
      2) Drain: NPS 2 tailpiece with stopper**.**
4. Molded Stone Fixture:
   a. Type: With back ledge for faucet.
   b. Number of Compartments: Two.
   c. Overall Dimensions: 40-inch width x 24-inch depth.
   d. Compartments:
      1) Dimensions: 19”x19”
      2) Drain: NPS 2 tailpiece with stopper**.**
5. Supports: Baked enamel steel angle legs.
6. Faucet(s):
   a. Number Required: One.
   b. Mounting: On back ledge.
7. Supply Fittings:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Loose key
      2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe**.**
8. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Trap(s):
      1) Size: NPS 2.
      2) Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall**;** and chrome-plated brass or steel wall flange.

2.12 SINK FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, two-lever-handle mixing valve.
   1. Commercial, Solid-Brass Faucets.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Bradley Corporation.
         2) Chicago Faucets.
         3) Delta Faucet Company.
         4) Elkay Manufacturing Co.
         5) Just Manufacturing.

6) Kohler Co.
7) Moen Incorporated.
8) Sloan Valve Company.
9) T & S Brass and Bronze Works, Inc.
10) Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset Single hole.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plated.
7. Maximum Flow Rate: 2.2 gpm.
8. Handle(s): Wrist blade, 4 inches.
9. Mounting Type: Deck, concealed.
10. Spout Type: Swivel gooseneck.
11. Vacuum Breaker: Not required.
12. Spout Outlet: Aerator.

2.13 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
1. Refer to fixture schedule for sizes.
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces.

2.14 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Lavatory:
1. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
2. Trap:
a. Size: NPS 1-1/2 by NPS 1-1/4 unless otherwise scheduled.
b. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

C. Sink:
   1. Drain: Strainer with NPS 1-1/2 offset and straight tailpiece.
   2. Trap:
      a. Size: NPS 1-1/2 unless otherwise scheduled.
      b. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.15 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Chicago Faucets.
      b. Lawler Manufacturing Co., Inc.
      c. Leonard Valve Company.
      d. Powers; a division of Watts Water Technologies, Inc.
   2. Description: Single-handle, thermostatic mixing valve with hot- and cold-water indicators; check stops; and shower head.
   3. Faucet:
      a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
      b. Body Material: Solid brass.
      c. Finish: Polished chrome plate.
      d. Shower-Arm, Flow-Control Fitting: 1.5 gpm.
      e. EPA WaterSense: Required.
      f. Mounting: Concealed.
      g. Operation: Single-handle, twist or rotate control.
      h. Antiscald Device: Integral with mixing valve.
      i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   4. Supply Connections: NPS 1/2.
   5. Shower Head:
      a. Standard: ASME A112.18.1/CSA B125.1.
      b. Type: Without ball joint, but with arm and flange.
      c. Shower Head Material: Metallic with chrome-plated finish.
      d. Spray Pattern: Adjustable.
      e. Integral Volume Control: Required.

2.16 SUPPORTS

A. Water Closet Carrier:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Zurn Industries, LLC.
   2. Standard: ASME A112.6.1M.

3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

B. Type I Urinal Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

C. Type II Urinal Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

D. Type II Lavatory Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

E. Type III Lavatory Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

2.17 GROUT

A. Refer to Division 20 “Common Work Results” for requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine counters, walls, and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:
   1. Install level and plumb according to roughing-in drawings.
   2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
   3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
   4. Support Installation:
      a. Use carrier supports with waste-fitting assembly and seal.
      b. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
   5. Flushometer-Valve Installation:
      a. Install flushometer-valve, water-supply fitting on each supply to each water closet.
      b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
      c. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
   6. Install toilet seats on water closets.
   7. Wall Flange and Escutcheon Installation:
      a. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
      b. Install deep-pattern escutcheons if required to conceal protruding fittings.
      c. Comply with escutcheon requirements specified in Division 20 "Common Work Results."
   8. Joint Sealing:
      a. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
      b. Match sealant color to water-closet color.
      c. Comply with sealant requirements specified in Division 07 "Joint Sealants."

B. Urinal Installation:
   1. Install urinals level and plumb according to roughing-in drawings.
   2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
   3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
   4. Support Installation:
      a. Install supports, affixed to building substrate, for wall-hung urinals.
      b. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
   5. Flushometer-Valve Installation:
      a. Install flushometer-valve water-supply fitting on each supply to each urinal.
      b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
      c. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
   6. Wall Flange and Escutcheon Installation:
      a. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
      b. Install deep-pattern escutcheons if required to conceal protruding fittings.
      c. Comply with escutcheon requirements specified in Division 20 "Common Work Results."
   7. Joint Sealing:
      a. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
      b. Match sealant color to urinal color.
      c. Comply with sealant requirements specified in Division 07 "Joint Sealants."

C. Lavatory Installation:
   1. Install lavatories level and plumb according to roughing-in drawings.
   2. Install supports, affixed to building substrate, for wall-mounted lavatories.
   3. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
   4. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 20 "Common Work Results."
   5. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 "Joint Sealants."
   6. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Division 20 "Mechanical Insulation."

D. Sink Installation:
   1. Install sinks level and plumb according to roughing-in drawings.
   2. Install supports, affixed to building substrate, for wall-hung sinks.
   3. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

4. Install water-supply piping with stop on each supply to each sink faucet.
   a. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Division 20 "General-Duty Valves for Piping."
   b. Install stops in locations where they can be easily reached for operation.
5. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 20 "Common Work Results."
6. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 "Joint Sealants."
7. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Division 20 "Mechanical Insulation."

E. Shower Installation:
1. Install water-supply piping with stop on each supply to each shower faucet.
   a. Exception: Use ball, gate, or globe valves if supply stops are not specified with shower. Comply with valve requirements specified in Division 22 "Valves for Plumbing Piping."
   b. Install stops in locations where they can be easily reached for operation.
2. Install shower flow-control fittings with specified maximum flow rates in shower arms.
3. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 20 "Common Work Results."
4. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Division 22 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets, flushometer valves, shower heads, etc. to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of fixtures, inspect and repair damaged finishes.

B. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Combination units.
   2. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Standard, Plumbed Emergency Shower with Eyewash Combination Units:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Safety; a division of Acorn Engineering Company.
      b. Bradley Corporation.
      c. Guardian Equipment Co.
      d. Haws Corporation.
      e. Speakman Company.
   2. Piping:
      a. Material: Chrome-plated brass or stainless steel.
      b. Unit Supply: NPS 1-1/4 minimum.
      c. Unit Drain: Outlet at back or side near bottom.
   3. Shower:
      a. Capacity: Not less than 20 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Pull rod.
      d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel.

e. Mounting: Pedestal.

4. Eyewash Unit:
   a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
   c. Control-Valve Actuator: Paddle.
   d. Spray-Head Assembly: Two receptor-mounted spray heads.
   e. Receptor: Chrome-plated brass or stainless-steel bowl.
   f. Mounting: Attached shower pedestal.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Safety; a division of Acorn Engineering Company.
      b. Armstrong International, Inc.
      c. Bradley Corporation.
      d. Guardian Equipment Co.
      e. Haws Corporation.
      f. Lawler Manufacturing Co., Inc.
      g. Leonard Valve Company.
      h. Powers; a division of Watts Water Technologies, Inc.
      i. Speakman Company.
      j. Watts; a Watts Water Technologies company.
   2. Description: Factory-fabricated equipment with thermostatic mixing valve.
      a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure. Mixing valve shall have 10 psi maximum pressure loss for required emergency equipment flowrate.
      b. Supply Connections: For hot and cold water.

2.3 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 22 "Valves for Plumbing Piping."
   1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
   2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Division 22 Section 221116 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Division 20 Section 200519 "Meters and Gages"

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Division 22 Section 221316 "Sanitary Waste and Vent Piping."

H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Division 22 Section 221316 "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Division 20 Section 200500 "Common Work Results for Mechanical."

J. Fill self-contained fixtures with flushing fluid.

3.3 CONNECTIONS

A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 22 221116 "Domestic Water Piping."

B. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Division 22 Section 221316 "Sanitary Waste and Vent Piping."

C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Division 20 Section 200553 "Identification for Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 224700 - DRINKING FOUNTAINS & ELECTRIC WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section includes pressure water coolers and related components.

1.3 DEFINITIONS

A. Cast Polymer: Dense, cast-filled-polymer plastic.

B. Fitting: Device that controls flow of water into or out of fixture.

C. Fixture: Drinking fountain or water cooler unless one is specifically indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"**;** State of Michigan Barrier Free Design; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61 and NSF 372 for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than one of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Wall mounted**,** standard, wheelchair accessible.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay Manufacturing Co.
      b. Halsey Taylor.
      c. Haws Corporation.
   2. Standards:
      a. Comply with NSF 61 and NSF 372.
      b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
      c. Comply with ICC A117.1.
   3. Cabinet: Bi-level with two attached cabinets.
   4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
   5. Control: Push buttonor Push bar.
   6. Bottle Filler: Sensor activation with 20-second automatic shutoff timer. Fill rate 0.5 to 1.5 gpm .
   7. Drain: Grid with NPS 1-1/4 tailpiece.
   8. Supply: NPS 3/8 with shutoff valve.
   9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
   10. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
12. Capacities and Characteristics: Refer to schedule on drawings.
13. Support: Type I Water Cooler Carrier.
14. Water Cooler Mounting Height: Handicapped/elderly according to ICC A117.1.

2.2 FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Josam Co.
    2. MIFAB Manufacturing, Inc.
    3. Smith, Jay R. Mfg. Co.
    4. Tyler Pipe; Wade Div.
    5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
    6. Zurn Plumbing Products Group; Specification Drainage Operation.

C. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
    1. Type I: Hanger-type carrier with two vertical uprights.
    2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
    3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section 220523 "Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section 079200 "Joint Sealants."

3.4 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors. Refer to Division 20 Section 200500 “Common Work Results”.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section 260526 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section 260519 Section "Low-Voltage Electrical Power Conductors and Cables."

E. Comply with water piping requirements specified in Division 22 Section 221116 "Domestic Water Piping."

F. Install ball, gate, or globe shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

G. Comply with soil and waste piping requirements specified in Division 22 Section 221316 "Sanitary Waste and Vent Piping."

3.6 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
   1. Remove and replace malfunctioning units and retest as specified above.
   2. Report test results in writing.

3.7 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.8 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224700

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

E. Division 26 Section 260500 “Common Work Results for Electrical” requirements apply to this section and requires contractor participation in the Above Ceiling Coordination Program.

1.2 DEFINITIONS

A. BAS: Building Automation System

B. DDC: Direct Digital Control

C. EMS: Energy Management System consisting of BAS (typically with a PC and support software), DDC controllers, and networking software/hardware/wiring.

D. I/O: Input/output

E. BACnet: A communications protocol for implementing interoperable controllers established by ASHRAE

F. MS/TP: Master-slave/token-passing network for BACnet

G. PC: Personal computer

H. PID: Proportional plus integral plus derivative

1.3 SYSTEM DESCRIPTION

A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The Systems Integrator (SI) contractor, under separate contract will provide PC-based programming workstations. Microcomputer controllers of modular design providing distributed processing capability and allowing future expansion of both input/output points and processing/control functions will be provided by the BAS contractor.

B. For this project, the system shall consist of the following components:
   1. Administration and Programming Workstation(s): The SI Systems Integrator supplier shall include Operation software and architecture as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable. Workstations must conform to the B-OWS BACnet device profile. All field level controllers must have the ability to be programmed by site personnel from a BAS contractor supplied and licensed programming tool or N4 embedded programming tool jar file.
   2. Web-Based Operator Workstations: The SI Systems Integrator supplier shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There will be no need for any additional computer based hardware to support the web-based user interface.
   3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS system supplier shall furnish needed quantity of Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. All field level controllers must have the ability to be programmed by site personnel from a BAS contractor supplied and licensed programming tool or N4 embedded programming tool jar file. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications to communicate with the workstations will not be accepted. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).

4. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. All field level controllers must have the ability to be programmed by site personnel from a BAS contractor supplied and licensed programming tool or N4 embedded programming tool jar file. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC).

C. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet, Modbus, XML and HTPS for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.

D. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.

E. The system shall enable an open architecture that utilizes BACnet functionality to assure interoperability between all system components. Native support for BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

F. The AAC shall be capable of communicating as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.

G. The system shall provide support for Modbus TCP and RTU protocols natively, and not require the use of gateways.

H. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives and power metering should easily coexist on the same network channel.
   1. The supplied system must incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. The system shall not require JAVA to be enabled in the browser.
   2. Data shall reside on a supplier-installed server for all database access.
   3. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network.

I. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in-place support facility within 120 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.

1.4 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
   1. Provide Building Automation System (BAS) as shown in the contract documents and described herein.
   2. Provide interface to BAS via BACnet as shown in the contract documents and described herein.
   3. Provide DDC System as shown in the contract documents and described herein.
   4. Sequences modified as a result of start-up, checkout, fine tuning, and/or commissioning shall be resubmitted to the Architect for record.
   5. Systems integration: The installing contractor is responsible for and shall provide the integration of the DDC with the existing web-based graphical user interface, including (but not limited to):
      a. Insuring that the new DDC Controllers shall interface to the existing web-based graphical user interface. There are three levels of system architecture: a campus-wide Management Level Network (MLN) that is Ethernet based IP protocol, a high performance peer-to-peer Building Level Network (BLN), and an Application Specific Controller Floor Level Network (FLN). Access to all levels from the web-based graphical user interface appears transparent to the user when accessing data graphically or developing control programs.
      b. New DDC Controllers shall be fully and readily accessible from existing graphical user workstations.
      c. If required for networking, a network interface controller including hardware and panel, software (or firmware), and coordinating electrical power (and UPS back-up if required by Owner) per the contract documents.
      d. Providing expansion of and/or upgrading of any network panel software/firmware and/or memory size to accommodate the additional point database and communication traffic (bandwidth) caused by accessing information across the network from the Owner’s web-based graphical user interface for graphical display purposes. Inclusive with this is necessary memory or bandwidth for trend data collection.

e. Coordination with the Owner's IT group in terms of their providing for the additional bandwidth requirements as a result of the installation.
f. All new graphics shall comply with existing district graphical standards. If software upgrades of existing graphics are required, such upgrades of the graphic user interface shall be provided as part of this project.

B. Related Sections include the following:
1. Division 20 Section 200519 "Meters and Gages" for measuring equipment that relates to this Section.
2. Division 26 Section 260943 "Network Lighting Controls" for requirements that relate to this Section.

1.5 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
1. Graphic Display: Display graphic with minimum 30 dynamic points with current data within 5 seconds.
2. Graphic Refresh: Update graphic with minimum 30 dynamic points with current data within 2 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 15 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
a. Water Temperature: Plus or minus 1-degree F.
b. Water Flow: Plus or minus 5 percent of full scale.
c. Water Pressure: Plus or minus 2 percent of full scale.
d. Space Temperature: Plus or minus 1-degree F.
e. Ducted Air Temperature: Plus or minus 1-degree F.
f. Outside Air Temperature: Plus or minus 2-degrees F.
g. Averaging Air Temperature: Plus or minus 2-degrees F.
h. Dew Point Temperature: Plus or minus 2.7-degrees F.
i. Temperature Differential: Plus or minus 0.27-degrees F.
j. Relative Humidity: Plus or minus 5-percent relative humidity (% RH).
k. Airflow (Terminal): Plus or minus 5-% FS.
l. Air Pressure (Space): Plus or minus 0.0005-inches wg.
m. Air Pressure (Ducts): Plus or minus 0.02-inches wg.
n. Carbon Dioxide: Plus or minus 50-ppm CO_2.
o. Electrical: Plus or minus 2-percent of reading (volts/amps/watts).

1.6 SEQUENCE OF OPERATION

A. Sequences of Operation are included on the temperature control drawings (plans).

1.7 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. Retain three subparagraphs below for DDC systems.
   2. Building Automation System: Include technical data for operator workstation, operating system software, color graphics; editors for graphics, point database, and programming; software licensing, software updates during construction, and other third-party applications.
   3. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for remote operator’s terminal, operator display menus, interface equipment to BAS, DDC Controllers, Unitary Controllers, Application Specific Controllers (e.g. Air Terminal Controller), transducers/transmitters, sensors, control dampers, damper actuators, control valves, valve actuators, relays/switches, auxiliary control panels.
   4. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
   2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   3. Wiring Diagrams: Power, signal, and control wiring.
   4. Details of control panel faces, including controls, instruments, and labeling.
   5. Written description of sequence of operation.
   6. Schedule of dampers including size, leakage, and flow characteristics.
      a. Coordinate dampers sizes with sheet metal and/or mechanical contractor before submitting.
   7. Schedule of valves including flow characteristics.
   8. Schedule of Terminal Equipment Controllers; e.g. air terminals, unit ventilators, etc.
   9. DDC System Hardware:
      a. Wiring diagrams for control units with termination numbers.
      b. Schematic diagrams and floor plans for field sensors and control hardware.
      c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

10. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
11. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

D. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

E. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

F. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals
2. Program Software Backup: On a USB Drive.
3. Device address list
4. Printout of software application and graphic screens
5. Software licenses required by and installed for DDC workstations and control systems

G. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

H. Field quality control test reports

I. Installing contractor’s commissioning reports

J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. Include the following:
1. Maintenance instructions and list of spare parts for each type of control device and the compressed air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
5. Calibration records and list of set points.

1.8 QUALITY ASSURANCE

A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 5 years.
   1. The Building Management System contractor shall have a full service facility within 120 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.
   2. Any installing contractor, not listed as prequalified in the Approved Manufacturer's section, shall submit credentials as detailed in the Pre-bid Submittal section for the engineer's review 2 weeks prior to bid date. Failure to follow the attached formats shall disqualify potential alternate bidders. Credentials must attest that the contractor meets all requirements of the specification and the Engineers judgment regarding approval to bid as an acceptable installer after reviewing the data will be final.
   3. The following contractors have been pre-qualified for installation and programming:
      a. SC Tech
      b. ControlNET
      c. Grand Valley Automation

B. All bidders must be authorized distributors or branch offices of the manufacturers specified.

C. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.

D. The BAS system supplier shall commission and set in operating condition all major equipment and systems, such as the hot water heating and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. If the vendor is providing an AFDD/CC system, use of the analytics shall be used to help commission the system.

E. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.

F. Required elements of the startup testing include:
   1. Measurement of voltage sources, primary and secondary
   2. Verification of proper controller power wiring.
   3. Verification of component inventory when compared to the submittals.
   4. Verification of labeling on components and wiring.

5. Verification of connection integrity and quality (loose strands and tight connections).
6. Verification of bus topology, grounding of shields and installation of termination devices.
7. Verification of point checkout.
8. Each I/O device is landed per the submittals and functions per the sequence of control.
9. Analog sensors are properly scaled and a value is reported
10. Binary sensors have the correct normal position and the state is correctly reported.
11. Analog outputs have the correct normal position and move full stroke when so commanded.
12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
14. Documentation of Loop tuning (sample rate, gain and integral time constant).

G. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following.
1. Graphics navigation.
2. Trend data collection and presentation.
3. Alarm handling, acknowledgement and routing.
4. Time schedule editing.
5. Application parameter adjustment.
6. Manual control.
7. Report execution.
8. Automatic backups.
9. Web Client access.

H. A Startup Testing Report and a Performance Verification Testing Report shall be provided upon test completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, DDC control sensors, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate equipment with Division 28 Section "Digital Addressable Fire-Alarm Systems" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

E. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

F. Coordinate installation of control dampers, smoke dampers, HVAC equipment isolation dampers, and pipe-mounted sensors and instruments with the mechanical and/or plumbing contractor.

G. Coordinate installation of duct, space, outdoor, or building static pressure sensors with the finished surfaces, installing contractor and the Architect prior to installation.

H. Coordinate installation of any exterior wall or roof-mounted sensors, instruments, or controllers required for the temperature control system with the General Contractor and the Architect prior to installation.

I. Coordinate the color selection process of any sensor or device intended to be mounted on finished surfaces with the Architect prior to installation.

1.11 OWNERSHIP

A. The Owner shall retain licenses to software for this project.

B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.

C. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.

D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
   1. Server and workstation software
   2. Application programming tools
   3. Configuration tools
   4. Network diagnostic tools
   5. Addressing tools
   6. Application files
   7. Configuration files
   8. Graphic files

9. Report files
10. Graphic symbol libraries
11. All documentation

1.12 WARRANTY

A. The control system shall be guaranteed for a period of two years after final approval by the Owner. The guarantee shall be provided for a completely installed system, including all components, parts, and assemblies of the control system. The guarantee shall cover parts, materials, and labor to locate and correct any defects in materials or workmanship.

B. The Contractor shall initiate the warranty period by formally transmitting to the Owner commencement notification of the period for the system and devices accepted. The warranty period begins when these devices are formally accepted by the Owner (refer to ACCEPTANCE PROCEDURE below).

C. Contact information shall be provided for quick service engineering assistance concerning hardware and software problems. There shall be provisions made for getting manufacturer certified diagnostic and repair personnel on the scene quickly should the need arise. There shall also be a software expert familiar with the software of this machine who can be easily contacted.

D. This system shall be inspected by the control system Contractor for a four-hour period once each quarter during the warranty period to run diagnostic tests and also provide maintenance instructions to the operating personnel.

E. The control system Contractor shall give the Owner 24 hours prior notification of each maintenance trip during the contract guarantee period. In addition, the Contractor shall furnish the Owner and Engineer a written record of each maintenance trip, number of employees present, time involved and work accomplished.

F. Owner shall be able to make changes to database, when prior database is stored on disk in case of error in change, without affecting or voiding warranty.

1.13 MAINTENANCE

A. The control system Contractor shall provide and maintain on site working spare parts for the control system during the warranty period including DDC Controllers, power supplies, modules, sensors, floor level (subnet) devices, transformers, etc. The owner will be custodian of these spare parts and shall be authorized to utilize them in performing first level maintenance. The control contractor shall refurbish/replace spare parts in exchange for failed items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
   1. Distech Controls, Inc.
   2. Delta Controls
   3. Schneider Electric USA (includes Tour Anderson, Invensys, Andover Controls)

2.2 OPEN, INTEROPERABLE SYSTEM ARCHITECTURE

A. General
   1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs) and a family of Standalone Digital Control Units (SDCUs). Administration and Programming Workstations (APWs) and Web-based Operator Workstations (WOWs) are provided by SI. Alarm notifications, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable will be provided by SI. All field level controllers must have the ability to be programmed by site personnel from a BAS contractor supplied and licensed programming tool or N4 embedded programming tool jar file.
   2. An Enterprise Level BAS provided by SI shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
   3. The Enterprise Level BAS shall support built-in reporting functionality without dependency on other software.
   4. The Enterprise Level BAS shall support standard accessing of data for third party reporting or analytics software.
   5. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
   6. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, and/or Modbus TCP protocol.

B. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported.

C. A sub-network of SDCUs using the BACnet IP, BACnet MS/TP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

D. The fieldbus layer shall support all of the following types of SDCUs:
   1. BACnet IP SDCU requirements: The system shall consist of one or more BACnet/IP field buses managed by the Network Server Controller.
   2. BACnet MS/TP SDCU requirements: (Only where shown on the control architecture drawings)

E. The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 38.4 kbps. The field bus layer consists of an RS485, token passing bus that supports Standalone Digital Control Units (SDCUs) for operation of HVAC. These devices shall conform to BACnet standard 135-2004. The NSCs shall be capable of at least two BACnet MS/TP field buses per NSC.

F. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.

G. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components. All added BAS supplied switches and routers must be approved by owner's Information Systems Department.

H. System Expansion
   1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
   2. Web-based operation shall be supported directly by the NSCs and require no additional software.
   3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.
   4. The system shall be able to operate normally and without restriction at multiple software version levels with the only requirement that each element of the hierarchy be at least as new a version as the newest version in the level below it. In other words, Enterprise Servers will be able to manage NSCs of different version provided that the Enterprise Server was the same or more recent version than the most recent NSC version.

I. All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP~~,~~ Modbus TCP, Modbus RTU (RS-485 and RS-232), and Modbus ASCII protocols.

2.3 OPERATOR WORKSTATION REQUIREMENTS:

A. General
   1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 3 concurrent client licenses at the enterprise level. Client licenses are licenses that can be used for variable designations of the users choosing; i.e. operator, engineering, or web capabilities.
   2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database. All field level controllers must have the ability to be programmed by site personnel from a BAS contractor supplied and licensed programming tool or N4 embedded programming tool jar file.
   3. At the NSC level, there shall be no cap on concurrent web-based workstations (webstations) other than what the CPU capacity can support.
   4. All configuration workstations shall be desktop personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
   5. A minimum of 1 physical Workstation shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are accomplished to the databases within the NSC. Systems with a central database will not be acceptable.

B. N4 Supervisor, Administration/Programming Workstation, and Webstation requirements
   1. The N4 Supervisor shall consist of the following:
      a. Processor
         1) Minimum: Intel Xeon CPU E5-2640 x64 (or better) compatible with dual and quad core processors
      b. Memory
         1) 64GB or higher recommended
      c. Operating systems:
         1) Microsoft Windows 10 64-bit
         2) Microsoft Windows 11 64-bit
         3) Microsoft Windows Server 2016
         4) Microsoft Windows Server 2019
      d. 10/100MBPS Ethernet NIC
      e. Storage
         1) Minimum: 1TB or higher
         2) Solid State Drive recommended
      f. Required additional software:
         1) Microsoft .Net 4.7.2 and later
      g. License agreement for all applicable software

2. The Workstation shall consist of the following:
   a. Processor
      1) Minimum: Intel Core i5 @ 2.0 GHz or equivalent
      2) Recommended: Intel Core i5 @ 3.0 GHz or better
   b. Memory
      1) Minimum: 8GB or higher
   c. Operating systems:
      1) Microsoft Windows 10 64-bit
      2) Microsoft Windows 11 64-bit
      3) Microsoft Windows Server 2016
      4) Microsoft Windows Server 2019
   d. 10/100MBPS Ethernet NIC
   e. Storage
      1) Minimum: 20GB
      2) Recommended: 1TB
      3) Solid State Drive recommended
   f. Required additional software:
      1) Microsoft .Net 4.7.2 and later
   g. License agreement for all applicable software
3. Web-Based Operator PC Requirements
   a. Any user on the network can access the system, using the following software:
   b. Minimum:
      1) Google Chrome 61 or higher
      2) Mozilla Firefox 60 or higher
      3) Microsoft Edge (EdgeHTML) 16 or higher
      4) Safari 11.1 or higher
   c. Recommended:
      1) Google Chrome 71 or higher
      2) Mozilla Firefox 64 or higher
      3) Microsoft Edge (EdgeHTML) 17 or higher
      4) Safari 11.4 or higher

C. General Administration and Programming Workstation Software
   1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
   2. The workstation functions shall include monitoring and programming of all DDC controllers. All field level controllers must have the ability to be programmed from the N4 workstation software.
   3. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.

4. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays stored at the NSC. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

D. User Interface:
1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.
2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/webstations localization.
3. The BMS workstation/webstations shall be capable of multiple language display, including English, Spanish, German, French, Japanese, Italian, Finnish, Portuguese, Swedish, Russian, and traditional and simplified Chinese. The multiple languages shall not require additional add on software from the standard workstation installer and shall be selectable within said workstation.
4. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
5. Personalized layouts and panels within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
6. Webstations shall give the user the same capabilities within the graphics pages as are given within the workstation but shall be mobile responsive for use on smaller devices.
7. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
8. Workstation shall indicate at all times the communication status between it and the server.
9. The BMS web interface shall enable presentation mode whereby any functionality for interactivity shall be disabled.
10. The BMS web interface shall automatically detect light mode and dark mode settings in the operating system and adapt accordingly.
11. The BMS web interface shall allow override of the operating systems light/dark mode settings so that the setting can be enabled independent of the operating system’s setting.
12. The BMS web interface shall automatically respond and adapt to different screen sizes and orientations from smart phone to smart televisions of any size.

13. The BMS web interface shall support slideshow functionality.
14. The BMS web interface shall support full screen mode displaying Alarm views / graphics / dashboards / Custom Reports.

E. User Access and Permissions
1. The BMS system shall allow for creation of one account per user.
2. The BMS shall support Groups where User Accounts associated with the group can inherit group permissions.
3. The BMS shall be able to specify each user account / group accessibility to each object in the system.
4. The BMS permission system shall be possible to integrate with Windows Active directory.
5. The BMS shall be able to report on the permission level across account / group for review / archiving / audit.
6. This username/password combination shall be linked to a set of capabilities within the software, set and editable only by user with system administrator privileges. The sets of capabilities shall include: edit or View only, Acknowledge alarms, Enable/disable Program and change values.
7. The system shall allow the above capabilities to be applied independently to each and every class of object in the system.
8. The BMS shall support integration with Windows Active Directory for user log on credentials.
9. The BMS shall support configurable reminder for “Days until password expires”.
10. The BMS shall support configurable password policy across:
    a. Minimum number of characters
    b. Minimum number of lowercase characters
    c. Minimum number of numeric characters
    d. Minimum number of special characters
    e. Number of consecutive unique passwords before reuse
    f. No more than three repeating identical characters
11. The BMS user account management shall support password policy with the following components:
    a. Mandatory change of password at first logon with default credentials
    b. Disabling of all imported user accounts by default
    c. Custom password complexity rules and its enforcement
    d. Custom password reuse and its enforcement
    e. Configurable black listing of passwords to limit the use of common known passwords (e.g. password)
    f. Password aging rules
12. The BMS shall be capable of enabling an anonymous access (guest account) to previously engineered views such as dashboards, graphics, etc. with configurable permissions and without username or password.
13. It shall be possible to configure the BMS system so that the guest account is used by default to simplify presentation of Kiosk Mode across multiple screens
14. The BMS shall provide time configurability to logout the user and to revert to a preconfigured presentation view, such as offered by the Guest account functionality.

15. The BMS shall provide configurability in managing access and permission levels based on location, IP addresses and address ranges, Schedule and Time of day and combination thereof.

F. System Security
1. The BMS system supplier shall be subjected to regular and verifiable best practice cyber security testing by the system supplier. Results of this testing shall be made available upon request prior to deployment of the system.
2. The BMS system supplier shall provide cyber security service incident escalation through help desk on a 7/24/365 basis.
3. The BMS shall support configuration for inactivity auto log-off of logged clients
4. The BMS system shall support Self-Signed Certificates, Default Certificates and/or Certification Authority (CA) certificates.
5. The BMS client communications (web access or rich client access) shall support TLS 1.2 encryption or higher
6. The BMS shall allow configuration in disabling all devices and software that support HTTP and require access via HTTPS.
7. The BMS must be able to Alarm or generate notification on failed access attempts
8. The BMS Servers shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks
9. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
10. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.
11. The BMS shall have the capability to use blacklisted and whitelisted IPs/MAC addresses to gate access
12. The BMS shall have the capability to differentiate, limit or enable, user access depending on Client's IP address/range (where) and time of day (when) the user is accessing the system.

G. Configuration Interface:
1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.

2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created form the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all “child” objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.

H. Color Graphic Displays
1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
   a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
   b. The system shall support HTML5 enabled graphics.
   c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
   d. The editor shall use Scalable Vector Graphics (SVG) technology.
   e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
   f. Support for high DPI icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
   g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
   h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
   i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.
   j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
   k. Graphics should rescale based on whatever monitor or viewing device is being used.
   l. Be able to create graphics on varying layers that can be moved and repeated.

m. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
n. The ability to create re-usable cascading menus.
o. The ability to have multiple instances of a graphic and edit one instance to change all.

3. Additionally, the Graphics Editor portion of the Engineering Software shall provide the following capabilities:
   a. Create and save pages.
   b. Group and ungroup symbols.
   c. Modify an existing symbol.
   d. Modify an existing graphic page.
   e. Rotate and mirror a symbol.
   f. Place a symbol on a page.
   g. Place analog dynamic data in decimal format on a page.
   h. Place binary dynamic data using state descriptors on a page.
   i. Create motion through the use of animated .gif files or JavaScript.
   j. Place test mode indication on a page.
   k. Place manual mode indication on a page.
   l. Place links using a fixed symbol or flyover on a page.
   m. Links to other graphics.
   n. Links to web sites.
   o. Links to notes.
   p. Links to time schedules.
   q. Links to any .exe file on the operator work station.
   r. Links to .doc files.
   s. Assign a background color.
   t. Assign a foreground color.
   u. Place alarm indicators on a page.
   v. Change symbol/text/value color as a function of an analog variable.
   w. Change a symbol/text/value color as a function of a binary state.
   x. Change symbol/text/value as a function of a binary state.

I. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.

J. Alarm Management
   1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
   2. Alarm management features shall include:
      a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels.

b. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
c. At the N4 Supervisor level the minimum number of active and viewable alarms shall be 10,000.
d. It shall be possible for the user to sort, filter and search on any available criteria such as priority, category, origin, alarm type, etc.
e. An active alarm viewer shall be included which can be customized for each user or user type to a hide or display any alarm attributes.
f. It shall be possible to present alarms with configurable colors based on priority, category, origin, alarm type, etc.
g. It shall be possible to linking files/documents/hyperlinks/navigation links/graphics link to an alarm for easy access upon occurrence
h. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
i. Alarm notifications must support multiple distribution methods within one notification
j. On alarm, it shall be possible to notify via email to a preconfigured list of recipients. through a Simple Mail Transfer Protocol (SMTP) or secure email using Simple Mail Transfer Protocol Secure (SMTPS). No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
k. On alarm, it shall be possible to notify via SNMP
l. On alarm, it shall be possible to notify via file (on disk) that would be consumable by other alarm management services
m. An operator shall have the capability to assign an alarm to another user of the system.
n. Individual alarms shall be able to be assigned to a user automatically via a preconfigured list of users and date/time. For example, a critical high temp alarm can be configured to be assigned to a Facilities Dept or to a Central Alarming workstation depending on time/date.
o. Playing an audible sound on alarm initiation or return to normal.
p. It shall be possible assigning a custom audio sound to each alarm / alarm-criteria (priority, category, origin, alarm type, etc.)
q. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
r. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to ‘normal’ and the quantity of disabled and hidden alarms.
s. The alarm viewer can be configured to auto hide alarms when triggered.
t. An operator shall have the capability to save and apply alarm favorites.
u. Alarms shall be configurable such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.

v. Alarms shall be configurable such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
w. It shall be possible to configure user-actions via user/group permissions when responding to an alarm
x. All operator actions responding to an alarm must be audit trailed.

K. Static Paginated Reporting / Custom Reporting
1. The BMS Software and Network Servers shall support built-in native reporting capability without dependency on any external software
2. It shall be possible to generate custom reports manually, via Schedule, Alarm triggered or custom conditions (e.g. program/schedule/etc.)
3. The Custom Reporting shall have no dependency on external database
4. The Custom Reporting shall have the capability of reporting on the full range of available data, most recent to historical data.
5. It shall be possible to generate reports containing current active alarms
6. The Building Management System software shall natively be capable of producing custom repots in txt, xlxs and pdf file formats.
7. The Custom Report capability at the BMS software shall support digital signing of pdf for traceability and authenticity.

L. Scheduling
1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment
1. Programming in the NSC shall be in graphical block format.

2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. The programmer's environment will include access to a superset of the same programming language supported in the SDCUs.
4. NSC devices will support a graphical function block programming language.
5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
6. It shall be possible to view graphical programming live and real-time from the Workstation.
7. Key terms should appear when typing (IntelliType).
8. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.
9. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

N. Saving/Reloading
1. The workstation software shall have an application to save and restore NSC and field controller memory files.
2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

O. Audit Trail
1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
3. The N4 Supervisor shall be able to store up to 5 million events.
4. The event view shall support viewing of up to 100,000 events.
5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
6. It shall be capable to search and view all forced values within the system.

P. Fault Tolerant N4 Supervisor Operation (Top level NSC)
1. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

Q. Web-based Operator Software
   1. General:
      a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
      b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
      c. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
   2. Graphic Displays
      a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
      b. Through the browser-based interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.
      c. System shall have out-of-the-box dashboards that enable customizable views of live data which can be public to all users or capable to make them specific to a user based on log in credentials.
      d. The user shall have the ability to create custom dashboards.
      e. The dashboards shall have a kiosk mode which allows for occupant level data display on monitors or tablets throughout the building.
   3. Alarm Management
      a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
      b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

R. Groups and Schedules
   1. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
   2. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.

S. User Accounts and Audit Trail
   1. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.

T. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.

2.4 NETWORK SERVER CONTROLLERS (NSC: ALSO KNOWN AS JACE-8000)

A. Network Server Controllers shall combine both network routing functions, control functions, and server functions into a single unit.

B. The BACnet NSC shall be classified as a "native" BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).

C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.

D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.

E. Whitelisting of file extensions for documents shall be capable.

F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2.

G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.

H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.

I. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.

J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.

K. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization by means of an Internet site including automatic synchronization
   6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
   7. Network Management functions for all LonWorks based devices

L. Hardware Specifications
   1. Memory:
      a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
   2. Each JACE-8000 shall provide the following on-board hardware for communication:
      a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.
         1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
         2) Support IPv4 addressing
         3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs
         4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices
         5) It shall be possible to disable Ethernet port 2
         6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port
         7) Where a switch is needed, use an approved model from owner's information technology dept.
      b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)
      c. One device USB port
      d. One host USB port
   3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in).

M. Modular Expandability:
   1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
   2. One shall be able to "hot-change" (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
   3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

N. Hardware Override Switches:
   1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

O. Universal Input Temperatures
   1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
      a. 10 kohm Type I
      b. 10 kohm Type II
      c. 10 kohm Type III
      d. 10 kohm Type IV
      e. Linearized 10 kohm Type V (FD w/11k shunt)
      f. Linearized 10 kohm
      g. 1.8 kohm
      h. 1 kohm
      i. 20 kohm
      j. 2.2 kohm
   2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.
      a. PT100
      b. PT1000
      c. Ni1000

P. Local Status Indicator Lamps:
   1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

Q. Real Time Clock (RTC):
   1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
   2. The RTC date and time shall also be accurate, up to 10 days, when the NSC is powerless.
   3. No batteries may be used to for the backup of the RTC.

R. Power Supply:
   1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
   2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

S. Automatic Restart After Power Failure:
   1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.

T. Data Retention:
   1. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

U. Software Specifications
   1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
   2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

V. User Programming Language:
   1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
   2. Network Server Controllers that use a “canned” program method will not be accepted.

W. Control Software:
   1. The NSC shall have the ability to perform the following pre-tested control algorithms:
      a. Proportional, Integral plus Derivative Control (PID)

b. Two Position Control
c. Digital Filter
d. Ratio Calculator
e. Equipment Cycling Protection

X. Mathematical Functions:
1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

Y. NSCs shall have the ability to perform any or all of the following energy management routines:
1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Enthalpy Switchover (Economizer)
9. Peak Demand Limiting
10. Temperature Compensated Duty Cycling
11. CFM Tracking
12. Heating/Cooling Interlock
13. Hot Water Reset

Z. History Logging:
1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.

5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.
9. The BMS software and Network Servers shall support recording of all historical data, independent of any limitation in its local memory, which will be readily available for reporting and analysis without additional configurations or actions.
10. All historical data shall be available for use by the operator to access in BMS or a third-party reporting systems.

AA. Alarm Management:
1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

BB. Embedded Web Server
1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

CC. The NSC controller shall comply with the following regulatory certifications
1. CE – EN 61000-6-3
2. CE – EN 61000-6-2
3. CE – EN 61010-1
4. CE – EN 61326-1
5. FCC CFR 47 Part 15 Class A
6. RCM
7. RoHS 2011/65/EU
8. China RoHS SJ/T 11364-2014
9. UL916 Energy Management equipment

DD. HMI
1. The NSC shall have an option for a tablet display
2. The tablet display shall be an industrial grade Human Machine Interface (HMI) that can be locked to the building management application to create a dedicated tool for local operation and maintenance.
3. The tablet display shall provide an easy-to-use interface through which users and engineers can locally access NSC's
4. The tablet display shall always start in a kiosk mode ensuring the end user can only use the device using the installed integration with the NSC.
5. The tablet display shall always require a password on start up
6. The tablet display shall require a password after a defined period of inactivity
7. The tablet display shall support being handheld or being installed on a control cabinet.
8. The tablet display user interface shall provide touchscreen navigation making it easy to operate and maintain the system.
9. The tablet display shall support robust physical panel mounting mechanisms provided with the product.
10. The tablet display shall have a screen size of 255mm or 10.1 inches
11. The tablet display shall support a screen resolution of 1280 by 800 pixels
12. The tablet display shall have a 16:10 aspect ratio
13. The tablet display shall be based on the Android platform
14. The tablet display shall have an IP54 rated frame that helps protect against dust and moisture.
15. The tablet display shall be powered by a 24 VDC power supply
16. The tablet display can be powered by a 24 VDC through the Y-shaped cable
17. The tablet display shall be able to communicate with the NSC over a wired (USB) connection running BACnet IP over USB.
18. The tablet display shall have an accessory Wi-Fi Module is an option instead of using USB for communication.
    a. Through the Wi-Fi module, you can establish wireless communication between the tablet display and the NCS connected to a wireless access point.
    b. The Wi-Fi module shall have an adhesive mount Wi-Fi antenna.
    c. The Wi-Fi module shall be compliant with IEEE 802.11 b/g/n
    d. The Wi-Fi module shall support enhanced wireless security using 64-bit and 128-bit WEP encryption
19. The tablet display shall connect to the NSC using only secure, HTTPS connections via the WebStation functionality of the NSC

20. The tablet display shall connect using a specific user and password combination defined as part of the NSC configuration

2.5 BACNET IP FIELDBUS CONTROLLERS

A. Controllers – BACnet/IP Protocol
   1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)
   2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
      a. All controllers shall be able to communicate peer-to-peer without the need for a NSC
      b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:
   1. Supporting IPv4 addressing
   2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
   3. It shall be possible to disable Ethernet port 2

C. Topologies
   1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
   2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
      a. In case of any disruption there shall be no communication interruption
      b. In case of any disruption there shall be system alarms that will inform the operator of the disruption

D. Performance
   1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
   2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability
   1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
   2. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs

3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
7. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output)
8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
    a. Control processes
    b. Energy management applications
    c. Alarm management
    d. Historical/trend data
    e. Maintenance support applications
    f. Custom processes
    g. Manal override monitoring
9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
    a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
        1) Universal Inputs – the following thermistors for use in the system without any external converters needed.
            a) 10 kohm Type I
            b) 10 kohm Type II
            c) 10 kohm Type III
            d) 10 kohm Type IV
            e) Linearized 10 kohm Type V (FD w/11k shunt)
            f) Linearized 10 kohm
            g) 1.8 kohm
            h) 1 kohm
            i) 20 kohm
            j) 2.2 kohm
            k) PT100
            l) PT1000
            m) Ni1000

2) Analog inputs
   a) Current Input - 0-20 mA
   b) Voltage Input 0-10 Vdc
3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
4) Digital outputs
5) Analog outputs of 4-20 mA and/or 0-10 Vdc

13. Real Time Clock (RTC):
    a. Provide internal clocks for all BACnet Controllers (B-AAC) using BACnet time synchronization services.
       1) Automatically synchronize system clocks daily from an operator-designated controller.
       2) The system shall automatically adjust for daylight saving time.
    b. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month.
    c. The RTC shall provide the following: time of day, day, month, year, and day of week.
    d. The RTC date and time shall also be accurate up to 7 days, from when the BACnet/IP Fieldbus controller has lost power with no reliance on.
14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications
    a. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in ‘flow thru’ differential pressure transducer
    b. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of ±5% at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within ±5% of setpoint at the specified minimum and maximum air flow parameters
    c. The BACnet/IP FieldBus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
    d. The BACnet/IP Fieldbus controller for VAV applications shall require no programing for air balancing algorithm
    e. All balancing parameters shall be synchronized in NSC
15. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection
16. Power Requirements. 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power
17. The BACnet/IP Fieldbus controller shall comply with the following regulatory certifications
    a. CE - EMCD 2014/30/EU
    b. CE LVD 2014/35/EU
    c. FCC CFR 47 Part 15 Class B
    d. RCM
    e. RoHS 2011/65/EU
    f. China RoHS SJ/T 11364-2014
    g. UL2043 (Plenum space mounting)
    h. UL916 Open-Energy Management equipment
    i. UL916 Energy Management equipment

18. Intelligent Space Sensor Interface –
    a. The BACnet/IP Fieldbus controllers shall support a dedicated RJ45 communication port to communicate and power up to 4 intelligent wall mount sensors without the use of on-board inputs or outputs
    b. It shall be possible to disable the RJ45 communication port.
19. The BACnet/IP Fieldbus controller for Connected Room solutions
    a. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v14 or later) as specified BACnet Advanced Application Controller (B-AAC)
    b. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
        1) All controllers shall be able to communicate peer-to-peer without the need for an NSC
        2) Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.
    c. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:
        1) Supporting IPv4 addressing
        2) Supporting Static IP setting, DHCP client and Auto-IP address acquisition
        3) It shall be possible to disable Ethernet port 2
        4) Each BACnet/IP controller shall be configurable to restrict communications to only whitelisted IP addresses.
    d. Topologies
        1) BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
        2) BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
            a) In case of any disruption there shall be no communication interruption
            b) In case of any disruption there shall be system alarms that will inform the operator of the disruption
    e. Performance
        1) Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2012 and the BACnet Device Profile supported.
        2) They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.
        3) Each BACnet/IP Fieldbus Controllers shall support upgrade of its firmware with no impact to its operation

f. Programmability
   1) The BACnet/IP Fieldbus controllers shall support graphical programming that will be consistent with the NSC.
   2) The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
   3) All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
   4) The BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
   5) The BACnet/IP Fieldbus controllers shall support two RS485 communication ports for connecting and supplying power to a range of protocol types
      a) BACnet/IP Fieldbus controllers shall support configurable selection of the supported protocol on the RS485 communications ports,
      b) BACnet/IP Fieldbus controllers shall support a communications capability for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
      c) BACnet/IP Fieldbus controllers shall support a communications capability for connecting and supplying power to a matching connected module for the purpose of control of lights and blinds that do not utilize any of the I/O points of the controller
      d) BACnet/IP Fieldbus controllers shall support a communications capability for connecting to open market Modbus devices

g. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
   1) Control processes
   2) Energy management applications
   3) Alarm management
   4) Historical/trend data
   5) Maintenance support applications
   6) Custom processes

h. In the case of communication disruption between the BACnet/IP Fieldbus controller and NSC/BMS, each BACnet/IP Fieldbus controller shall support storage of local trend data up to 2x the number of its built-in I/O at the collection rate of 5 min for 5 days.

i. The BACnet/IP Fieldbus controller analog or universal input shall use a 16-bit A/D converter.

j. The BACnet/IP Fieldbus controller analog or universal output shall use a 10-bit D/A converter.

k. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
   1) Up to 8 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
      a) Universal Inputs – the following thermistors for use in the system without any external converters needed.
      b) 10K Ohm Type I
      c) 10K Ohm Type II
      d) 10K Ohm Type III
      e) 10K Ohm Type IV
      f) Linearized 10K Ohm Type V (FD w/11k shunt)
      g) Linearized 10K Ohm
      h) 1.8K Ohm
      i) 1K Ohm
      j) 20K Ohm
      k) 2.2K Ohm
      l) PT100
      m) PT1000
      n) Ni1000 ,
      o) Voltage Input - 0-10 Vdc
      p) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
      q) Digital outputs
      r) Analog outputs 0-10 Vdc
l. Internal Clock
   1) Provide internal clocks for all BACnet Controllers (B-AAC) using BACnet time synchronization services.
      a) Automatically synchronize system clocks daily from an operator-designated controller.
      b) The system shall automatically adjust for daylight saving time.
   2) Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month.
   3) The RTC shall provide the following: time of day, day, month, year, and day of week.
   4) The RTC date and time shall also be accurate up to 7 days, from when the BACnet/IP Fieldbus controller has lost power with no reliance on batteries
m. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection
n. Power Requirements. 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power
o. Power Requirements. A line voltage version shall be available 230 VAC
p. In the case of power disruption, each BACnet/IP Fieldbus controller shall support power failure recovery within 10 seconds and resume operation from where the disruption had occurred
q. The BACnet/IP Fieldbus controller shall be able to be plenum mounted (UL2043 compliant)

r. The BACnet/IP Fieldbus controller shall meet the open class standard of UL916 permitting its installation without secondary enclosure where appropriate
s. The BACnet/IP Fieldbus controller shall comply with the following regulatory certifications
    1) CE - EMCD 2014/30/EU
    2) CE LVD 2014/35/EU
    3) FCC CFR 47 Part 15 Class B
    4) RCM
    5) RoHS 2011/65/EU
    6) China RoHS SJ/T 11364-2014
    7) UL2043 (Plenum space mounting)
    8) UL916 Open-Energy Management equipment
    9) UL916 Energy Management equipment
t. Intelligent Space Sensor Interface - The BACnet/IP Fieldbus controllers shall support an RJ45 communication port to communicate and power up to 4 intelligent wall mount sensors without the use of on-board inputs or outputs
    1) It shall be possible to disable the RJ45 communication port

20. The BACnet/IP Fieldbus controller for remote IO
    a. It shall be possible to extend Inputs / Outputs required in NSC or BACnet/IP Fieldbus Controllers over the IP network
    b. The BACnet/IP IO expansion device shall be equipped with 2x 10/100bT Ethernet communication ports with active switch supporting the following configurations:
        1) Supporting IPv4 addressing
        2) Supporting Static IP setting, DHCP client and Auto-IP address acquisition
        3) It shall be possible to disable Ethernet port 2
    c. The BACnet/IP IO expansion device shall support daisy and RSTP topologies
    d. The BACnet/IP I/O expansion device shall be capable of sharing its local I/O resources with one or multiple applications distributed across one or multiple NSCs or BACnet/IP Fieldbus Controllers.
    e. The BACnet/IP I/O expansion device shall support BACnet Alarm and Trend locally
    f. Outputs of the BACnet/IP I/O expansion device shall support user configurable fallback value that is triggered in case of communication disruption.

F. The Intelligent Space Sensor shall be capable of displaying measured space temperature from 0 to 50 °C (32 to 122 °F) with accuracy of ±0.2 °C (±0.4 °F) selectable for 0.1 or 1 degree display resolution of °F or °C
    1. Sensing Element: 10k Type 3 Thermistor
    2. Accuracy of ±0.2 °C (±0.4 °F)
    3. Resolution: 0.1 or 1 degree display resolution
    4. Range: 0 to 50 °C (32 to 122 °F)

G. The Intelligent Space Sensor shall have the option for humidity sensor support sensing humidity from 0 % RH to 100 % RH Digital humidity indication (selectable for 0.1 or 1% RH with selectable display resolution of 0.1 or 1 % RH
   1. Accuracy: ±2 % RH
   2. Resolution: 0.1 or 1 % RH
   3. Range: 0 % RH to 100 % RH

H. The Intelligent Space Sensor shall have the option for support of CO2 sensor with display resolution with 0 to 2000 ppm resolution
   1. Accuracy: ±30 ppm ±2% of measured value
   2. Range: 0 to 2,000 ppm
   3. Operating elevation: 0 to 16,000 ft.
   4. Temperature dependence: 0.11% FS per ˚F
   5. Stability: <2% of FS over life of sensor (15 years)
   6. Sensing method: Non-dispersive infrared (NDIR), diffusion sampling

I. The Intelligent Space Sensor shall have the option for motion sensor

J. Display options: The Intelligent Space Sensor shall be capable of displaying the following elements:
   1. Space temperature
   2. Cooling space temperature set point
   3. Heating space temperature set point
   4. Current heating or cooling mode
   5. Current occupancy mode
   6. Fan speed
   7. Current time

2.6 BACNET FIELDBUS AND BACNET SDCUS

A. Networking
   1. IP Network: All devices that connect to the WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
   2. IP To Field Bus Routing Devices
      a. A Network Server Controller shall be used to provide this functionality.
      b. These devices shall be configurable locally with IP crossover cable and configurable via the IP network.
      c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the IP level of the architecture are forwarded.

B. Field Bus Wiring and Termination
   1. The wiring of components shall use a bus or daisy chain concept with no tees, stubs, or free topology.
   2. Each field bus shall have a termination resistor at both ends of each segment.
   3. The field bus shall support the use of wireless communications.

C. Repeaters
   1. Repeaters are required to connect two segments.

2. Repeaters shall be installed in an enclosure. The enclosure may be in an interstitial space.

D. Field Bus Devices
1. General Requirements
a. Devices shall have a light indicating that they are powered.
b. Devices shall be locally powered. Link powered devices (power is furnished from a central source over the field bus cable) are not acceptable.
c. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.)

E. Advance Application Controllers (B-AAC)
1. The key characteristics of a B-AAC are:
a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model.
b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by additional circuit boards that physically connect to the basic controller.
c. The application to be executed by a B-AAC is created by an application engineer using the vendor's application programming tool.
d. If local time schedules are embedded, the B-AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
e. If local trend logging is embedded, the B-AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
f. If local alarm message initiation is embedded, the B-AAC shall:
1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient off the alarm message.
2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,
g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data.
h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
i. Shall support the receipt and response to Time Synchronization commands from a BACnet Building Controller.
j. Shall support the "Who is" and "I am." BACnet services.
k. Shall support the "Who has" and "I have." BACnet services.

2. Analog Input Circuits
   a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment.
   b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS).
   c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two-point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument).
   d. For non-linear sensors such as thermistors and flow sensors the B-AAC shall provide software support for the linearization of the input signal.
3. Binary Input Circuits
   a. Dry contact sensors shall wire to the controller with two wires.
   b. An external power supply in the sensor circuit shall not be required.
4. Pulse Input Circuits
   a. Pulse input sensors shall wire to the controller with two wires.
   b. An external power supply in the sensor circuit shall not be required.
   c. The pulse input circuit shall be able to process up to 20 pulses per second.
5. True Analog Output Circuits
   a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC).
   b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment.
6. Binary Output Circuits
   a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps.
   b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC.
7. Program Execution
   a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control.
   b. The sample rate for a process control loop shall be adjustable and shall support a minimum sample rate of 1 second.
   c. The sample rate for process variables shall be adjustable and shall support a minimum sample rate of 1 second.
   d. The sample rate for algorithm updates shall be adjustable and shall support a minimum sample rate of 1 second.
   e. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle.

8. Local Interface
   a. The controller shall support the connection of a portable interface device such as a laptop computer or vendor unique hand-held device. The ability to execute any tasks other than viewing data shall be password protected. Via this local interface, an operator shall be able to:
      1) Adjust application parameters.
      2) Execute manual control of input and output points.
      3) View dynamic data.

F. Application Specific Devices
   1. Application specific devices shall have fixed function configurable applications.
   2. If the application can be altered by the vendor's application programmable tool, the device is an advanced application controller and not an application specific device.
   3. Application specific devices shall be BTL certified.

G. Room controllers
   1. For connected room solutions that do not require integrated lighting and blind busses built into a singular unit, the system shall include a BACnet MS-TP enabled controller specifically designed for room control.
   2. The controller shall communicate via BACnet MS-TP. It should also be capable of MODBUS RTU communication.
   3. The controller shall be capable of controlling fan coil units, cooling VVT zones with reheat, fin-tube radiators, cabinet heaters, radiant panel heaters, electric re-heat zones, terminal reheats, rooftop units (1H1C, 2H2C, 3H2C, MH2C), or heat pumps, if necessary.
   4. The controller shall house an onboard temperature sensor, and options for onboard humidity and occupancy sensor.
   5. The controller shall utilize a touch screen interface and have multiple options for casings and fascias. The screen shall be a TFT transmissive LED backlit LCD touchscreen with at least 5 color options.
   6. Controller will have password protection to prevent unauthorized access to the configuration menu parameters.
   7. The controller will have integrated Zigbee wireless communications with predefined profiles for Zigbee door and window switches, occupancy sensors, water leakage detectors, CO2 sensors, and additional temperature and humidity sensors.
   8. The controller will be capable of hosting at least 10 Zigbee sub devices.
   9. The controller will be capable of being programmed with customizable scripts via the open programming language Lua. It shall be equipped with at least 256KB of SRAM with 80KB configurable/reserved for Lua scripting purposes

2.7 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors
   1. Basis of design Manufacturers: Veris Industries or BAS manufacturer equivalent
   2. All temperature devices shall use thermistors or RTDs accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.

3. Room Sensor: Standard space sensors shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series
   a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
   b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
4. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. Basis of Design: Veris TD Series
5. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. Basis of Design: Veris TA Series
6. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications. Basis of Design: Veris TI Series
7. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, Basis of Design: Veris TO Series
8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Wall Transmitter
   1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
   2. Transmitters shall be accurate to +/- 3% at full scale.
   3. Transmitter shall have replaceable sensing element.
   4. Sensor type shall be thin-film capacitive.
   5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
   6. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F
   7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
   8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
   9. Transmitter shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box.
   10. Transmitter shall have option of having an LCD display
   11. Transmitter shall have option of being NIST certified
   12. Transmitter shall have option of an integrated temperature sensor
   13. Basis of Design: Veris HWL Series

C. Humidity Duct Transmitter
   1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
   2. Transmitters shall be accurate to +/- 3 % at full scale.
   3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
   4. Transmitter shall have replaceable sensing element.
   5. Sensor type shall be thin-film capacitive.
   6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
   7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
   8. Output shall be 4-20 mA or 0-5/0-10 VDC.
   9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
   10. Transmitter shall have option of being NIST certified
   11. Transmitter shall have option of an integrated temperature sensor
   12. Basis of Design: Veris HD Series

D. Humidity Outdoor Transmitter
   1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
   2. Transmitters shall be accurate to +/- 3% at full scale.
   3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
   4. Transmitter shall have replaceable sensing element.
   5. Sensor type shall be thin-film capacitive.
   6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
   7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
   8. Output shall be 4-20 mA or 0-5/0-10 VDC.
   9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
   10. Transmitter shall have option of being NIST certified
   11. Transmitter shall have option of an integrated temperature sensor
   12. Basis of Design: Veris HO Series

E. Carbon Dioxide Wall Transmitter:
   1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
   2. Sensor type shall be Non-dispersive infrared (NDIR).
   3. Accuracy shall be ±30 ppm ±2% of measured value with annual drift of ±10 ppm. Minimum five year recommended calibration interval.
   4. Repeatability shall be ±20 ppm ±1% of measured value
   5. Response Time shall be <60 seconds for 90% step change
   6. Outputs shall be field selectable Protocol: BACnet with SPDT Relay 1A@30VDC
   7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
   8. Temperature Range: 32° to 122°F (CO_2 only), or 50° to 95°F (with humidity option)
   9. Output range shall be programmable 0-2000 or 0-5000 ppm
   10. Transmitter shall be available in an off white enclosure for mounting on a standard electrical box.

11. Transmitter shall have an option of an LCD display for commissioning and provide additional faceplate to conceal LCD display where occupants may misinterpret CO2 readings.
12. Transmitter shall have option of an integrated temperature sensor and/or humidity sensor
13. Basis of Design: Veris CWL

F. Carbon Dioxide Duct Transmitter:
1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be ±30 ppm ±2% of measured value with annual drift of ±10 ppm. Minimum five year recommended calibration interval.
4. Repeatability shall be ±20 ppm ±1% of measured value
5. Response Time shall be <60 seconds for 90% step change
6. Outputs shall be field selectable Analog: 4-20mA or 0-5/0-10VDC with SPDT Relay 1A@30VDC
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: 32° to 122°F
9. Output range shall be programmable 0-2000 or 0-5000 ppm
10. Enclosure shall not require remote pickup tubes and make use of integrated H-beam probe to channel air flow to sensor.
11. Enclosure lid shall require no screws and make use of snap on features for attachment
12. Enclosure shall be made of high impact ABS plastic
13. Transmitter shall have option of an LCD display
14. Transmitter shall have option of an integrated temperature sensor and/or humidity sensor
15. Basis of Design: Veris CDL

G. Air Pressure Transmitters.
1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
2. Sensor shall be microprocessor profiled ceramic capacitive sensing element
3. Transmitter shall have 14 selectable ranges from 0.1 – 10” WC
4. Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
5. Transmitter shall be field configurable to mount on wall or duct with static probe
6. Transmitter shall be field selectable for Unidirectional or Bidirectional
7. Maximum operating pressure shall be 200% of design pressure.
8. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power
10. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
11. Transmitter shall have an LCD display
12. Units shall be field selectable for WC or PA
13. Transmitter shall have provision for zeroing by pushbutton or digital input.
14. Transmitter shall be available with a certification of NIST calibration
15. Basis of Design: Veris model PXU.

H. Liquid Differential Pressure Transmitters:
1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent

2. Transmitter shall be microprocessor based
3. Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure
4. Transmitter shall have 4 switch selectable ranges
5. Transmitter shall have test mode to produce full-scale output automatically.
6. Transmitter shall have provision for zeroing by pushbutton or digital input.
7. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
8. Transmitter shall have field selectable electronic surge damping
9. Transmitter shall have an electronic port swap feature
10. Transmitter shall accept 12-30 VDC or 24 VAC supply power
11. Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
12. Performance:
    a. Accuracy shall be ±1% F.S. and ±2% F.S. for lowest selectable range
    b. Long term stability shall be ±0.25%
    c. Sensor temperature operating range shall be -4° to 185°F
    d. Operating environment shall be 14° to 131°F; 10-90% RH noncondensing
    e. Proof pressure shall be 2x max. F.S. range
    f. Burst pressure shall be 5x max. F.S. range
13. Transmitter shall be encased in a NEMA 4 enclosure
14. Enclosure shall be white powder-coated aluminum
15. Transmitter shall be available with a certification of NIST calibration
16. Transmitter shall be preinstalled on a bypass valve manifold
17. Basis of Design: Veris PW

I. Current Sensors
1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system. Basis of Design manufacturer is Veris Industries or BAS manufacturer equivalent

J. Current Status Switches for Constant Load Devices
1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
3. Visual LED indicator for status.
4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
5. Normally open current sensor output. 0.1A at 30 VAC/DC.
6. Basis of Design: Veris Model H608.

K. Current Status Switches for Constant Load Devices (Auto Calibration)
1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer

3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
5. Nominal Trip Point: ±40%, ±60%, or on/off (user selectable)
6. Normally open current sensor output. 0.1A at 30 VAC/DC.
7. Basis of Design: Veris Model H11D.

L. Current Status Switches for Variable Frequency Drive Application
1. Basis of Design Manufacturer: Veris Industries or BAS manufacturer equivalent
2. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
3. Visual LED indicator for status.
4. Alarm Limits: ±20% of learned current in every 5 Hz freq. band
5. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
6. Normally open current sensor output. 0.1A at 30 VAC/DC.
7. Basis of Design: Veris Model H614.

2.8 STATUS SENSORS AND DEVICES - ELECTRIC

A. Status Input for Fan: Differential pressure switch with pilot-duty rated contacts and adjustable range of 0- to 5-inch wg.
1. Manufacturers:
a. Cleveland Controls.

B. Status Input for Pump: Liquid differential pressure switch with pilot-duty rated contacts and adjustable pressure range of 20- to 60-psigand differential pressure range of 5- to 30-psig, SPDT contacts pilot-duty rated or for application, ¼” female NPT pipe connections.
1. Manufacturers:
a. United Electric Controls.

C. Sensing Inputs for Electric Motors:
1. Manufacturers:
a. American Aerospace Controls.
2. Current Transformer/Transmitter: Comply with ISA 50.00.01, current-sensing, fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current and 1 percent full-scale accuracy, for AC or DC applications.
3. Voltage Transformer/Transmitter (100- to 600-V AC): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy, for AC or DC applications.
4. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor, for AC and DC applications.

D. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
   1. Manufacturer's
      a. DDC equipment manufacturer's recommended product

E. Water Flow Switch: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
   1. Manufacturers:
      a. Xylem.
      b. I.T.M. Instruments.

F. Liquid Leak Detectors
   1. Liquid detectors shall utilize microchip technology for detection of conductive liquids through one of the following types of sensors: gold-plated probes, self-adhesive sensor tape with copper electrodes and durable cotton cover, or rope type sensor. Detectors shall be selected based on the best use for the application. Power requirement shall be 11-27 VAC or VDC and have a green LED normal operation indicator. Unit shall have a SPDT pilot duty low voltage alarm contact. Unit shall be waterproof and rustproof. A red LED shall indicate the presence of liquid. Unit shall have an adjustable setpoint.
   2. Approved Manufacturers:
      a. R. E. Technologies.
      b. Dorlen Products. (Water Alert)

G. Control Relay: Monitors or controls AC or DC motors or other equipment (as required), with cover, with visual indicator when energized, and two SPDT contacts rated 120/250 VAC at 8 Amps.
   1. Manufacturers:
      a. Dayton.
      b. Omron.
      c. Functional Devices.

H. Damper End Switch (limit switch): Fully encapsulated, mercury-type, damper end switch with two contacts per switch; one for interlock wiring and one for DDC input.
   1. Manufacturers:
      a. KELE Controls part number TS-470-2.

I. Emergency Power-Off (EPO) Push-button: ADA compliant, push-button switch with clear cover to prevent inadvertent closure. Push-to-activate push-button, key-to-reset feature, and providing two SPDT contacts rated 120/250 VAC at 10 Amps.
   1. Manufacturers:
      a. Safety Technology International – model SS-2212PO.

J. Boiler EPO Contactor: Electrically operated, electrically held; provide contactor in NEMA-12 rated enclosure. Six (6) normally closed contacts rated 120/250 VAC at 20 Amps.
   1. Manufacturers:
      a. Allen-Bradley.

b. Cutler-Hammer.
c. Square-D.

2.9 OCCUPANCY, DAYLIGHTING, AND PHOTO-ELECTRIC SENSORS

A. Refer to Division 26 Section "Lighting Control Devices" for equipment that relates to this Section.

2.10 FLOW METERS

A. Liquid Flow Meters: (Electro-Magnetic Type)
1. Manufacturers (Water or Glycol/Water):
   a. ABB.
   b. Siemens.
   c. EMCO.
   d. Rosemount.
   e. Krohne.
2. The meter system shall consist of a primary flow sensor and transmitter. The flow sensor shall be equipped with 150-lb. flanges. The meter system shall be installed with all necessary grounding components and gaskets per manufacturer's instructions. The meter shall be capable of bi-directional operation. The meter shall be sized appropriately for the range of flow for the system. The electrodes shall be stainless steel or Hasteloy C. The transmitter shall be provided with a remote mounting bracket, cable, integral LCD display, NEMA 4X housing, and shall indicate flow rate, totalize flow, and shall have an isolated 2-wire 4-20 mA linear output signal and a pulsed output signal for totalization. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or integral keypad menu switching. Unit electronics shall have noise immunity. The primary flow sensor and transmitter shall be mounted in accessible locations. Unit shall have the capability to maintain flow total in non-volatile memory. The flow meter shall be provided with a 1-year warranty and application non-degraded performance guarantee. The flow meter and transmitter as a unit shall have the following minimum characteristics:
   a. Flow meter Liner:
   b. Heating hot water, domestic hot water, and other water systems operating at or above 110-degrees F: Teflon
   c. Accuracy:
   d. At 1- to 33-feet per second velocity: plus or minus 0.5-% of rate.
   e. At 0.3-feet per second velocity: ±2% of rate.
   f. Each unit shall be factory calibrated for the specified flow and shall be calibrated in both directions if the application is bi-directional. Calibration shall be a minimum of three point. Specific performance test data shall be furnished with the meter.
   g. Each meter shall provide two analog 4- to 20-mA signals or a single 4-to 20-mA signal and a digital contact closure on reverse flow.
3. Provide a phenolic tag for each transmitter to identify service and meter ID number (i.e. HOT WATER HEATING FLOW, FM-1, etc.).

2.11 DDC BTU METERING

A. DDC BTU metering shall be accomplished using the following equipment at each metering point:
   1. One (1) liquid flow meter unit with current-loop transmitter as specified elsewhere in this section.
      a. Flow meter range shall be 125% of the maximum expected flow capacity.
   2. Two (2) high-precision matched temperature sensor assemblies with current-loop transmitters. Sensors with stainless steel wells shall be installed in each respective supply and return pipe as shown on project drawings for ferrous piping (use copper or brass wells for copper piping).
      a. Manufacturers: MINCO and TCS
      b. Temperature sensors shall be a matched pair selected for this application.
      c. Temperature sensor accuracy shall be plus or minus 0.1-degrees F at calibration temperature. Calibration temperature for heating hot water is 140.0-degrees F
   3. These devices shall be wired to a local DDC panel. Calculations for instantaneous and totalized load shall be incorporated into the panel control code, and the necessary virtual points shall be created to allow remote monitoring and trending via the DDC system.

B. DDC shall perform BTU computations using linear, square law, or multi-point linearization data interpretation, as needed, based on the flow meter used. Inputs shall include:
   1. 4- to 20-ma signal from hydronic flow meter
   2. 4- to 20-ma signal from two, high-accuracy, immersion temperature sensors

C. Input devices shall be rated for the environment in which they are installed. DDC shall perform rate of flow calculations as well as monitor the flow and totalize it weekly, monthly, and yearly. These values shall be available at the BAS in graphical format for operator monitoring. Flow rate alarms shall be programmed for low flow and high flow conditions.

D. Provide an equipment tag for each transmitter device to identify service and ID number

2.12 THERMOSTATS

A. Manufacturers:
   1. Distech Controls
   2. Delta Controls
   3. Schneider Electric
   4. Erie Controls.
   5. Danfoss Inc.
   6. Heat-Timer Corporation.
   7. Sauter Controls Corporation.
   8. Tekmar Control Systems.
   9. Theben AG - Lumilite Control Technology.

B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55- to 85-degrees F setpoint range, and 2-degrees F maximum differential.

C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed setpoint adjustment, 55- to 85-degrees F setpoint range, and 2-degrees F maximum differential.
   1. Selector Switch: Integral, manual, On-Off-Auto.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
   1. Bulbs in water lines with separate wells of same material as bulb.
   2. Bulbs in air ducts with flanges and shields.
   3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
   4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
   5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
   6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

E. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable setpoint.

F. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable setpoint in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

G. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12-inches of bulb length is equal to or above setpoint.
   1. Bulb Length: Minimum 20-feet.
   2. Quantity: One thermostat for every 20-sq. ft. of coil surface.

H. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25-psig, and cast housing with position indicator and adjusting knob.

2.13 HUMIDISTATS

A. Manufacturers:
   1. MAMAC Systems.
   2. Rotronic Instrument Corp.

B. Electric:
   1. Room or Duct-Mounted Humidistats: Electric insertion, 2-position type, with adjustable 2 percent RH throttling range, 20 to 90 percent RH operating range, and single- or double-pole contacts. Calibrated for +/- 5% RH accuracy.

2.14 CONTROL VALVES

A. Manufacturers
   1. Belimo

B. Ball Valves
   1. ½" to ¾" Ball Valve
      a. Forged brass body rated at no less than 600 psi, chrome plated brass ball with blowout proof stem or optional stainless steel ball with blowout proof stem,
      b. Valves are to be in two-way and three-way configurations.
      c. Connection: Female NPT end fittings, Teflon® PTFE seat, characterizing disc glass filled PEEK providing equal percentage flow curve on two-way valve.
      d. Operating Temperature 20…250°F chilled or hot water with up to 60% glycol solution.
      e. Two-way and Bypass port should be ANSI Class IV (0.01% of Cv) seat leakage.
      f. Rangeability must be at least 300:1.
      g. Tool-less actuator connection.
      h. System Static Pressure Limit should be 600 psig (4137 Pa)
      i. Basis of Design: Schneider Electric VBB/VBS Ball Valves, or BAS manufacturer equivalent
      j. ½" to 3" 2-way and ½" to 2" 3-way Ball Valves
         1) Valves must be for control of hot or chilled water, or solutions of up to 50% glycol.
         2) Ball valves must have close-offs of 40…130 psi depending on size.
         3) Valves will provide CVs from 0.33…266 depending on size.
         4) Valve characterizing insert, is to be made of glass-filled Noryl™ and provide equal percentage flow.
         5) Valve body is to be made of forged brass ASTM B283-06 and rated for static pressure of 360 psi at fluid temperatures of 20…250°F (-7…121°C).
         6) All valves are to have balls made of nickel/chromium plated brass with two-way valves having stainless steel balls as an option. All valve stems are to be stainless steel with reinforce Teflon® EPDM O-ring seals.
         7) 2-way valves are to be ANSI Class IV (0.01% of Cv) shutoff. 3-way valves are to be ANSI Class IV (0.01% of Cv piped coil-side outlet to the port A only.
         8) Fluid (water) temperature are a minimum 20°F (-7°C) and a maximum of 250°F (121°C).
   2. Globe Valves (Bronze ½" to 2")

3. Control Valves: Factory fabricated, with body material, and pressure class based on maximum pressure and temperature rating of piping system with a body rating of not less than 400 psig at 150°F, 321 psig at 281°F per ANSI B16.15.
4. Valves two way NPS 2” and Smaller: Operator, stem and plug assembly, and spring-loaded PTFE/EPDM valve stem packing cartridge must be removable for future replacement to restore the valves back to their original condition. Material grade properties must meet the fluid temperature and pressure requirements:
    a. Standard duty bronze body, 316 stainless steel vertical stem, brass plug, soft seal, and bronze seat, renewable packing cartridge, and screwed/sweat/flared ends. Valves shall have allowable media temperature of 20°F …281°F to assure reliability with dual temperature applications.
    b. Heavy duty bronze body, 316 stainless steel vertical stem, 316 stainless steel plug, soft seal, and 316 stainless steel seat, renewable packing cartridge, and screwed ends. Valves shall have allowable media temperature of 20°F …340°F to assure to assure reliability with dual temperature applications.
    c. High temperature bronze body, 316 stainless steel vertical stem, 316 stainless steel plug, and 316 stainless steel seat, renewable packing cartridge, and screwed ends. Valves shall have allowable media temperature of 20°F …400°F.
    d. Two-way fluid system globe valves shall have the following characteristics:
        1) Rangeability: Greater than 100:1 for all valves with flow coefficients of 0.4 and higher to provide stable control under light load conditions.
        2) Maximum Allowable Seat Leakage: Standard and heavy duty valves must be designed to meet ANSI Class V (0.0005 ml per minute per “of orifice diameter per psi differential) up to 35 psi close off differential pressure and ANSI Class IV seat leakage (maximum 0.01% of full open valve capacity) above 35 psi with appropriate actuator. High temperature valves must meet ANSI Class III seat leakage (maximum 0.1% of full open valve capacity).
        3) The valve must be able to operate with a full-open operating differential of no less than 87 psi.
        4) Flow Characteristics: Modified equal percentage characteristics for standard duty water applications and modified linear for heavy duty and high temperature steam applications with gradual opening for light loads.
        5) Sizing:
            a) Two Position Water: Line size or size using a differential pressure of 1 psi.
            b) Modulating Water: 2 PSI or as listed on schedules.

e. Valves 3-Way mixing (two inlets and one outlet) NPS 2” and Smaller:
   1) Operator, stem and plug assembly, and spring-loaded PTFE/EPDM valve stem packing cartridge must be removable for future replacement to restore the valves back to their original condition. Material grade properties must meet the fluid temperature and pressure requirements:
      a) Standard duty bronze body, 316 stainless steel vertical stem, brass plug, and bronze seat, renewable packing cartridge, and screwed or sweat ends. Valves shall have allowable media temperature of 20°F…281°F to assure reliability with dual temperature applications.
      b) Heavy duty bronze body, 316 stainless steel vertical stem, 316 stainless steel plug, and 316 stainless steel seat, renewable disc and packing cartridge, and screwed ends. Valves shall have allowable media temperature of 20°F …340°F to assure reliability with dual temperature applications.
f. 3-Way mixing hydronic system globe valves shall have the following characteristics:
   1) Rangeability: Greater than 100:1 for all valves to provide stable
   2) Maximum Allowable Seat Leakage: A port must be designed to meet ANSI Class V (0.0005 ml per minute per “of orifice diameter per psi differential) up to 35 psi close off differential pressure and ANSI IV seat leakage (maximum 0.01% of full open valve capacity) above 35 psi with appropriate actuator. B port must meet ANSI Class III seat leakage (maximum 0.1% of full open valve capacity).
   3) The valve must be able to operate with a full-open operating differential of 87 psi.
   4) Flow Characteristics: Modified linear characteristics with gradual opening for light loads.
   5) Sizing: Modulating Water: Maximum 2 psi or as listed on schedules.
g. Valves 3-Way diverting (one inlet and two outlets) NPS 2” and Smaller:
   1) Operator, stem and plug assembly, and spring-loaded PTFE/EPDM valve stem packing cartridge must be removable for future replacement to restore the valves back to their original condition. Valves must be designed specifically for diverting service, and mixing valves designed for mixing service must not be used for diverting applications. Material grade properties must meet the fluid temperature and pressure requirements:
      a) Standard duty bronze body, 316 stainless steel vertical stem, brass plug, and bronze seat, renewable disc and packing cartridge, and screwed ends. Valves shall have allowable media temperature of 20°F …281°F to assure reliability with dual temperature applications.
h. 3-Way diverting hydronic system globe valves shall have the following characteristics:
   1) Rangeability: Greater than 100:1 for all valves to provide stable control under light load conditions.
   2) Maximum Allowable Seat Leakage: ANSI Class III seat leakage (maximum 0.1% of full open valve capacity).

3) Maximum Allowable Pressure Differential: 35 psi in.an open position.
4) Flow Characteristics: Modified linear characteristics with gradual opening for light loads.
5) Sizing:
a) Modulating Water: Maximum 2 psi or as listed on schedules

i. Required Certifications: Pressure Equipment Directive (PED 97/23/EC), RoHS (Restriction of Hazardous Substances) and REACH (Regulation, Evaluation, Authorization, and Restriction of Chemicals), Canadian Registration Number.
j. Valve and Operator: To assure maximum performance and operation of the valve assembly both the valve and the actuator must be tested and approved by the valve manufacturer to assure compatibility of all components and performance to the specifications.

5. Butterfly Valves
a. Valve body are to be polyester coated iron ASTM A126 lug mating with ANSI class 125/150 flanges.
b. Disc Type: Ductile iron nylon 11 coated.
c. Valve Stem:
d. 2…8” 416 stainless steel double D stem.
e. Valve seat: EPDM tongue and groove seat and molded O-ring flange seat
f. Flow Characteristics: Modified equal percentage.
g. Close-Off Pressure Rating: Bubble-tight shutoff (no leakage).
h. Valve fluid temperature rating: -40…250°F (-40…121°C) 9. Valve will have two (2) inch extended neck (because of heat). 10. Valve must except pneumatic or electric/electronic actuators 11. Valves must have a minimum of a two (2) year warranty.
i. Valve will have two (2) inch extended neck (because of heat).
j. Valve must accept pneumatic or electric/electronic actuators.
k. Valves must have a minimum of a two (2) year warranty.

6. Flanged Valves
a. Bodies: Shall be American Factory fabricated with ASTM A 126 Class B cast iron body material with the pressure class within the maximum pressure and temperature rating of the piping system. (125 body rating with not less than 200 psig at 150°F, decreasing to 169 psig at 281F per ANSA B16.1)
b. Serviceability: 2-Way valve operators, stem and plug assemblies and spring-loaded PTFE/EPDM valve stem packing cartridges must be removable for future replacement to restore the valves back to their original condition.
c. Construction: Material grades must meet the fluid temperature and pressure requirement temperatures of 20°F …281°F to assure reliability throughout all application temperature ranges.
d. Packings: Shall be cartridges suitable for replacement as units withstanding the full operating temperature ranges, including daily and seasonal fluctuations of water, 60% glycol and steam fluids.
e. Characteristics
1) Rangeability: Two way,100:1 and greater for stable control under light load.
2) Shutoff, 2-Way: Leakage allowed: ANSI Class IV (0.01% of max flow)

3) 3-Way: Leakage allowed: ANSI Class III (0.1% of max flow)
4) Flow curves: 2-Way modified equal percentage characteristic.
5) Mixing and Diverting: Linear, modified with gradual opening for light loads.

f. Piping
1) Diverting valves, with the common port at the bottom can be used for mixing.
2) Mixing valves with the common port at the end must not be used for diverting applications.

g. Sizing
1) Two Position Water: Line size or size using a differential pressure of 1 psi.
2) Modulating Water: 2 PSI or as listed on schedules.

h. Certifications for All Models: Pressure Equipment Directive (PED 97/23/EC), RoHS (Restriction of Hazardous Substances) and REACH (Regulation, Evaluation, Authorization, and Restriction of Chemicals

2.15 CONTROL VALVE ACTUATORS

A. Manufacturers
1. Belimo

B. ½" to ¾" Ball Valve Actuators
1. Size for torque required for valve close-off pressure for system design.
2. Coupling: Direct coupled to valve body without use of external devices/tools
3. Auxiliary End Switch (optional) to be SPST 24 Vac/Vdc,101 mA to 5 mA maximum on selected two-position models.
4. Controller Signal Two-position, Floating or Proportional (0…5 Vdc, 0…10 Vdc, 5…10 Vdc, or 4…20 mA dc). Design allows for change via DIP switches without removal of cover.
5. Manual operating lever and position indicator must be standard.
6. Power Requirements: 24 Vac for floating, proportional, and 110…230 Vac for two position multi-voltage types
7. Actuators must be available with either Spring Return (SR) or Non-Spring Return (NSR) models.
8. Operating Temperature Limit Floating is to be 32…140°F (0…60°C) Proportional 32…140°F (0…60°C) Two-Position 32…169°F (0…76°C)
9. Wiring (depending on model) Removable Terminal Block, 10 ft. (3.05 m) Plenum Cable, 18 in. (45 cm) Appliance Wire
10. Locations must be rated NEMA 2, IEC IP31. (Indoor Use Only.) Actuators with terminal block or plenum cable leads are plenum rated per UL file number E9429.
11. Agency Listings: ISO 9001, cULus, and CE.

C. ½" to 3" 2-way and ½" to 2" 3-way Ball Valves Actuators
1. Size for torque required for valve close-off pressure for system design.
2. Actuators are to be available in spring return (SR) and non-spring return (NSR) models. Spring Return (SR) actuators are to provide a choice to return direction.
3. Actuators are to be available in models for two-position, floating and proportional control.

4. All actuator models are to be equipped with pigtail leads, manual override, and auxiliary switch(es)
5. Operating temperatures' Floating Non-Spring Return (NSR) with 33 lb.-in. of torque must be -25 to 130 °F (-32 to 55°C). All other actuators are to -22 to 140 °F (-30 to 60 °C)
6. Actuators must be NEMA 2 rated.
7. Agency Listings: ISO 9001, cULus, and CE.

D. ½" to 2" Bronze, Linear Globe Valve Actuators/67 or 78 lbs. force
1. Actuator must have bi-color LED status indication for motion indication, auto calibration and alarm notification.
2. When the actuator is properly mounted must have a minimum of a NEMA 2 (IP53) rating.
3. Actuators are to be non-spring return.
4. Actuators are to be floating (used for two-position) or proportional models.
5. Proportional models will have optional models with a position output signal with field selectable 2…10 Vdc and 0…10 Vdc input signals and selectable input signal direct or reverse acting.
6. Actuator must have auto calibration which provides precise control by scaling the input signal to match the exact travel of the valve stem
7. Actuators must come in models with Pulse Width Modulated (PWM) with field selectable 0.59 to 2.93 sec and 0.1 to 25.5 sec input signal ranges with a position output signal
8. Actuators must have manual override with automatic release.
9. Models with position feedback output signal include field selectable 2…10 Vdc or 0…5 Vdc output signal
10. Removable wiring screw terminal with ½" conduit opening.
11. Actuator operating temperature ranges:
    a. When controlling fluid up to 266°F (130°C) = ambient air temperature is to be 23…131°F (-5…55°C)
    b. Fluid up to 281°F (138°C) = 23…127°F (-5…53°C)
    c. Fluid up to 340°F (171°C) = 23…115°F (-5…46°C)
    d. Fluid up to 400°F (204°C) = 23…102°F (-5…39°C)
12. Actuator agency Listings: cUL-us LISTED mark, NEMA 2, NEC class 2 FCC part-15 class B, Canadian ICES-003, ESA registered, Plenum rated per UL 20430

E. ½" to 2" Bronze, Linear Globe Valve Actuators/105 lbs. force
1. Actuators must have Two- Position, Floating, and Proportional models.
2. Proportional models will a controller input signal of either a 0…10 Vdc, 2…10 Vdc, 4…20 mAdc, 0…3 Vdc, or 6…9 Vdc. Control function direct/reverse action is switch selectable on most models.
3. Actuator force is to be 105 lb. (467 newton) with ½" (13 mm) nominal linear stroke
4. Power requirements 24 Vac, 120 Vac or 230 Vac depending on model.
5. Actuator housings rated for up to NEMA 2/ IP54.
6. Actuator is to have overload protection throughout stroke.
7. Actuator Operating temperature -22…140°F (-30…60°C) up to a maximum valve fluid temperature of 366°F (186°C).
8. Actuator must automatically set input span to match valve travel.
9. Actuator must have manual override to allow positioning of valve and preload.

10. Actuator is to be spring return.
11. Actuator is to mount directly to valves without separate linkage.
12. Actuator agency Listings: UL 873, CUL: UL

F. ½" to 2" Bronze, Linear Globe Valve Actuators/220 lbs. force
1. Actuators must have Two- Position for a SPST controller, Floating for a SPST controller, and Proportional models will a controller input signal of either a 0…10 Vdc, 2…10 Vdc, 4…20 mAdc, or 6…9 Vdc. Control function direct/reverse action is jumper selectable
2. Actuator is to be spring return.
3. Actuator will have 220 lb. force (979 newton) with ½" (13 mm) or 1" (25 mm) nominal linear stroke
4. Feedback on proportional model with 2…10 Vdc (max. 0.5 mA) output signal or to operate up to four like additional slave actuators.
5. Actuator operating temperature is 0…140°F (-18…60°C) up to a maximum valve fluid temperature of 281°F (138°C), 0…120°F (-18…49°C) up to a maximum valve fluid temperature of 300°F (149°C), 0…100°F (-18…38°C) up to a maximum valve fluid temperature of 340°F (171°C), 0…90°F (-18…32°C) up to a maximum valve fluid temperature of 366°F (186°C).
6. Actuator must automatically set input span to match valve travel
7. Actuator is to have a 24 Vac power supply on Two-position and Proportional models and 120 Vac on Two-position models.
8. Actuator housings rated for up to NEMA 2/ IP54
9. Actuator must have manual override to allow positioning of valve and preload
10. Actuator is to mount directly to vales without separate linkage.
11. Actuator agency Listings: UL 873, CUL: UL

G. ½" to 2" Bronze, Linear Globe Valve Actuators with linkage SR
1. Actuators with 35, 60, 133, or 150 lb.-in of force depending on model.
2. Actuator housings rated for up to NEMA 2/ IP54 with a 150 lb.-in. rated a NEMA 4.
3. Actuators are to be spring return.
4. Actuators are to have Two-position, Floating and Proportional models.
5. Actuators must have overload protection throughout rotation.
6. Actuator have an optional built-in auxiliary switch to provide for interfacing or signaling on selected models.
7. Actuator agency listings: UL-873, C22-2 No.24-83, CUL0

H. ½" to 2" Bronze Body, Linear Globe Valve Actuators with linkage SR & NSR
1. Actuators are to be either floating SPDT control or proportional control 0…10, 2…10 Vdc or 4…20 mA with a 500-ohm resistor included.
2. Actuators are to be direct/reverse with selectable DIP switches.
3. Actuators are to have 90 lb. (400N), 180 lb. (800N), or 337 lb. (1500N) of force on Non-Spring Return (NSR) 157 lb. of force on the Spring Return model. Note: Not every actuator is for every valve.
4. Actuators are to be powered with 24 Vac or 24 Vdc.
5. All Non-Spring Return (NSR) actuators are to be NEMA 2, vertical mount only. Spring Return (SR) actuators are to have NEMA 4 models.
6. Actuators must have manual override to allow positioning of the valve.

7. Actuators must have selectable valve sequencing and flow curves of either equal percentage or linear.
8. Actuators must have internal torque protection throughout stroke.
9. Actuator operating temperature is 14…122°F (-10…50°C) for chilled water applications, 14…113°F (-10…45°C) up to a maximum valve fluid temperature of 281°F (138°C), 14…107°F (-10…42°C) up to a maximum valve fluid temperature of 300°F (149°C), 14…100°F (-10…38°C) up to a maximum valve fluid temperature of 340°F (171°C), 14…90°F (-10…32°C) up to a maximum valve fluid temperature of 366°F (186°C).
10. Actuator agency listings (North America) UL873, cULus, RCM, CE

I. 2 ½" to 6" Cast Iron Flanged Globe Valve Linear Actuators with linkage
1. Actuators are to be either floating SPDT control or proportional control 0…10, 2…10 Vdc or 4…20 mA with a 500-ohm resistor included.
2. Actuators are to direct/reverse acting with selectable DIP switch.
3. Actuators are to have 180 lb. (800N) or 337 lb. (1500N) of force.
4. Actuators will need a 24 Vac or Vdc power supply.
5. Actuators are to be rated NEMA 2, vertical mount only.
6. Actuators must have manual override to allow positioning of the valve.
7. Actuators must have selectable valve sequencing and flow curves of either equal percentage to linear.
8. Actuators must have Internal torque protection throughout stroke.
9. Actuator operating temperature is 14…122°F (-10…50°C) for chilled water applications, 14…113°F (-10…45°C) up to a maximum valve fluid temperature of 281°F (138°C), 14…107°F (-10…42°C) up to a maximum valve fluid temperature of 300°F (149°C).
10. Actuator agency listings (North America) UL873, cULus, RCM, CE

J. 2-½" to 6" Cast Iron Flanged Globe Valve Actuators/220 lbs. force.
1. Actuators must have Two- Position for a SPST controller, Floating for a SPST controller, and Proportional models will a controller input signal of either a 0…10 Vdc, 2…10 Vdc, 4…20 mAdc, or 6…9 Vdc. Control function direct/reverse action is jumper selectable.
2. Actuator is to be spring return.
3. Actuator will have 220 lb. force (979 newton) with ½" (13 mm) or 1" (25 mm) nominal linear stroke.
4. Feedback on proportional model with 2…10 Vdc (max. 0.5 mA) output signal or to operate up to four like additional slave actuators.
5. Actuator must automatically set input span to match valve travel.
6. Actuator Operating temperature 0…140°F (-18…60°C) up to a maximum valve fluid temperature of 300°F (149°C).
7. Actuator is to have a 24 Vac power supply on Two-position and Proportional models and 120 Vac on Two-position models.
8. Actuator housings rated for up to NEMA 2/IP54.
9. Actuator must have manual override to allow positioning of valve and preload.
10. Actuator is to mount directly to vales without separate linkage.
11. Actuator agency Listings: UL 873, CUL: UL.

K. 2-½" to 6" Cast Iron Flanged Globe Valve Actuators with linkage SR.
   1. Actuators with 60, 133, or 150 lb.-in of force depending on model.
   2. Actuator housings rated for up to NEMA 2/ IP54 with a 150 lb.-in. rated a NEMA 4.
   3. Actuators are to be spring return.
   4. Actuators are to have Two-position, Floating and Proportional models.
   5. Actuators must have overload protection throughout rotation.
   6. Actuator have an optional built-in auxiliary switch to provide for interfacing or signaling on selected models.
   7. Actuator agency listings: UL-873, C22-2 No.24-83, CUL0.
   8. Basis of Design: Schneider Electric SmartX, or approved equal.

L. 2" to 18" 2-Way and 2" to 16" 3-Way Linear Butterfly Valve Actuator with linkage NSR
   1. The butterfly valve actuators are to be Non-Spring Return (NSR) two-position and proportional taking 0…10 Vdc or 4…20 mA models. All Actuators are to be NEMA 4, manual override (hand wheel) two auxiliary switches, and built-in heater.
   2. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
   3. Actuators must be available in 24 Vac and 120 Vac models.
   4. Actuators must have Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another. .
   5. Actuator operating temperature shall be -40…150°F (-40…60°C).
   6. Actuator agency listings (North America) UL, CSA and CE

M. 2" to 4" 2-Way and 3-Way Butterfly Valve Actuators SR
   1. The butterfly valve actuators are to be Spring Return (SR) two-position and proportional taking 2…10 Vdc or 4…20 mA models. All Actuators are to be NEMA 2.
   2. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
   3. Actuators must be available in 24 Vac models.
   4. Actuators shall have two SPDT auxiliary switch models.
   5. Actuators must have Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
   6. Actuator operating temperature shall be -22…140°F (-12…60°C).
   7. Actuator agency listings (North America) UL, CSA and CE

N. 2" to 6" 2-Way and 3-Way Butterfly Valve Actuators NSR
   1. The butterfly valve actuators are to be Non-Spring Return (NSR) two-position and proportional taking 0…10 Vdc or 4…20 mA models. All Actuators are to be NEMA 2.
   2. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
   3. Actuators must be available in 24 Vac models.
   4. Actuators shall have two SPDT auxiliary switch models.
   5. Actuators must have Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
   6. Actuator operating temperature shall be -4…122°F (-2…50°C).
   7. Actuator agency listings (North America) UL, CSA and CE

2.16 DAMPERS

A. Manufacturers:
   1. American Warming and Ventilating.
   2. Ruskin
   3. Greenheck
   4. Mestek.
   5. TAMCO.
   6. United Enertech Corp.

B. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS system supplier. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.

C. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.
   1. Damper blade width shall not exceed eight inches. Seals and 3/8-inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.
   2. For high performance applications, control dampers will meet or exceed the UL Class I leakage rating.
   3. Provide opposed blade dampers for modulating applications and parallel blade for two position control.

2.17 DAMPER ACTUATORS

A. Manufacturers:
   1. Belimo

B. Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque.

C. Direct-coupled damper actuators must have a five-year warrantee.

D. Size for torque required for damper seal at maximum design conditions and valve close-off pressure for system design.

E. Direct-coupled damper actuators should accommodate 3/8”, ½” 1.05” round or 3/8” …½” and ¾” square damper shafts.

F. Actuator operating temperature minimum requirements: 44, 88 and 133 lb.-in. are –25°F…130°F (–32°C…55°C). The 30, 35, 60, 150 and 300 lb.-in. are -25°…140°F (-30°C… 60 °C). The 270 are -22°…122°F (-30°C… 50 °C).

G. Overload protected electronically throughout rotation except for selected Floating actuators the have a mechanical clutch.

H. Spring Return Actuators: Mechanical fail safe shall incorporate a spring-return mechanism.

I. Non-Spring Return Actuators shall stay in the position last commended by the controller with an external manual gear release to allow positioning when not powered.

J. Power Requirements: 24Vac/dc

K. Proportional Actuators controller input range from 0…10 Vdc, 2…10 Vdc or 4…20 mA models.

L. Housing: Minimum requirement NEMA type 2 with NEMA type 4 available for applications requiring higher ratings.

M. Actuators with a microprocessor should not be able to be modified by an outside source (cracked or hacked).

N. Actuators of 133 and 270 lb.-in. of torque or more should be able to be tandem mount or “gang” mount.

O. Agency Listings: ISO 9001, cULus, CE and CSA

2.18 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 26 Low Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 GENERAL

A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of other specifications and Drawings.

B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.

C. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

D. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.

E. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

F. Code Compliance
   1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications.

G. Cleanup
   1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 SYSTEM ACCEPTANCE TESTING

A. All application software will be verified and compared against the sequences of operation.

B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.

D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.

E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

3.3 INSTALLATION

A. Hardware Installation Practices for Wiring
   1. All controllers are to be mounted vertically and per the manufacturer’s installation documentation.
   2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
   3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.

4. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
6. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
7. Wires are to be kept a minimum of three (3) inches from hot water piping.
8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
9. Provide fire caulking at all rated penetrations.

B. Installation Practices for Field Devices
1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
5. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
6. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.

C. Wiring, Conduit, and Cable
1. All wire will be copper and meet the minimum wire size and insulation class listed below:
   a. Power - 12 Gauge - 600 Volt
   b. Class One - 14 Gauge Std. - 600 Volt
   c. Class Two - 18 Gauge Std. - 300 Volt
   d. Class Three - 18 Gauge Std. - 300 Volt
   e. Communications - Per Mfr.
2. Power and Class One wiring may be run in the same conduit.
3. Class Two and Three wiring and communications wiring may be run in the same conduit. (Separate from Power and Class One wiring)
4. Where different wiring classes terminate within the same enclosure, maintain clearances, and install barriers per the National Electric Code.

5. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
6. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.
7. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.
8. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.
9. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.
10. Only glass fiber is acceptable, no plastic.
11. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS system supplier shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

D. Enclosures
1. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

E. Identification
1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.

3. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
4. All I/O field devices inside FIP's shall be labeled.

F. Existing Controls.
1. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

G. Location
1. The location of sensors is per mechanical and architectural drawings.
2. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

H. Software Installation
1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.4 TRAINING

A. The BAS system supplier shall provide both on-site and classroom training to the Owner’s representative and maintenance personnel per the following description:

B. On-site training shall consist of a minimum of (8) hours of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include
1. System Overview
2. System Software and Operation
3. System access
4. Software features overview
5. Changing setpoints and other attributes
6. Scheduling
7. Editing programmed variables
8. Displaying color graphics
9. Running reports
10. Workstation maintenance
11. Viewing application programming
12. Operational sequences including start-up, shutdown, adjusting and balancing.
13. Equipment maintenance

3.5 CONTROL SYSTEM SWITCH-OVER

A. Demolition of the existing control system will occur after the new temperature control system is in place including new sensors and new field interface devices.

B. Switch-over from the existing control system to the new system will be fully coordinated with the Owner. A representative of the Owner will be on site during switch-over.

C. The Contractor shall minimize control system downtime during switch-over. Sufficient installation mechanics will be on site so that the entire switch-over can be accomplished in a reasonable time frame.

D. Remove controls which will not remain as part of the building automation system, including all associated wiring and conduit, and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed will be disposed of by the Contractor. Demolition will include removing existing control panels, existing control devices, existing wire/cable raceways and all pneumatic control tubing and raceways. All demolished components will be properly disposed of offsite. ABANDONMENT OF ANY EXISTING CONTROL PANELS, RACEWAYS, WIRES/CABLES, PNEUMATIC TUBING/RACEWAYS IS NOT PERMITTED – THIS WILL BE STRICTLY ENFORCED

3.6 DATABASE CONFIGURATION.

A. The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

3.7 POINT TO POINT CHECKOUT.

A. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the owner or owner's representative.

3.8 WORKSTATION CHECKOUT

A. A checkout of all front end equipment shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project.

3.9 BAS FIELD CONTROLLERS CHECKOUT

A. A checkout of all field devices shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project

3.10 DOCUMENTATION

A. As built software documentation will include the following:
   1. Descriptive point lists
   2. Application program listing
   3. Application programs with comments.
   4. Printouts of all reports.
   5. Alarm list.
   6. Printouts of all graphics
   7. Commissioning and System Startup

3.11 AN ELECTRONIC COPY OF ALL DATABASES, CONFIGURATION FILES, OR ANY TYPE OF FILES CREATED SPECIFICALLY FOR EACH SYSTEM.

3.12 ADJUSTING

A. Calibrating and Adjusting:
   1. Calibrate installed devices and instruments, whether electric or pneumatic.
   2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
   3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
   4. Control System Inputs and Outputs:
      a. Check analog inputs at 0, 50, and 100 percent of span.
      b. Check analog outputs using milli-ampere meter at 0, 50, and 100 percent output.
      c. Check digital inputs using jumper wire.
      d. Check digital outputs using ohmmeter to test for contact making or breaking.
      e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
   5. Flow:
      a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
      b. Manually operate flow switches to verify that they make or break contact.
   6. Pressure:
      a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
      b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
   7. Temperature:
      a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
      b. Calibrate temperature switches to make or break contacts.
   8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.

9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature, CO, CO_2, static pressure, humidity, etc., set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.13 GRAPHIC DISPLAY GENERATION

A. Provide the following graphic displays as a minimum at the operator workstations, arranged in logical penetration paths:
1. Overall campus layout which shows all of the buildings on the Owner's campus.
2. Individual building layout or isometric for each building connected to the system.
3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
   a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
   b. System name.
   c. Area served.
   d. Present value or status of all inputs, along with present setpoint.
   e. Present percent open for each damper, valve, etc. based on commanded position.
   f. Reset schedule parameters for all points, where applicable.
   g. Present occupancy mode.
   h. Present economizer mode, where applicable.
   i. Present outside air temperature.
   j. Associated space conditions and setpoints, where applicable.
   k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
   l. Color coding to indicate normal and abnormal values, alarms, etc.
5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.

6. Sequence of operation in written (text) format for each HVAC system.
7. Overall BAS system schematic.
8. System management graphic for each network device and/or DDC panel.
9. Provide a separate page for critical alarm summary.

B. Contractor to provide graphics that are fully operational prior to commissioning.

END OF SECTION 230900

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated, stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   4. Pressure regulators. Indicate pressure ratings and capacities.
   5. Service meters. Indicate pressure ratings and capacities.
   6. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
   1. Shop Drawing Scale: 1/4 inch per foot
   2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Welding certificates.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.10 SERVICE METERS

A. Local utility to provide and install service meter, service piping up to building, and service regulator. All piping and fittings downstream of the meter is the responsibility of the mechanical contractor.

1.11 COORDINATION

A. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.

e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

B. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type L
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.
3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.

2.2 PIPING SPECIALTIES

A. Kitchen Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Corrugated stainless-steel tubing with polymer coating.
4. Operating-Pressure Rating: 0.5 psig.
5. End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. Refer to "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Brass or Bronze Ball Valves with Brass or Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. A. Y. McDonald Mfg. Co.
      b. BrassCraft Manufacturing Company.
      c. Conbraco Industries.
      d. Milwaukee Valve Company.
      e. Hammond Valve, Milwaukee Valve Company.
   2. Body: Forged brass or bronze, complying with ASTM B 584.
   3. Ball: Chrome-plated brass or bronze.
   4. Stem: Brass or Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body packnut design with adjustable-stem packing.
   7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. A. Y. McDonald Mfg. Co.
   b. American Production Valve
   c. Mueller Co.
   d. Xomox Corporation.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. A. Y. McDonald Mfg. Co.
   b. Flowserve Corporation.
   c. Homestead Valve.
   d. Milliken Valve Company.
   e. Mueller Co.
   f. R&M Energy Systems.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASCO Power Technologies.
      b. Eaton Corporation.
      c. Eclipse Innovated Thermal Technologies.
      d. Honeywell International Solutions.
      e. Johnson Controls.
   2. Body: Brass or aluminum.
   3. Seats and Disc: Nitrile rubber.
   4. Springs and Valve Trim: Stainless steel.
   5. Normally closed.
   6. Visual position indicator.
   7. Electrical operator for actuation by appliance or fire-suppression system automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASCO Power Technologies.
      b. Dungs, Karl.
      c. Eclipse Innovated Thermal Technologies.
      d. Goyen Valve Corp.
      e. Magnatrol Valve Corporation.
      f. Parker Hannifin Corporation.
      g. Watts.
   2. Pilot operated.
   3. Body: Brass or aluminum.
   4. Seats and Disc: Nitrile rubber.
   5. Springs and Valve Trim: Stainless steel.
   6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
   7. NEMA ICS 6, Type 4, coil enclosure.
   8. Normally closed.
   9. Visual position indicator.

2.6 PRESSURE REGULATORS

A. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Actaris.
      b. American Meter Company.
      c. Eclipse Inovated Thermal Technologies.
      d. Fisher Control Valves and Instruments.
      e. Invensys.
      f. Itron Gas.
      g. Maxitrol Company.
      h. Richards Industries.
   2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
   3. Springs: Zinc-plated steel; interchangeable.
   4. Diaphragm Plate: Zinc-plated steel.
   5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
   6. Orifice: Aluminum; interchangeable.
   7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
   8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
   9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
   10. Overpressure Protection Device: Factory mounted on pressure regulator.
   11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
   12. Maximum Inlet Pressure: 2 psig

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Canadian Meter Company.
      b. Eaton Corporation.
      c. Harper Wyman Co.
      d. Maxitrol Company.
      e. SCP.
   2. Body and Diaphragm Case: Die-cast aluminum.
   3. Springs: Zinc-plated steel; interchangeable.
   4. Diaphragm Plate: Zinc-plated steel.
   5. Seat Disc: Nitrile rubber.
   6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
   7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
   8. Regulator shall include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
   9. Maximum Inlet Pressure: 2 psig

2.7 SERVICE METERS

A. Contractor to coordinate installation of Natural Gas equipment with local utility company and provide terminations as required facilitating the meter assembly installation by the local utility company.

2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. A. Y. McDonald Mfg. Co.
      b. Capitol Manufacturing Company.
      c. Central Plastics Company.
      d. Hart Industrial Union.
      e. Jomar Valve.
      f. Matco-Norca.
      g. Watts.
      h. Wilkins.
      i. Zurn Industries.
   2. Standard: ASSE 1079.
   3. Minimum Operating-Pressure Rating: 150 psig
   4. Combination fitting of copper alloy and ferrous materials.
   5. Insulating materials suitable for natural gas.
   6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Company.
      b. Central Plastics Company.
      c. Metco-Norca.
      d. Watts.
      e. Wilkins.
   2. Standard: ASSE 1079.
   3. Minimum Operating-Pressure Rating: 150 psig
   4. Combination fitting of copper alloy and ferrous materials.
   5. Insulating materials suitable for natural gas.
   6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

D. Dielectric-Flange Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems.

b. Calpico.
c. Central Plastics Company.
d. Pipeline Seal and Insulator.

2. Nonconducting materials for field assembly of companion flanges.
3. Minimum Operating-Pressure Rating: 150 psig
4. Companion-flange assembly for field assembly.
5. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
6. Insulating materials suitable for natural gas.
7. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 SLEEVES

A. Refer to Division 20 Section 200500 “Common Work Results” for requirements.

2.10 MECHANICAL SLEEVE SEALS

A. Refer to Division 20 Section 200500 “Common Work Results” for requirements.

2.11 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. Refer to Division 20 Section 200500 “Common Work Results” for requirements.

2.12 GROUT

A. Refer to Division 20 Section 200500 “Common Work Results” for requirements.

2.13 LABELING AND IDENTIFYING

A. Refer to Division 20 “Mechanical Identification” for requirements.

B. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

2.14 METERS AND GAGES

A. Refer to Division 20 “Meters and Gages” for requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install fittings for changes in direction and branch connections.

C. Protect all steel pipe fittings from corrosion prior to painting. See Article 3.11.

D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

E. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

R. Concealed Location Installations
   1. Prohibited Locations:
      a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural-gas piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

T. Connect branch piping from top or side of horizontal piping.

U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

V. Do not use natural-gas piping as grounding electrode.

W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Service meter assembly will be purchased by the owner and furnished and installed by the gas utility company.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.

3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 20 Section 200529 "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Division 20 Section 200553 "Mechanical Identification" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, , and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel
      d. Color: Yellow

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.13 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.
   3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1and smaller shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:
   1. Steel pipe with steel welding fittings and welded joints.

3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
   1. Two-piece, full port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
   1. Two-piece, full port, bronze ball valves with bronze trim.
   2. Cast-iron, lubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
   1. Two-piece, full port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
   1. Two-piece, full port, bronze ball valves with bronze trim.
   2. Cast-iron, lubricated plug valve.

E. Valves in branch piping for single appliance shall be the following:
   1. Two-piece, full port, bronze ball valves with bronze trim.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Copper tube and fittings.
   2. Steel pipe and fittings.
   3. Joining materials.
   4. Transition fittings.
   5. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe and tube.
   2. Fittings.
   3. Joining materials.
   4. Piping application schedule (specific to the piping materials being used on each system).

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Other building services.
   3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 125 psig at 200 deg F.
   2. Makeup-Water Piping: 80 psig at 150 deg F.
   3. Condensate-Drain Piping: 150 deg F.
   4. Blowdown-Drain Piping: 200 deg F.
   5. Air-Vent Piping: 200 deg F.
   6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B88, Type K.

C. DWV Copper Tubing: ASTM B306, Type DWV.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

E. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

A. Refer to Division 20 Section 200500 “Common Work Results for Mechanical” for requirements.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Refer to “Piping System Application Schedule” in drawings.

B. Condensate-Drain Piping: Type DWV drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 20 Section 200523 "General-Duty Valves for Piping."

Q. Install air vents and pressure-relief valves in accordance with Division 23 Section 232116 "Hydronic Piping Specialties."

R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. Install shutoff valve immediately upstream of each dielectric fitting.

U. Comply with requirements in Division 20 Section 200516 "Expansion Fittings and Loops for Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

V. Comply with requirements in Division 20 Section 200553 "Mechanical Identification" for identifying piping.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 20 Section 200500 “Common Work Results for Mechanical”.

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 20 Section 200500 “Common Work Results for Mechanical”.

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 20 Section 200500 “Common Work Results for Mechanical”.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Division 20 Section 200529 "Hangers and Supports" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12inches of each fitting and coupling.

E. Support vertical runs of copper tubing and steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of fiberglass piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Division 20 Section 200519 "Meters and Gages."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   5. After hydrostatic test pressure has been applied for at least 2.5 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing.

C. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.
   3. Set makeup pressure-reducing valves for required system pressure.
   4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
   5. Set temperature controls so all coils are calling for full flow.
   6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
   7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:
   1. Hydronic specialty valves.
   2. Air-control devices.
   3. Strainers.
   4. Connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Include construction details and material descriptions for hydronic piping specialties.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 125 psig at 200 deg F.
   2. Makeup-Water Piping: 80 psig at 150 deg F.
   3. Condensate-Drain Piping: 150 deg F.
   4. Air-Vent Piping: 200 deg F.
   5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 20 Section 200523 "General-Duty Valves for Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section 230900 "Instrumentation and Control for HVAC.

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps.
      b. Bell & Gossett.
      c. Flow Design.
      d. Griswold Controls.
      e. HCI (Hydronics Components Inc)
      f. Macon Balancing.
      g. Nexus Valve.
      h. Taco.
   2. Body: Bronze or brass body, ball with calibrated orifice or venturi.
   3. Ball: Stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE.
   6. End Connections: Threaded or socket.
   7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   8. Handle Style: Lever, with memory stop to retain set position.
   9. CWP Rating: Minimum 125 psig.
   10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps.
      b. Bell & Gossett.
      c. Flow Design.
      d. Griswold Controls.
      e. HCI (Hydronics Components Inc)
      f. Macon Balancing.
      g. Nexus Valve.
      h. Taco.
   2. Body: Cast-iron or steel body, globe or butterfly pattern with calibrated orifice or venturi.
   3. Ball: Stainless steel.
   4. Butterfly Valve: Epoxy coated cast iron.
   5. Stem Seals: EPDM O-rings.
   6. Disc: Glass and carbon-filled PTFE.
   7. Seat: PTFE.
   8. End Connections: Flanged or grooved.
   9. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   10. Handle Style: Lever, with memory stop to retain set position.
   11. CWP Rating: Minimum 125 psig.
   12. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol.
      b. Armstrong Pumps.
      c. Bell & Gossett.
      d. Conbraco Industries.
      e. Spence Engineering Company.
      f. Watts.
   2. Body: Bronze or brass.
   3. Disc: Glass and carbon-filled PTFE.
   4. Seat: Brass.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.
   7. Low inlet-pressure check valve.
   8. Inlet Strainer: removable without system shutdown.
   9. Valve Seat and Stem: Noncorrosive.
   10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves: ASME labeled.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol.

b. Armstrong Pumps.
c. Bell & Gossett.
d. Conbraco Industries.
e. Spence Engineering Company.
f. Watts.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol.
b. Armstrong Pumps.
c. Bell & Gossett.
d. Nexus Valve.
e. Taco.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol.
b. Armstrong Pumps.
c. Bell & Gossett.
d. Nexus Valve.
e. Taco.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.

8. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol.
   b. Armstrong Pumps.
   c. Bell & Gossett.
   d. Taco.
2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. In-Line Combination Air & Dirt Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Spirotherm Spirovent.
   b. Bell & Gossett CRS.
2. Full flow coalescing type combination air eliminator and dirt separator for hydronic systems based upon system flow with pipe size.
3. Separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles. The vessel diameter and height above and below the inlet / outlet connections must be equal to the basis of design.
4. Unit shall include internal tube elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must consist of a copper or stainless steel core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
5. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
6. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
7. Provide removable lower head for inspection.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

D. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

E. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

F. Expansion Fittings: Comply with requirements in Division 20 Section 200516 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each hydronic terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air and dirt separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Provide strainers upstream of each connection to water to water heat pumps with mesh size complying with reviewed submittals.

F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. This Section includes the following:
   1. Close-coupled, in-line centrifugal pumps.
   2. Separately coupled, base-mounted, end-suction centrifugal pumps.
   3. Wet-rotor pumps.
   4. Automatic condensate pump units.

1.3 DEFINITIONS

A. ECM: Electronically commutated motor.

B. EPDM: Ethylene propylene diene monomer.

C. EPR: Ethylene propylene rubber.

D. FKM: Fluoroelastomer polymer.

E. HI: Hydraulic Institute.

F. NBR: Nitrile rubber or Buna-N.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump.
   1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
   2. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.
   1. Show pump layout and connections.

2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.
4. PER_{CL} Index (for pumps regulated by the DOE standards).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Mechanical Seals: One mechanical seal for each pump.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Comply with requirements in Division 20 “Common Motor Requirements for Mechanical Equipment”.

C. Any pump supplied that is regulated by the Department of Energy pump standards shall be tested using the PER_{CL} method. The pump nameplate shall bear the PER_{CL} index. Pumps bearing only the PER_{VL} index will not be accepted. Submittals shall clearly identify the PEI's index and affirm that the index meets the DOE pump standards.

D. Selection:
1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.
2. Pump speed shall be limited to 1,800 RPM except as scheduled.
3. Shaft first critical speed shall not be less than 25 percent greater than operating speed.
4. Maximum impeller diameter shall not be greater than 90 percent of "cut water" diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.
5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.
6. Select pump at a point no greater than 85 percent of end of curve flow.
7. Maximum pump suction velocity:
   a. In-line: 12 fps.
   b. End suction: 13 fps.
   c. Double suction: 15 fps.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:
1. Armstrong Pumps.
2. Bell & Gossett.
3. Grundfos Pumps Corporation.
4. Paco Pumps.
5. Peerless Pump Company.
6. Taco.

B. Source Limitations: Obtain pumps from single source from single manufacturer.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psigminimum working pressure and a continuous water temperature of 225 deg F.

D. Pump Construction:
   1. Casing: Radially split, cast iron, with drain plug at bottom and air vent at top of volute, threaded gauge tappings at inlet and outlet, and flanged connections.
   2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
   3. Pump Shaft Sleeve: Type 304 stainless steel.
   4. Pump Stub Shaft: Type 304 stainless steel.
   5. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and NBR bellows and gasket. Include water slinger on shaft between motor and seal.

E. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
   1. Enclosure: Totally enclosed, fan cooled.
   2. NEMA Premium Efficient motors as defined in NEMA MG 1.
   3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   5. Variable-speed motor.
   6. Provide integral pump motor variable-speed controller.

2.4 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:
   1. Armstrong Pumps.
   2. Bell & Gossett.
   3. Paco Pumps.
   4. Peerless Pump Company.
   5. Taco.

B. Source Limitations: Obtain pumps from single source from single manufacturer.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psigminimum working pressure and a continuous water temperature of 225 deg F.

D. Pump Construction:
   1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections.
   2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
   3. Pump Shaft: Type 304 stainless steel.

4. Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and NBR bellows and gasket.
5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

E. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration.

F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36/A36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

H. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
1. Enclosure: Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Variable-speed motor.
6. Provide integral pump motor variable-speed controller.

2.5 AUTOMATIC CONDENSATE PUMP UNITS

A. Manufacturers:
1. Aurora Pump.
2. Beckett Corporation.
3. Flowserve Corporation.
4. Hartell Pumps.
5. Little Giant Pump Co.
6. Mepco.

B. Source Limitations: Obtain pump units from single source from single manufacturer.

C. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Collects and removes condensate from fan coil units, air handling units, condensing boilers, and similar components. Include factory- or field-installed check valve and a 72-inch-minimum, electrical power cord with plug.

2.6 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:
1. Angle pattern.

2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze 16-mesh wire startup and Type 304 stainless steel permanent strainers with3/16-inch perforations and 51 percent open area.
4. Type 304 stainless steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

2.7 INTEGRAL PUMP MOTOR VARIABLE-SPEED CONTROLLERS

A. Where specified or scheduled, provide pumps with an integral pump motor speed controller.
   1. Motor: Operates as constant- or variable-speed pump with speed regulated by an integrated variable-speed drive.
   2. Integrated Pump Controller: Supports direct communication with the building management system (BMS) with built-in support for the following protocols: BACnet MS/TP.
   3. Commissioning and pump set up access to pump controls via the following:
      a. A web interface (data exchange).
      b. A user interface located on the face of speed controller to adjust modes and mode values.
      c. An electronic display that reads real-time mode set values, flow, head, speed, and power and that locks out unauthorized adjustment of pump.
   4. Provide electronics with "Auto" as factory default but slope of the proportional curve will automatically match the required system curve, constant pressure control (delta-p/c), variable differential pressure control (delta-p/v), constant curve duty (uncontrolled pump), and rpm regulation. RPM (speed) regulation can be accomplished by the following:
      a. Manual (via user interface or HTML).
      b. Remote via 0 to 10 V dc.
      c. Data protocol communications with the BMS.
   5. Pump Electronics: Standard with multiple digital inputs and one external digital output to be available for additional mechanical room control and pump status monitoring.
   6. Controller: Mounted on or adjacent to the motor. Provide enclosure rated to UL Type 12.
   7. Electronically Protected Pumps: Rated for continuous duty and with built-in startup circuit. Provide overcurrent, line surge and current limit protection, thermal monitoring, heat sink status and over temperature protection.
   8. Pump capable of being monitored continuously via integrated Internet link.
   9. Integrated pump controller system to have the following features:
      a. Controller software shall be capable of sensorless control in variable-volume systems without need for pump-mounted (internal/external) or remotely mounted differential pressure sensor.
      b. Integrated Pump Controller Sensorless Control: Operates under Quadratic Pressure Control (QPC) to ensure that head reduction with reducing flow conforms to quadratic control curve.
      c. Controller:
         1) Minimum head of 40 percent of design duty head.

2) User-adjustable control mode settings and minimum/maximum head set points using built-in programming interface.

d. Controller Integrated Control Software:
   1) Capable of controlling pump performance for non-overloading power at every point of operation.
   2) Capable of maintaining flow rate data.

2.8 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Provide pumps so they are specified or scheduled with ECM.
   1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
   2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
   3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
   4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
   5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
   6. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain. Provide auxiliary drain pan for pump units located above ceiling.

E. Equipment Mounting:
   1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03 Section 033000 "Cast-in-Place Concrete."
   2. Comply with requirements for vibration isolation devices specified in Division 20 Section 200548 "Vibration Controls."

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.
   1. Comply with requirements for hangers and supports specified in Division 20 Section 200529 "Hangers and Supports."

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.

C. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

D. Comply with pump and coupling manufacturers' written instructions.

E. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check, shutoff, and throttling valves on discharge side of pumps.

F. Install Y-type strainer and suction diffuser and shutoff valve on suction side of base mounted pumps.
   1. Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.

G. Install Y-type strainer and shut off valve on suction side of inline pumps.

H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

J. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.

3.5 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Division 26 Section 260519 "Low Voltage Electrical Power Conductors and Cables."

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping. Use startup strainer for initial startup.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

6. Start motor.
7. Open discharge valve slowly.
8. Remove suction diffuser startup strainers after 48 hours of continuous circulation.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Hydronic pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

E. Division 20 Section 205993 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

F. Division 23 Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Double-wall rectangular ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

1.3 DEFINITIONS

A. ASCE/SEI: American Society of Civil Engineers/Structural Engineers Institute.

B. ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers.

C. AWS: American Welding Society.

D. CFR: Code of Federal Regulations.

E. EPA: Environmental Protection Agency.

F. EPDM: Ethylene-propylene-diene terpolymer rubber.

G. ICC: International Code Council.

H. IESNA: Illuminating Engineers Society of North America.

I. HEPA: High Efficiency Particulate Arrestor.

J. LEED: Leadership in Energy and Environmental Design.

K. NADCA: National Air Duct Cleaners Association.

L. NAIMA: North American Insulation Manufacturers Association.

M. NFPA: National Fire Protection Association.

N. NRTL: Nationally Recognized Testing Laboratory.

O. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

P. SPIDA: Spiral Duct Manufacturers Association.

Q. UL: Underwriters Laboratories, Inc.

R. VOC: Volatile Organic Compound.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

3. Seismic-restraint devices.

B. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1-foot scale. Show fabrication and installation details for metal ducts. Shop drawings are to be reviewed by the Architect prior to any fabrication.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top and bottom of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Penetrations of smoke barriers and fire-rated construction.
   6. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Fire alarm devices.
      g. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
   3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. NFPA Compliance:
   1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”
   2. NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems.”

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eastern Sheet Metal (ESM).
   2. Lindab.
   3. McGill AirFlow.
   4. SEMCO.
   5. Sheet Metal Connectors.
   6. Spiral Manufacturing Co.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse joints in ducts larger than 60 inches in diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

2. Fabricate round ducts 90 inches and smaller in diameter with one of the following based on indicated pressure class:
   a. Equal to or greater than +/- 4 inches.
      1) Butt Weld Seam.
      2) Spiral Seam.
   b. Equal to or less than +/- 4 inches.
      1) Spiral Seam.
      2) Lap and Rivet.
      3) Grooved Seam
   c. Exposed ductwork shall be spiral seam unless otherwise noted.
3. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. McGill AirFlow.
   2. MKT Metal Manufacturing.
   3. Pro-Fab Sheet Metal.
   4. Sheet Metal Connectors.
   5. Universal Spiral Air.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Coat insulation with antimicrobial coating.
   4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. CertainTeed Corporation.
   3. Johns Manville.
   4. Knauf Insulation.
   5. Owens Corning.
      a. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg Fat 75 deg F mean temperature.
         2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F> at 75 deg F mean temperature.
   6. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   7. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; and when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches
   3. Sealant: Modified styrene acrylic.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch w.g., positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   1. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch w.g., positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
   1. General: Single-component, acid-curing, silicone, elastomeric.
   2. Type: S.
   3. Grade: NS.
   4. Class: 25.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch w.g. and shall be rated for 10-inch w.g. static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through required exit stairwells, elevator hoistways and machinery rooms, transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Outdoor, Supply-Air Ducts: Seal Class A.
   3. Outdoor, Exhaust Ducts: Seal Class C.
   4. Outdoor, Return-Air Ducts: Seal Class C.
   5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch w.g. and Lower: Seal Class B.
   6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch w.g.: Seal Class A.
   7. Unconditioned Space, Exhaust Ducts: Seal Class C.
   8. Unconditioned Space, Return-Air Ducts: Seal Class B.
   9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch w.g. and Lower: Seal Class C.
   10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch w.g.: Seal Class B.
   11. Conditioned Space, Exhaust Ducts: Seal Class B.
   12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
   a. Ducts with a Pressure Class Higher Than 3-Inch w.g.: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

b. Supply Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
c. Return Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
d. Exhaust Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
e. Outdoor Air Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. New ducts that are protected from debris during onsite storage and after installation, and meet the requirements of the Duct System Cleanliness Test do not require additional cleaning.

C. New ducts that are utilized for temporary heating and cooling, include MERV 8 filtration on all points of intake (return air), and meet the requirements of the Duct System Cleanliness Test do not require additional cleaning.

D. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section 233300 "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   4. Coils and related components.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   6. Supply-air ducts, dampers, actuators, and turning vanes.
   7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
   4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
   5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
   6. Provide drainage and cleanup for wash-down procedures.
   7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Division 20 Section 200593 "Testing, Adjusting, and Balancing."

3.10 DUCT SCHEDULE

A. See duct application schedule on plans.

B. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel].
   2. Aluminum Ducts: Aluminum

C. Liner:
   1. Supply Air Ducts: Fibrous glass, Type 1 inch thick.
   2. Return Air Ducts: Fibrous glass, Type 1 inch thick.
   3. Transfer Ducts: Fibrous glass, Type 1 inch thick.

D. Double-Wall Duct Interstitial Insulation:
   1. Supply Air Ducts: 1 inch thick.
   2. Return Air Ducts: 1 inch thick.

E. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 without vanes.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.
   2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
      a. Velocity 1000 fpm or Lower: 90-degree tap.
      b. Velocity 1000 to 1500 fpm: Conical tap.
      c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

E. Division 23 Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

F. Division 28 Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.2 SUMMARY

A. Section Includes:
1. Backdraft dampers.
2. Pressure relief doors.
3. Barometric relief dampers.
4. Manual volume dampers.
5. Control dampers.
6. Fire dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Flange connectors.
10. Duct silencers.
11. Turning vanes.
12. Remote damper operators.
13. Duct-mounted access doors.
14. Duct access panel assemblies
15. Flexible connectors.
16. Flexible ducts.
17. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      b. Manual volume damper installations.
      c. Control damper installations.
      d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
      e. Duct security bars.
      f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with AMCA 500-D testing for damper rating.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance.
   2. American Warming and Ventilating.
   3. Cesco Products.
   4. Duro Dyne.
   5. Greenheck Fan Corporation.
   6. Nailor Industries.
   7. Pottorff.
   8. Ruskin Company.
   9. SEMCO.
   10. Vent Products Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm

D. Maximum System Pressure: 3-inch wg.

E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch width, with sealed edges.

G. Blade Action: Parallel.

H. Tie Bars and Brackets: Galvanized steel.

I. Return Spring: Adjustable tension.

J. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20-gage minimum.
      b. Sleeve Length: 6 inches minimum.
   6. Screen Mounting: Rear mounted.
   7. 90-degree stops.

2.4 PRESSURE RELIEF DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Kees.
   3. Ruskin.

B. Door and Frame Material: Galvanized sheet steel.

C. Door: Single wall or Double wall with insulation fill with metal thickness applicable for duct pressure class.

D. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

E. Factory set at 4-inch wg. and adjustable in the field.

F. Doors close when pressures are within set-point range.

G. Hinge: Continuous piano.

H. Latches: Cam.

I. Seal: Neoprene or foam rubber.

J. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.5 MANUAL VOLUME DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance.
   2. American Warming and Ventilating.
   3. Flexmaster U.S.A.
   4. Greenheck Fan Corporation.
   5. McGill AirFlow.
   6. METALAIRE.
   7. Nailor Industries.
   8. Pottorff.
   9. Ruskin Company.
   10. Vent Products Company.

B. Low-Leakage, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Air Balance.
      b. American Warming and Ventilating.
      c. Flexmaster U.S.A.
      d. Greenheck Fan Corporation.
      e. METALAIRE.
      f. Nailor Industries.
      g. Ruskin Company.
   2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat shaped.
      b. 0.094-inch- thick, galvanized sheet steel.
      c. Mitered and welded corners.
      d. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized roll-formed steel, 0.064 inch thick.
   6. Blade Axles: Galvanized steel
   7. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   8. Jamb Seals: Cambered
   9. Accessories:
      a. Include locking device with 2” stand-off bracket to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:
   1. Size: 1-inch diameter.
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:
   1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating.
   2. Cesco Products.
   3. Duro Dyne.
   4. Greenheck Fan Corporation.
   5. McGill AirFlow.
   6. METALAIRE.
   7. Nailor Industries.
   8. Ruskin Company.
   9. Vent Products Company.
   10. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
   1. Hat shaped.
   2. 0.094-inch- thick, galvanized sheet steel
   3. Mitered and welded corners.

D. Blades:
   1. Multiple blade with maximum blade width of 6 inches
   2. Parallel- and opposed blade design.
   3. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- diameter; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
   1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
   1.].
   2. Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

3. Thrust bearings at each end of every blade.

2.7 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.
   2. Cesco Products.
   3. Greenheck Fan Corporation.
   4. McGill AirFlow.
   5. METALAIRE.
   6. Nailor Industries.
   7. Ruskin Company.
   8. Vent Products Company,
   9. Ward Industries.

B. Type: Dynamic rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch w.g. static pressure class and minimum 2000-fpmvelocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.138-inch-thick, as indicated, and of length to suit application.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.8 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance.
   2. Cesco Products.

3. Greenheck Fan Corporation.
4. Nailor Industries.
5. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

D. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- thick, galvanized sheet steel.

E. Leakage: Class I.

F. Rated pressure and velocity to exceed design airflow conditions.

G. Mounting Sleeve: Factory-installed, 0.05-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

H. Smoke dampers are normally two-position but modulating dampers can be used for duct static pressure control or building pressurization control in high-rise buildings

I. Damper Motors: Two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:
1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.
   2. Cesco Products.
   3. Greenheck Fan Corporation.
   4. Nailor Industries.
   5. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch w.g. static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded corners.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Blades: Roll-formed, horizontal, 0.063-inch- thick, galvanized sheet steel.

H. Leakage: Class **I**.

I. Rated pressure and velocity to exceed design airflow conditions.

J. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application.

K. Master control panel for use in dynamic smoke-management systems.

L. Combination Fire/Smoke dampers are normally two-position but modulating dampers can be used for duct static pressure control or building pressurization control in high-rise buildings

M. Damper Motors: Two-position action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section 230900 "Instrumentation and Control for HVAC."
   3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft, size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

O. Accessories:
1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted

2.10 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries.
2. Elgen.
3. Nexus PDQ.
4. Ward Industries, Inc.

B. Description: factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.11 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Industrial Noise Control.
2. McGill AirFlow.
3. Price Industries.
4. Ruskin Company.
5. Vibro-Acoustics.
6. VAW Systems.

B. General Requirements:
1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:
   1. Rectangular straight with splitters or baffles.
   2. Rectangular elbow with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, , galvanized sheet steel, 0.034 inch thick.

E. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034-inch-thick, and with 1/8-inch- diameter perforations.

F. Connection Sizes: Match connecting ductwork unless otherwise indicated.

G. Principal Sound-Absorbing Mechanism:
   1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
   2. Dissipative type with fill material.

H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
   1. Joints: Lock formed and sealed.
   2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
   3. Reinforcement: Cross or trapeze angles for rigid suspension.

I. Accessories:
   1. Factory-installed end caps to prevent contamination during shipping.
   2. Removable splitters.

J. Source Quality Control: Test according to ASTM E 477.
   1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with air velocity of at least 2000-fpm face velocity.
   2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch w.g. static pressure, whichever is greater.

2.12 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries.
   2. Duro Dyne.
   3. METALAIRE.
   4. SEMCO.
   5. Ward Industries.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 36 inches wide and double wall for larger dimensions.

2.13 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Metropolitan Air Technology (MAT).
   2. Pottorff.
   3. Ventfabrics.
   4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass

D. Cable: Stainless steel

E. Wall-Box Mounting: Recessed, 2 inches deep.

F. Wall-Box Cover-Plate Material: Painted Steel

2.14 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating.
   2. Cesco Products.
   3. Ductmate Industries.
   4. Flexmaster U.S.A.
   5. Greenheck Fan Corporation.
   6. McGill AirFlow.
   7. Nailor Industries.
   8. Pottorff.
   9. Ruskin.

10. Ventfabrics.
11. Ward Industries.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries.
2. Duro Dyne.
3. Ventfabrics.
4. Ward Industries.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.
4. Service Temperature: Minus 67 to plus 500 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.16 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Atco.
   2. Flexmaster U.S.A.
   3. Hart & Cooley
   4. Thermaflex.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; vapor-barrier film.
   1. Pressure Rating: 10-inch w.g. positive and 1.0-inch w.g. negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Insulated, Flexible Duct: UL 181, Class 1, polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation vapor-barrier film.
   1. Pressure Rating: 4-inch w.g. positive and 0.5-inch w.g. negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 20 to plus 175 deg F.
   4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

D. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with zinc-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.17 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of Pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft, control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.
   3. Install stainless steel volume dampers in stainless steel ducts and PVC coated steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. Upstream and downstream from duct filters.
   3. At outdoor-air intakes and mixed-air plenums.
   4. At drain pans and seals.
   5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   7. At each change in direction and at maximum 50-foot spacing.
   8. Upstream and downstream from turning vanes.
   9. Upstream or downstream from duct silencers.

10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Division 20 Section 200553 "Mechanical Identification" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch w.g. and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly

O. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. This Section includes the following:
   1. Centrifugal roof ventilators.
   2. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set(s) for each belt-driven unit.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Engineering & Mfg. Corp.
   2. Aerovent.
   3. Breidert Air Products.
   4. Carnes Company.
   5. Greenheck Fan Corporation.
   6. Hartzell Fan.
   7. Loren Cook Company.
   8. PennBarry.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
   2. Hinged kit: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:
   1. Resiliently mounted to housing.
   2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
   5. Fan and motor isolated from exhaust airstream.

E. Accessories:
   1. Variable-Speed Controller (See plans): Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Disconnect Switch (All fans): Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   3. Bird Screens (Non upblast): Removable, 1/2-inch mesh, aluminum.
   4. Dampers (Non upblast): Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 18 inches.
   3. Metal Liner (Non-upblast): Galvanized steel.
   4. Vented Curb (Upblast fan only): Unlined with louvered vents in vertical sides.

2.2 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Engineering & Mfg. Corp.
   2. Carnes Company.
   3. Greenheck Fan Corporation.
   4. Hartzell Fan.
   5. Loren Cook Company.
   6. PennBarry.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:
   1. Variable-Speed Controller (All fans): Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Companion Flanges (All fans): For inlet and outlet duct connections.
   3. Dampers (See plans for locations): Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   4. Motorized Dampers (See plans for locations): Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
   5. Disconnect Switch (All fans): Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Division 07 Section 077200 "Roof Accessories" for installation of roof curbs.

C. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1-inch Vibration-control devices are specified in 20 Section 200548 "Vibration Controls."

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 20 Section 200553 "Mechanical Identification."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
   10. Shut unit down and reconnect automatic temperature-control operators.
   11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 20 Section 200593 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233433 - AIR CURTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section includes air curtains with hot-water heat.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties, and accessories.

B. Shop Drawings: For air curtains. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For air curtains indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of air-curtain mounting assemblies.
   2. Design Calculations: Calculate requirements for selecting vibration isolators

1.4 INFORMATIONAL SUBMITTALS

A. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air curtains to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish one set of filters.
   2. Furnish one set of fan belts for each unit.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with AMCA 220, "Laboratory Methods of Testing Air Curtains for Aerodynamic Performance Ratings," for airflow, outlet velocity, and power consumption.

C. Comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils," for components, construction, and rating.
   1. Certify coils according to ARI 410.

D. Comply with NSF 37, "Air Curtains for Entranceways in Food and Food Service Establishments."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.
   1. Warranty Period (Water Heating Units): 24 months.

PART 2 - PRODUCTS

2.1 AIR-CURTAIN UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berner International.
   2. Loren Cook Company.
   3. Marley Engineered Products.
   4. Mestek, Inc.; L. J. Wing Division.

B. Housing:
   1. Materials: Heavy-gage, aluminum construction.
      a. Anodized Finish: Match finish and color of adjacent architectural metals. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   2. Discharge Nozzle: High efficiency, low noise, Integral part of the housing, containing fixed air-directional vanes.

C. Mounting Brackets: Steel, for wall mounting.

D. Air-Intake Grille:
   1. Grille: Perforated, Integral part of and same material as the housing.

E. Fans:
   1. Centrifugal, forward curved, double width, double inlet.
   2. Statically and dynamically balanced.

F. Direct drive Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Multispeed.
   3. Resiliently mounted.
   4. Continuous duty.
   5. Integral thermal-overload protection.
   6. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
   7. Disconnect: Internal power cord with plug and receptacle.

G. Water Coils:
   1. Type: Continuous-circuit.
   2. Piping Connections: Threaded on same end.
   3. Tube Material: Copper, complying with ASTM B 75.
      a. Tube Diameter: 0.625 inch.
   4. Fins: Aluminum
   5. Headers: Cast iron with drain and air vent tappings
   6. Frames: Galvanized-steel channel frame, 0.052 inch
   7. Ratings: According to ASHRAE 33.
   8. Working-Pressure Ratings: 200 psig, 325 deg F.

H. Filters:
   1. Washable Panel Filters: Removable, stainless-steel, baffle-type filters with spring-loaded fastening; with minimum 0.0781-inch- thick, stainless-steel filter frame.

I. Controls:
   1. Automatic Door Switch: Roller type installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
   2. Time-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.
   3. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, terminal strip, and NEMA 250, enclosure. BACnet capable.

J. Accessories:
   1. Mounting Brackets: Adjustable mounting brackets for drum-type roll-up doors.

2.2 SOURCE QUALITY CONTROL

A. Source Quality Control: Test to 300 psig and to 200 psig underwater.

B. Testing: Test and inspect steam coils according to ASHRAE 33.

C. Steam coils will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for hot-water piping systems to verify actual locations of piping connections before air-curtain installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install air curtains with clearance for equipment service and maintenance.

B. Comply with requirements for hangers and supports specified in Division 20 Section 200529 ”Hangers and Supports."

3.3 CONNECTIONS

A. Comply with requirements for heating hot water piping specified in Division 23 Section 232113 "Hydronic Piping" and Division 23 Section 232116 “Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. After installing air curtains completely, perform visual and mechanical check of individual components.

2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
3. Inspect for water leaks.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-curtain unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust motor and fan speed to achieve specified airflow.

B. Adjust discharge louver.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air curtains.

END OF SECTION 233433

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. This Section includes the following:
   1. Single-duct air terminal units.
   2. Casing liner.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air terminal units.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Hangers and supports, including methods for duct and building attachment.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Size and location of initial access modules for acoustic tile.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   1. Anemostat.Johnson Controls.
   3. Nailor Industries.
   4. Price Industries.
   5. Titus.
   6. Trane.
   7. Tuttle & Bailey.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 22 gauge galvanized steel, single wall.
   1. Casing Liner: Comply with requirements in "Casing Liner" Article for duct liner.
   2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
   3. Air Outlet: S-slip and drive connections.
   4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   6. Provide mounting brackets on casing.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
   2. Damper Position: Normally open.

3. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.

E. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

F. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section 230900 "Instrumentation and Control for HVAC."

G. Control devices shall be compatible with temperature controls system specified in Division 23 Section 230900 "Instrument and Control for HVAC."

2.3 CASING LINER

A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Minimum Thickness: 3/4 inch
      a. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
         2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. Adhesive VOC Content: 80 g/L or less.
      b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Division 20 Section 200529 "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.3 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

B. Hot-Water Piping: Comply with requirements in Division 23 Section 232113 "Hydronic Piping" and Division 23 Section 232116 “Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Comply with requirements in Division 23 Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section 233300 "Air Duct Accessories."

3.4 IDENTIFICATION

A. Comply with requirements in Division 20 Section 200553 "Mechanical Identification" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

D. Division 23 Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUMMARY

A. Section Includes:
1. Round diffusers.
2. Square ceiling diffusers.
3. Perforated grilles.
4. Louver face diffusers and grilles
5. Drum louvers.
6. Fixed face grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, fire alarm devices, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Round Diffuser
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products.
   b. Carnes Company.
   c. Hart & Cooley.
   d. METALAIRE.
   e. Nailor Industries.
   f. Price Industries.
   g. Titus.
   h. Tuttle & Bailey.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel
4. Finish: Baked enamel
5. Face Style: Round plaque
6. Mounting: Duct connection.
7. Pattern: Fully adjustable.
8. Accessories:
   a. Safety chain.

B. Square Ceiling Diffusers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products.
   b. Carnes Company.
   c. Hart & Cooley.
   d. METALAIRE.
   e. Nailor Industries.
   f. Price Industries.
   g. Titus.
   h. Tuttle & Bailey.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel
5. Face Size: 24 by 24 inches
6. Face Style: Plaque.
7. Mounting: T-bar
8. Pattern: Fixed.

C. Perforated Grille:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products.

b. Carnes Company.
c. Hart & Cooley.
d. METALAIRE.
e. Nailor Industries.
f. Price Industries.
g. Titus.
h. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel.
5. Face Size: See plans
6. Duct Inlet: See plans.
7. Face Style: Flush.
8. Mounting: Surface or T-bar.
9. Pattern Controller: None.

D. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products.
   b. Carnes Company.
   c. Hart & Cooley.
   d. METALAIRE.
   e. Nailor Industries.
   f. Price Industries.
   g. Titus.
   h. Tuttle & Bailey.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel
5. Face Size: See plans.
6. Mounting: Surface or duct
7. Pattern: Two-way.
8. Accessories:
   a. Adjustable pattern vanes.

2.2 HIGH-CAPACITY DIFFUSERS

A. Drum Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products.
   b. Carnes Company.
   c. Hart & Cooley.
   d. Krueger.
   e. METALAIRE.
   f. Nailor Industries.
   g. Price Industries.
   h. Titus.

i. Tuttle & Bailey.
2. Airflow Principle: Extended distance for high airflow rates.
3. Material: Aluminum, heavy gage extruded.
4. Finish: White baked acrylic.
5. Border: 1-1/4-inch width with countersunk screw holes.
6. Gasket between drum and border.
7. Body: Drum shaped; adjustable vertically.
8. Blades: Individually adjustable horizontally.
9. Mounting: Surface to **duct**.
10. Inlet Width: See plans
11. Inlet Length: See plans.
12. Accessories:
    a. Opposed-blade steel damper.
    b. Duct-mounting collars with countersunk screw holes.
    c. Pole operator bracket.
    d. Adjustment pole.

2.3 REGISTERS AND GRILLES

A. Fixed Face Grille**:**
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Anemostat Products.
    b. Carnes Company.
    c. Hart & Cooley.
    d. Krueger.
    e. Nailor Industries.
    f. Price Industries.
    g. Titus.
    h. Tuttle & Bailey.
2. Material: Aluminum.
3. Finish: Baked enamel
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Retain first subparagraph below if mounting frame is required.
8. Mounting: Lay in.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Support flexible duct connectors at connection to air diffusion devices with “FLEXFLOW ELBOW” elastomeric duct elbow support as manufactured by Thermaflex or approved equal.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Roof hoods.
   2. Goosenecks.

1.3 PERFORMANCE REQUIREMENTS

A. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
   1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members to which roof curbs and ventilators will be attached.
   2. Sizes and locations of roof openings.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

B. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use screws for exposed fasteners unless otherwise indicated.

2.2 FABRICATION, GENERAL

A. Factory fabricate roof hoods to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Engineering & Mfg. Corporation.
   2. Aerovent.
   3. Carnes Compnay.
   4. Greenheck Fan Corporation.
   5. Loren Cook Company.
   6. PennBarry.

B. Factory fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch-thick hood suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 18 inches.

E. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

F. Galvanized-Steel Sheet Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
   2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
   3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
      a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 GOOSENECKS

A. Shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 6-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.

B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 18 inches.

C. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire

D. Galvanized-Steel Sheet Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
   2. Field-Painted Finish: Apply an air-dried primer immediately after cleaning and pretreating. Apply baked enamel finish to to match relief hood color as closely as possible for 2 mil thickness total.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install goosenecks on curb base

C. Install gravity ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section 079200 "Joint Sealants" for sealants applied during installation.

F. Label gravity ventilators according to requirements specified in Division 20 Section 200553 "Mechanical Identification."

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Division 23 Section 233113 "Metal Ducts". Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. This Section includes the following:
   1. Listed double-wall vents.
   2. Listed grease ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Special gas vents.
   2. Grease ducts.
   3. Guy wires and connectors.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
   2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section 077200 "Roof Accessories."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Heat-Fab.
   2. Metal-Fab.
   3. Selkirk Corporation.
   4. Schebler Co.
   5. Z-Flex.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Aluminized or Stainless steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
   1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

2.2 LISTED GREASE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Heat-Fab.
   2. Metal-Fab.
   3. Schebler Co.
   4. Selkirk Inc.
   5. Van-Packer Company.

B. Description: Double-wall metal vents tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a **1-inch** annular space filled with high-temperature, ceramic-fiber insulation.

D. Inner Shell: ASTM A 666, Type 304 stainless steel.

E. Outer Jacket: Aluminized steel where concealed. Stainless steel where exposed.

F. Accessories: Tees, elbows, increasers, hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters and drain fittings.

2.3 GUYING AND BRACING MATERIALS

A. Cable: Three galvanized, stranded wires of the following thickness:
   1. Minimum Size: 1/4 inch in diameter.
   2. For ID Sizes 4 to 15 Inches: 5/16 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Special Gas Vent: Condensing gas appliances.

B. Listed Grease Ducts: Type I commercial kitchen grease duct.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain. Slope grease ducts at a minimum of 2% back in direction of the grease hood or toward an approved grease reservoir.

E. Provide listed and labeled grease duct cleanouts with tight fitting doors constructed of steel having thickness not less than that required for the duct, on horizontal sections of grease ducts not more than 20 ft. apart. Install per the manufacturers listing requirements and local code requirements.

F. Lap joints in direction of flow.

G. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section includes gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and sections, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Source quality-control reports.

C. Field quality-control reports.

D. Efficiency Data Points: Data shall be submitted per ASHRAE 155 Method of Testing for Rating Commercial Space Heating Boiler Systems. This data shall cover steady state thermal efficiency, part load efficiency, and idling energy input rate. Efficiency data not supported by a third party published test standard shall not be permitted.

E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period. Where "prorated" is indicated, the boiler manufacturer will cover the indicated percentage of cost of replacement parts. With "prorated" type, covered cost decreases as age of equipment increases.
   1. Warranty Period for Fire-Tube Condensing Boilers:
      a. Heat Exchanger and Tank: 10 years from date of Substantial Completion.
      b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Lifetime of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements" and other requirements in Chapter 6.

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 431, Subpart E, Appendix N.

2.2 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AERCO Benchmark.
   2. Cleaver Brooks Clearfire-CE.
   3. Lochinvar Crest.

4. Patterson Kelly Sonic.

B. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Units are to be for water-heating service only.

C. Primary Heat Exchanger: Corrosion-resistant Type 316 stainless steel.

D. Secondary Heat Exchanger: Corrosion-resistant Type 316 stainless steel.

E. Combustion Chamber and Flue Pipes: Corrosion-resistant stainless steel.

F. Pressure Vessel: Carbon steel with welded heads and tube connections.

G. Burner: Natural gas, forced draft.

H. Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.
   1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 20 "Common Motor Requirements for Mechanical Equipment."
      a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

I. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

J. Ignition: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.

K. Casing:
   1. Jacket: Factory painted sheet metal, with snap-in or interlocking closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   3. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the heat exchanger.
   4. Combustion-Air Connections: Inlet and vent duct collars.

L. Capacities and characteristics are listed in the mechanical schedule drawing.

2.3 TRIM FOR HOT-WATER BOILERS

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate**,** and high limit with manual reset.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. High and low gas-pressure switches.

F. Alarm bell with silence switch.

G. Boiler Air Vent: Automatic.

H. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.4 CONTROLS

A. Refer to Division 23 Section 230900 "Instrumentation and Control for HVAC."

B. Boiler operating controls shall include the following devices and features:
   1. Control transformer.
   2. Set-Point Adjust: Set points shall be adjustable.
   3. Electric, factory-fabricated and factory-installed panel to control burner-firing rate, to reset supply-water temperature inversely with outside-air temperature. Reset information to be provided by the building control system or a outside-air temperature sensor provided by the boiler manufacturer. Coordinate requirements with Division 23 Section 230900 "Instrumentation and Control for HVAC."
      a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
   1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
   2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
   3. Blocked Inlet Safety Switch: Manual-reset pressure switch factory mounted on boiler combustion-air inlet.
   4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
   1. Hardwired Points:
      a. Monitoring: On/off status, common trouble alarm, low water level alarm.
      b. Control: On/off operation, hot water supply temperature set-point adjustment.

2. A BACnet communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. All monitoring and control features, which are available at the local boiler control panel, shall also be available at the remote operator workstation through the building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are shown on Drawings and specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
   1. House in NEMA 250, Type 1 enclosure.
   2. Wiring shall be numbered and color-coded to match wiring diagram.
   3. Install factory wiring outside of an enclosure in a metal raceway.
   4. Field power interface shall be to non-fused disconnect switch
   5. Provide branch power circuit to each motor and to controls
   6. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Refer to Division 23 Section 235100 "Breechings, Chimneys, and Stacks."

2.7 CONDENSATE-NEUTRALIZATION UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Neutra-Safe Corporation.
   2. SFA Saniflo USA.
   3. Skidmore Pump.
   4. Wessels Company.

B. Description: Factory-fabricated and -assembled condensate-neutralizing capsule or tank assembly of corrosion-resistant plastic material with threaded or flanged inlet and outlet pipe connections. Device functions to prevent acidic condensate from damaging grain system. It is to be piped to receive acidic condensate discharged from condensing boiler and neutralize it by chemical reaction with replaceable neutralizing agent. Neutralized condensate is then piped to suitable drain.

C. Capsule or Tank features:
   1. All corrosion-resistant material.
   2. Suitable for use on all natural gas and propane boilers.
   3. Includes initial charge of neutralizing agent.
   4. Neutralizing agent to be easily replaceable when exhausted.
   5. Inlet and outlet pipe connections.

D. Capsule Configuration:
   1. Low-profile design for applications where boiler condensate drain is close to the floor.
   2. Easily removed and opened for neutralizing agent replacement.
   3. Multiple units may be used for larger capacity.

E. Tank Configuration:
   1. Utilized where boiler is elevated or where tank is installed in a pit with tank top flush with floor.
   2. Top easily removed for neutralizing agent replacement.
   3. Internal baffles to channel flow for complete neutralization.
   4. Integral bypass to prevent condensate backflow into appliance.
   5. Multiple units may be used for larger capacity.

2.8 SOURCE QUALITY CONTROL

A. UL Compliance: Test gas-fired boilers having input of more than 400,000 Btu/h (117 kW) for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

B. UL Compliance, Gas-Fired: Test gas-fired boilers for compliance with UL 2764. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

C. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

D. Test and inspect factory-assembled boilers, before shipping, in accordance with 2017 ASME Boiler and Pressure Vessel Code. Factory test boilers for safety and functionality; fill boiler with water, and fire throughout firing range, to prove operation of all safety components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.
   1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Equipment Mounting:
   1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03 Section 033000 "Cast-in-Place Concrete."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 PIPING CONNECTIONS

A. Comply with requirements for hydronic piping specified in Division 23 Section 232113 "Hydronic Piping."

B. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. When installing piping adjacent to boiler, allow space for service and maintenance of condensing boilers. Arrange piping for easy removal of condensing boilers.

E. Install condensate drain piping to condensate-neutralization unit and from neutralization unit to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow. Include any vent drains.

F. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

G. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve, and union or flange at each connection.

H. Install piping from safety relief valves to nearest floor drain.

3.4 DUCT CONNECTIONS

A. Boiler Venting:
   1. Comply with all boiler manufacturer's installation instructions.
   2. Refer to Division 23 Section 235100 “Breechings, Chimneys, and Stacks.”

3.5 ELECTRICAL CONNECTIONS

A. Connect wiring according to Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations.

B. Tests and Inspections:
   1. Perform installation and startup checks according to manufacturer's written instructions.
   2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
      b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Boiler will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video record the training sessions and provide electronic copy to Owner.
   1. Instructor shall be factory trained and certified.

2. Provide not less than two sessions of 4 hours of training for 8 hours total.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 235216

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Packaged energy recovery units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which equipment or suspension systems will be attached.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) of each type of filter specified.
   2. Fan Belts: One set(s) of belts for each belt-driven fan in energy recovery units.
   3. Wheel Belts: One set(s) of belts for each heat wheel.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance:
   1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
   2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."

C. ASHRAE Compliance:
   1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
   2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

E. UL Compliance:
   1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

1.8 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
   3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
   4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AAON
   2. Daikin Applied
   3. Trane.
   4. Johnson Controls

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed and calked weathertight, removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch- thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
   1. Inlet: Weatherproof hood, with damper for exhaust.
      a. Exhaust: Spring-return, two-position, motor-operated damper.
      b. Supply: Gravity backdraft damper

D. Heat Recovery Device: Heat wheel

E. Supply and Exhaust Fans: Forward-curved, centrifugal or SWSI centrifugal flexible duct connections.
   1. Motor and Drive: Direct driven, motor mounted on adjustable base.
   2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
   3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   4. Spring isolators on each fan having 1-inch static deflection.

F. Supply-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
   3. Coil Split: Row split interlaced.
   4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

G. Outdoor-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

H. Hot-Gas Reheat Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

I. Cooling-Coil Condensate Drain Pans:
   1. Fabricated from stainless-steel sheet and sloped in multiple planes to collect and drain condensate from cooling coils, coil piping connections, coil headers, and return bends.
   2. Complying with requirements in ASHRAE 62.1.
   3. Drain Connections: At low point of pan with minimum 1 ½” threaded nipple.
   4. Units with stacked coils shall have an intermediate drain pan to collect and drain condensate from top coil.

J. Indirect-Fired Gas Furnaces:
   1. Description: Factory assembled, piped, and wired; complying with NFPA 54, "National Fuel Gas Code," and ANSI Z21.47, "Gas-Fired Central Furnaces."
      a. AGA Approval: Furnace shall bear label of AGA.
   2. Burners: Stainless steel.
      a. Ignition: Electronically controlled electric spark with flame sensor.
   3. Heat-Exchanger Drain Pan: Stainless steel.
   4. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
   5. Gas Control Valve: Electronic modulating.
   6. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.
   7. Access: Fabricate section to allow removal and replacement of furnace and to allow in-place access for service.

K. Piping and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.
   1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
   2. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
   3. Include non-fused disconnect switches.
   4. Variable-speed controller to vary fan capacity from 100 to approximately 50 percent.

2.2 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: See schedule.

B. Compressor: Hermetic, scroll or inverter scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:
   1. Refrigerant: R-410A
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.
   9. Low-ambient kit high-pressure sensor.
   10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
   11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
   12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.3 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, MERV 8 Pre, and MERV 13 Final.

2.4 CONTROLS

A. Control equipment and sequence of operation are specified in Division 23 Section 230900 "Instrumentation and Control for HVAC."

B. DDC Controller:
   1. Controller shall have volatile-memory backup.

2. Safety Control Operation:
   a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
   b. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28 Section 283111 "Digital, Addressable Fire-Alarm System"
   c. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F
   d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
4. Unoccupied Period:
   a. Heating Setback: 10 deg F.
   b. Cooling Setback: System off.
   c. Override Operation: Two hours.
5. Supply Fan Operation:
   a. Occupied Periods: Run fan continuously.
   b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:
   a. Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain room or discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
   b. Unoccupied Periods: Compressors off.
7. Hot-Gas Reheat-Coil Operation:
   a. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles compressor.
   b. Unoccupied Periods: Reheat not required.
8. Gas Furnace Operation:
   a. Occupied Periods: Modulate burner to maintain room or discharge temperature.
   b. Unoccupied Periods: Cycle burner to maintain setback temperature.
9. Economizer Outdoor-Air Damper Operation:
   a. Occupied Periods: Open to 10 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F]. Use mixed-air temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
   c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 2- to 10-V dc.

10. Carbon Dioxide Sensor Operation:
    a. Occupied Periods: Reset minimum outdoor-air ratio down to minimum 10 percent to maintain maximum 1,000-ppm concentration.
    b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
11. VVT Relays:
    a. Provide heating- and cooling-mode changeover relays compatible with VVT terminal control system required in Section 233600 "Air Terminal Units" and Section 230900 "Instrumentation and Control for HVAC."

C. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:
    a. Adjusting set points.
    b. Monitoring supply fan start, stop, and operation.
    c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
    d. Monitoring occupied and unoccupied operations.
    e. Monitoring constant and variable motor loads.
    f. Monitoring variable-frequency drive operation.
    g. Monitoring cooling load.
    h. Monitoring economizer cycles.

2.5 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure gauge with integral switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Coil guards of painted, galvanized-steel wire.

D. Hail guards of galvanized steel, painted to match casing.

2.6 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    a. Materials: ASTM C 1071, Type I or II.
    b. Thickness: 1 inch
2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
    a. Liner Adhesive: Comply with ASTM C 916, Type I.

b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.
e. Curb Height: 18 inches

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install gas-fired furnaces according to NFPA 54, "National Fuel Gas Code."

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to ARI Guideline B. Install air-to-air energy recovery equipment on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section 077200 "Roof Accessories." Secure air-to-air energy recovery equipment to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Unit Support: Install unit level on structural curbs or pilings. Coordinate wall penetrations and flashing with wall construction. Secure air-to-air energy recovery equipment to structural support with anchor bolts.

D. Install units with clearances for service and maintenance.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section 232113 "Hydronic Piping" and Division 23 Section 232116 “Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance.

C. Connect piping to units mounted on vibration isolators with flexible connectors.

D. Connect cooling condensate drain pans with air seal trap at connection to drain pan and install cleanouts at changes in pipe direction.

E. Gas Piping: Comply with requirements in Division 23 Section 231123 "Facility Natural-Gas Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Make connection with AGA-approved flexible connectors.

F. Comply with requirements for ductwork specified in Division 23 Section 233113 "Metal Ducts."

G. Indirect-Fired Furnace Vent Connections: Comply with Division 23 Section 235100 "Breechings, Chimneys, and Stacks."

H. Install electrical devices furnished with units but not factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Adjust seals and purge.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   4. Set initial temperature and humidity set points.
   5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units. Minimum of 8 hours of on-site training.

END OF SECTION 237200

SECTION 237413 – PACKAGED UNITARY ROOFTOP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 013100 “Project Management and Coordination”, applies to this section and will require the contractors’ participation in the Above Ceiling Coordination Program.

D. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. This Section includes packaged, outdoor-mounted air conditioning units 20 tons and smaller with the following components and accessories:
   1. Direct-expansion cooling.
   2. Hot-gas reheat.
   3. Gas furnace.
   4. Economizer outdoor- and return-air damper section.
   5. Integral, space temperature controls.
   6. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

H. VVT: Variable-air volume and temperature.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which RTUs will be attached.
   2. Roof openings
   3. Roof curbs and flashing.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set for each belt-driven fan.
   2. Filters: One set of filters for each unit.

1.8 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
   3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
   4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trane.
   2. Daikin Applied.
   3. Johnson Controls.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
   1. Exterior Casing Thickness: 0.0626 inch thick.

C. Inner Casing Fabrication Requirements:
   1. Inside Casing: Galvanized steel, 0.034 inch perforated 40 percent free area.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   1. Materials: ASTM C 1071, Type I.
   2. Thickness: 1 inch.
   3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
   4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple
   3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved centrifugal; with permanently lubricated, ECM motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

C. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

D. Relief-Air Fan: Forward curved shaft mounted on permanently lubricated motor.

E. Fan Motor: Comply with requirements in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."

2.4 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
   3. Coil Split: Row split interlaced.
   4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

B. Outdoor-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

C. Hot-Gas Reheat Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: See schedule.

B. Compressor: Hermetic, scroll or inverter scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:
   1. Refrigerant: R-410A
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.
   9. Low-ambient kit high-pressure sensor.
   10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
   11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
   12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, MERV 8 Pre, and MERV 13 Final.

2.7 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
   1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.
   1. Fuel: Natural gas.
   2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve with vertical stainless steel extension.

E. Safety Controls:
   1. Gas Control Valve: Modulating.
   2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

A. Control equipment and sequence of operation are specified in Division 23 Section 230900 "Instrumentation and Control for HVAC."

B. DDC Controller:
   1. Controller shall have volatile-memory backup.
   2. Safety Control Operation:
      a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
      b. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28 Section 283111 "Digital, Addressable Fire-Alarm System".
      c. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F
      d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
   3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
   4. Unoccupied Period:
      a. Heating Setback: 10 deg F.
      b. Cooling Setback: System off.
      c. Override Operation: Two hours.
   5. Supply Fan Operation:
      a. Occupied Periods: Run fan continuously.
      b. Unoccupied Periods: Cycle fan to maintain setback temperature.
   6. Refrigerant Circuit Operation:
      a. Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain room or discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
      b. Unoccupied Periods: Compressors off.
   7. Hot-Gas Reheat-Coil Operation:
      a. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles compressor.
      b. Unoccupied Periods: Reheat not required.
   8. Gas Furnace Operation:
      a. Occupied Periods: Modulate burner to maintain room or discharge temperature.
      b. Unoccupied Periods: Cycle burner to maintain setback temperature.
   9. Economizer Outdoor-Air Damper Operation:
      a. Occupied Periods: Open to 10 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use mixed-air temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
      b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 2- to 10-V dc.

10. Carbon Dioxide Sensor Operation:
    a. Occupied Periods: Reset minimum outdoor-air ratio down to minimum 10 percent to maintain maximum 1,000-ppm concentration.
    b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
11. VVT Relays:
    a. Provide heating- and cooling-mode changeover relays compatible with VVT terminal control system required in Section 233600 "Air Terminal Units" and Section 230900 "Instrumentation and Control for HVAC."

C. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:
    a. Adjusting set points.
    b. Monitoring supply fan start, stop, and operation.
    c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
    d. Monitoring occupied and unoccupied operations.
    e. Monitoring constant and variable motor loads.
    f. Monitoring variable-frequency drive operation.
    g. Monitoring cooling load.
    h. Monitoring economizer cycles.
    i. Monitoring air-distribution static pressure and ventilation air volume.

2.11 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure gauge with integral switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Coil guards of painted, galvanized-steel wire.

D. Hail guards of galvanized steel, painted to match casing.

2.12 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    a. Materials: ASTM C 1071, Type I or II.

b. Thickness: 1 inch

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
   d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 18 inches

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Unit Support: Install unit level on structural curbs or pilings. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 20, Division 22, and Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

C. Install piping adjacent to RTUs to allow service and maintenance.
   1. Gas Piping: Comply with applicable requirements in Division 23 Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

D. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section 233300 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to furnace combustion chamber.

3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.

d. Outdoor-air intake volume.

27. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Minimum of 8 hours of on-site training.

END OF SECTION 237413

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 “General Commissioning Requirements”, applies to this section and will require the contractors’ participation in the commissioning process.

1.2 SUMMARY

A. Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) for each unit.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: Five year(s) from date of Substantial Completion.
      c. For Labor: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. LG.
   2. Mitsubishi.
   3. Multi-Aqua.
   4. Panasonic.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:
   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
   2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
   3. Fan: Direct drive, centrifugal.
   4. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."
      b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
      c. Enclosure Type: Totally enclosed, fan cooled.
      d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
      e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
      f. Provide unit-mounted disconnect switch.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   6. Condensate Drain Pans:
      a. Fabricated to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends), and to direct water toward drain connection.
         1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
         2) Depth: A minimum of 1 inch deep.
      b. Single-wall, corrosion resistant.
      c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple.
         1) Minimum Connection Size: NPS 1.
      d. Float Level Switch: Designed to connect to the control board to prevent condensate overflow.
   7. Condensate Pump: Provide capability to pump full drain rise / distance as shown on plans. Provide unit with reservoir and sensor.
   8. Air Filtration Section:
      a. General Requirements for Air Filtration Section:
         1) Comply with NFPA 90A.
         2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
         3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
      b. Washable Filters:
         1) Nano platinum and electrostatic anti-allergy enzyme filters.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:
   1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
   2. Compressor: Inverter-driven twin rotary. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
      a. Compressor Type: Inverter scroll
      b. Variable speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
      c. Refrigerant Charge: R-410A.
      d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
   3. Fan: Aluminum-propeller type, directly connected to motor.
   4. Motor: Permanently lubricated, with integral thermal-overload protection.
   5. Low Ambient Kit: Provide baffles as required to permit operation down to -40 deg F.
   6. Provide with hail guards.
   7. Refrigerant Line Kit: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends. Length as required for application / distance.
   8. Electrical: Single point connection. Indoor unit is powered directly from the outdoor unit.
   9. Roof equipment support curbs: Galvanized-steel sheet; unitized construction with integral base plate, continuous welded corner seams, pressure treated wood nailer, counterflashing with screws.
      a. Overall Height: 18 inches.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Division 23 Section 230900 "Instrumentation and Control for HVAC."
   1. Unit Controls Interface: BACnet

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
   1. Compressor time delay.
   2. 24-hour time control of system stop and start.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Roof pipe penetration curb: Galvanized-steel sheet; unitized construction with integral base plate, 1 ½" insulation and 2x2 treated wood nailer. Furnish with thermoplastic cover, fanstening screws, and graduated step boots with stainless steel clamps. Provide cap package as required for number of refrigerant pipes / application.
   a. Overall Height: 12 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Where refrigerant piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238213 - RADIANT CEILING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section Includes:
   1. Hydronic radiant ceiling panels.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment.
   2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

PART 2 - PRODUCTS

2.1 HYDRONIC RADIANT CEILING PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aero Tech Mfg.
   2. AIRTEX Radiant Systems.
   3. Sterling.
   4. Sun-El Corporation.

B. Description: Linear sheet-metal panel with serpentine water piping, suitable for lay-in installation flush with T-bar ceiling grid.
   1. Panels: Fluted extruded aluminum, approximately 0.115 inches thick. Furnish blank filler pieces at corners and other locations required to form a continuous line.

2. Backing Insulation: Minimum 2-inch-thick, mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory-applied jacket.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive radiant heating and cooling units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic piping connections to verify actual locations before radiant heating and cooling unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install radiant ceiling panels level and plumb.

B. Suspend radiant ceiling panels from structure.

C. Coordinate layout and installation of radiant heaters and suspension-system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communications system, security system, and partition assemblies.

D. Support for Radiant Ceiling Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.
   1. Install a minimum of four ceiling support-system rods or wires for each panel. Locate not more than 6 inches from panel corners.
   2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
   3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans, or center in acoustical panel and support panels independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section 232113 "Hydronic Piping" and Division 23 Section 232116 “Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Unless otherwise indicated, install shutoff valve and union or flange at each connection.

C. Install piping adjacent to unit to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to maintain radiant ceiling panels.

END OF SECTION 238213

SECTION 238229 – RADIANT WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section includes flat-pipe wall mounted steel radiators.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Indicate location and size of each field connection.
   4. Indicate location and arrangement of piping valves and specialties.
   5. Indicate location and arrangement of integral controls and other accessories.

C. Color Samples for Verification: For each type of exposed finish.

PART 2 - PRODUCTS

2.1 FLAT-PIPE STEEL RADIATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Runtal North America.
   2. Sterling Hydronics.
   3. Vulcan Radiator.
   4. Zehnder Rittling.

B. Heating Elements: One piece all welded steel, and formed into flat, square, steel header with minimum thickness of 0.109 inch. Include threaded piping and air-vent connections.
   1. Working Pressure: 56 psig; 0.048 inch.

C. Mounting: Wall brackets with maximum spacing of 36 inches.

D. Finish: Powder coat finish in manufacturer's standard color as selected by Architect.

E. Accessories:
   1. Steel piping end covers and center panels with finish to match radiator finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive radiators for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of radiators.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb.

B. Install expansion compensation hoses.

C. Install piping covers.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section 232113 "Hydronic Piping". Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect radiators and components to piping according to Division 23 Section 232113 "Hydronic Piping".
   1. Install shutoff valves on inlet and outlet, and balancing valve on outlet. See details on plans.

C. Install control valves as required by Division 23 Section 230900 "Instrumentation and Control for HVAC."

D. Install piping adjacent to radiators to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238229

SECTION 238239 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section includes cabinet unit heaters with centrifugal fans and hot-water coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluorethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include location and size of each field connection.
   4. Include details of anchorages and attachments to structure and to supported equipment.
   5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
   6. Indicate location and arrangement of piping valves and specialties.
   7. Indicate location and arrangement of integral controls.
   8. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Cabinet Unit-Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hot Water Cabinet Unit Heater Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Airtherm.
   2. Carrier Corporation.
   3. Modine.
   4. Rittling.
   5. Sterling.
   6. Trane.
   7. Vulcan Radiator.

2.2 DESCRIPTION

A. Factory-assembled and -tested unit complying with AHRI 440.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 2021.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 CABINETS

A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect
   1. Vertical Unit, Exposed Front Panels: Minimum 16 gauge galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   2. Horizontal Unit, Exposed Bottom Panels: Minimum 16 gauge galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
   3. Recessed Flanges: Steel, finished to match cabinet.
   4. Control Access Door: Key operated.
   5. False Back: Minimum 18-gauge steel, finished to match cabinet.
   6. Insulation: Front panel and internal cabinet shall be insulated with minimum ¼" thick closed cell insulation.

2.5 FILTERS

A. Material: 1" disposable pleated high efficiency, MERV 8.

2.6 COILS

A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

2.7 CONTROLS

A. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section 200513 "Common Motor Requirements for Equipment."
   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
   4. Aquastat: Monitors the temperature of water leaving the coil and cycles fan on when pre-determined water temperature is reached.

B. Control devices and operational sequences are specified in Division 23 Section 230900 "Instrumentation and Control for HVAC" and on the drawings.

C. DDC Terminal Controller:
   1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
   2. Unoccupied Period Override: Two hours.
   3. Unit Supply-Air Fan Operations:
      a. Occupied Periods: Fan runs when activated by aquastat.
      b. Unoccupied Periods: Fan runs when activated by aquastat.

4. Heating-Coil Operations:
   a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
   b. Unoccupied Periods: Modulate control valve if room temperature falls below setback temperature.
5. Controller shall have volatile-memory backup.

D. Interface with DDC System for HVAC Requirements:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net compatible for central BAS workstation and include the following functions:
   a. Adjust set points.
   b. Cabinet unit-heater start, stop, and operating status.
   c. Data inquiry, including room-air temperature.
   d. Occupied and unoccupied schedules.

E. Electrical Connection: Factory-wired motors and controls for a single field connection.

2.8 ACCESSORIES

A. Motor Starter: Manual reset with toggle switch and thermal overload protection.

B. Disconnect Switch: 15 amp. Installed on face of electrical junction box.

C. Wall Trim: For recessed and fully recessed wall and ceiling mounted units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping connections to verify actual locations before unit-heater installation.

C. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section 079200 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Suspend ceiling mounted cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 20 Section 200548 "Vibration Controls."

D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Piping installation requirements are specified in the following Sections:
   1. Division 23 Section 232113 "Hydronic Piping."
   2. Division 23 Section 232116 "Hydronic Piping Specialties."

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Division 23 Section 232113 "Hydronic Piping".

F. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 238239

SECTION 238240 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

C. Division 01 Section 019113 General Commissioning Requirements, applies to this section and will require the contractors' participation in the commissioning process.

1.2 SUMMARY

A. Section includes propeller unit heaters with hot-water and electric-resistance heating coils.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. PTFE: Polytetrafluoroethylene plastic.

C. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include location and size of each field connection.
   4. Include details of anchorages and attachments to structure and to supported equipment.
   5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
   6. Indicate location and arrangement of piping valves and specialties.
   7. Indicate location and arrangement of integral controls.
   8. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hot Water Unit Heater Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Daikin Applied.
   2. Modine.
   3. Reznor.
   4. Rittling.
   5. Sterling.
   6. Trane.
   7. Vulcan Radiator.

B. Electric Unit Heater Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brasch Manufaturing Co.
   2. Chromalox.
   3. Electra Tek Corp.
   4. Indeeco.
   5. Markel Products; a division of TPI Corporation.
   6. Sterling Radiator.
   7. Trane

2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in vertical or horizontal discharge configuration with adjustable discharge louvers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 2021.

D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and - tested propeller unit heaters before shipping.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

A. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.

B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

C. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
   1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
   2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.6 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 20 Section 200513 "Common Motor Requirements for Mechanical Equipment."

2.7 CONTROLS

A. Aquastat (Water coil units only): Monitors the temperature of water leaving the coil and cycles fan on when pre-determined water temperature is reached.

B. DDC Terminal Controller:
   1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
   2. Unoccupied Period Override: Two hours.
   3. Electric Unit Supply-Air Fan and Coil Operations: Operate together to maintain room temperature settings in occupied and unoccupied modes.

4. Hot Water Unit Supply-Air Fan Operations:
   a. Occupied Periods: Fan runs when activated by aquastat.
   b. Unoccupied Periods: Fan runs when activated by aquastat.
5. Heating-Coil Operations:
   a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
   b. Unoccupied Periods: Modulate control valve if room temperature falls below setback temperature.
6. Controller shall have volatile-memory backup.

C. Interface with DDC System for HVAC Requirements:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net compatible for central BAS workstation and include the following functions:
   a. Adjust set points.
   b. Unit-heater start, stop, and operating status.
   c. Data inquiry, including room-air temperature.
   d. Occupied and unoccupied schedules.

D. Electrical Connection: Factory-wired motors and controls for a single field connection.

2.8 ACCESSORIES

A. Disconnect Switch: Unit mounted toggle switch for on/off control of fan operation.

B. Manual Starter: Unit mounted toggle switch with thermal overload protection.

C. Speed Controller: Unit mounted allowing adjustment of fan speed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping connections to verify actual locations before unit-heater installation.

C. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers.

D. Hanger rods and attachments to structure are specified in Division 20 Section 200529 "Hangers and Supports."

E. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Piping installation requirements are specified in the following Sections:
   1. Division 23 Section 232113 "Hydronic Piping."
   2. Division 23 Section 232116 "Hydronic Piping Specialties."

B. Install piping adjacent to machine to allow service and maintenance.

C. Comply with safety requirements in UL 1995.

D. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of propeller unit heater. Hydronic specialties are specified in Division 23 Section 232113 "Hydronic Piping" and Division 23 Section 232116 “Hydronic Piping Specialties."

E. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
   3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

END OF SECTION 238240

SECTION 260010 - GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 01, Commissioning Requirements, applies to this section and will require the contractor participation in the commissioning process.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for electrical systems provided under CSI Divisions 26, 27 and 28. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Divisions 26, 27 and 28 Specification sections and as indicated on Drawings.

B. Codes and Standards: Perform all Work in accordance with applicable Federal, State and local codes rules, ordinances and regulations. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standards, Rules and Regulations of NFPA, NECA, UL, and as follows unless otherwise indicated.

1. A.N.S.I. - American National Standards Institute
2. A.S.T.M. - American Society for Testing Materials
3. I.C.E.A. - Insulated Cable Engineers Association
4. I.E.E.E. - Institute of Electrical and Electronics Engineers

5. N.E.C. - National Electrical Code

6. N.E.C.A. -National Electrical Contractors Association

7. N.E.M.A. - National Electrical Manufacturer's Association

8. U.L. - Underwriters Laboratories, Inc.

9. N.E.C.A. 1-2000, “Practices for Good Workmanship in Electrical Contracting (ANSI).”

C. Where available products included in the work shall be “Listed”, as defined in article 100 of the NEC, by a nationally recognized testing laboratory. The listing shall be acceptable to the authority having jurisdiction. The listing shall indicate that the product’s safety-related standards have been evaluated with regard to all reasonably foreseeable safety-related hazards, including fire, electrical shock and mechanical hazards.

D. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.

E. All materials shall be new unless indicated otherwise to reuse existing equipment.

F. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

G. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

H. Performance Requirements: Perform all work following practices for good workmanship, in accordance with the latest accepted standards and practices for the trades involved.

I. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner’s Representatives causes interference.

1.4 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor.

B. Rules of local utility companies shall be complied with. Coordinate with the utility companies supplying service to the installation and determine all required interface devices, including the following, and include the cost of all such items and all utilities costs in proposal. Including.

1. All current and potential transformers,
2. Meter boxes,
3. C.T. cabinets and meters which will be required.
4. Surge protection,
5. Raceway sizes,
6. Connection points.

C. Prepare any detailed Drawings or diagrams which may be required by the governing authorities or authorities having jurisdiction. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.5 DRAWINGS

A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.6 CONSTRUCTION DOCUMENT INTERPRETATION

A. Any conflict within the documents shall be included with the highest cost.

1.7 MATERIAL AND EQUIPMENT MANUFACTURERS

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided;

1. Shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation,
2. Shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified,
3. Shall be compatible with the other components of the system,
4. Shall be by the same manufacturer, and
5. Shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications.

All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, mechanical work, controls work, technology work and building alterations shall be included in the original Bid.

1.8 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.9 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.

D. Submit for approval shop drawings for all electrical systems and equipment as listed below. Where items are referred to by symbolic designation on the Drawings and in the Specifications, all submittals shall bear a similar designation (light fixtures, wiring devices, etc.) as identified on the Drawings and in the Specifications and shall be submitted together and under the same cover, unless requested otherwise. Refer to other sections of the electrical Specifications for additional requirements.

1. Cable Trays
2. Wiring Devices
3. Lighting Control Devices
4. Electrical Power Monitoring and Control
5. Packaged Engine Generators
6. Enclosed Switches and Circuit Breakers
7. Transfer Switches
8. Enclosed Controllers
9. Switchboards
10. Panelboards
11. Enclosed Bus Assemblies
12. Dry Type Transformers (600 V and Less)
13. Fuses
14. Interior Lighting
15. Programmable Lighting Controls
16. Exterior Lighting
17. Dimming Controls
18. Fire Alarm
19. Underground Ducts and Raceways

1.11 COORDINATION DRAWINGS

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 1 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

1. Routine maintenance procedures.

2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.

3. Trouble-shooting procedures.

4. Contractor's telephone numbers for warranty repair service.

5. Submittals.

6. Recommended spare parts lists.

7. Names and telephone numbers of major material suppliers and subcontractors.

8. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

A. Submit record drawings in compliance with Division 1.

B. Contractor shall submit to the Architect/Engineer, record drawings in portable device format which have been neatly marked to represent as-built conditions for all new electrical work.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 1 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26, 27 or 28 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. Contractor shall be responsible for any and all temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items. If mounting heights are not indicated, install to provide maximum possible physical space for access after installation without adding a hazardous situation. Contact the Architect for direction.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 DEMOLITION WORK

A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures and associated conduit and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work. Remove abandoned wire and cable. Remove abandoned raceways unless removal will require extensive building wall or structure removal which was not part of the work. Abandoned raceways to remain shall be left in a safe and finished condition.

B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

3.3 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Prior to rough in, allow for flexibility, ten feet in any direction, in the final location of electrical system and wiring devices without additional cost to the Owner.

3.4 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the

services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.5 TEMPORARY SERVICES

A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 1, complete temporary electrical and telecommunication (voice/data) services for use during construction.

3.6 DISPOSAL

A. Fluorescent Lamps

1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).

2. Hazardous materials, including fluorescent lamps, shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.

3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.

4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.

B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.

2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.

3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.

4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.

3.7 ACCESS DOORS, CHASES AND RECESSES

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.8 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to General Conditions for requirements.

B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.9 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. Backfill all excavations, away from wall footings, with well-tamped granular material.

1. Place granular backfill in layers not more than 8 inches in thickness, Compact each layer to 95 percent, Excavated material shall not be used.

2. Outside building, first place granular material, as indicated above, up to 12 inches over top of pipe. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

D. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing.

3.10 EQUIPMENT CONNECTIONS

A. As included in the work, make connections to equipment, motors, elevator controllers and associated equipment, lighting fixtures, and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.11 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 EXTRA WORK

A. For any extra electrical work which may be proposed, this Contractor shall furnish to the Construction Manager, an itemized breakdown of the estimated cost of the

materials and labor required to complete this work. Proceed only after receiving a written order from the Construction Manager establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, submit unit prices (same prices for increase/decrease of work) for the following items:

1. 1/2", 3/4", 1", 1-1/2" conduit;
2. #12, #10, #8, #6, #2 wire;
3. Receptacles,
4. GFCI receptacle,
5. Data or network box,
6. Fire alarm devices,
7. Clock.
8. Light Fixtures by type.
9. Motor control devices

3.14 DRAWINGS AND MEASUREMENTS

A. These Specifications and accompanying Drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if called for by both. The Contractor understands that the work herein described shall be complete in every detail.

B. The Drawings are not intended to be scaled for rough-in measurements or to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION 260010

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 01, Commissioning Requirements, apply to this section and all of Division 26, 27 and 28, and will require the contractor participation in the Commissioning Process.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Plastic. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 27 Section “Communications Horizontal Cabling” for cabling used for voice and data circuits.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, and SO.

D. Multi-conductor Cable: Comply with NEMA WC 70 for Type SO with ground wire.

E. Fire-resistive Cable: Comply with NEMA WC 70. Cable shall be UL labeled as 2-hour fire-rated, type MI mineral-insulated with nickel-clad copper conductor, magnesium oxide insulation, copper alloy sheath, and rated 600 volts. Provide factory installed terminations or field termination kits from the same manufacturer as the cable.
1. Pentair Pyrotenax
2. In lieu of the mineral-insulated cable above, a 2-hour fire rated metal clad cable may be substituted. Provide RSCC & Cable VITALink.

F. VFD Cable
1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.
6. Thomas & Betts

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material type, and class for application and service indicated.

C. Push-in (pluggable, snap style, etc.) connectors shall not be used.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded.
1. Aluminum conductors are permitted for feeder size #1/0AWG and larger (where permissible by equipment being connected).

B. Branch Circuits: Copper. Unless indicated otherwise, solid for conductors #10AWG and smaller, stranded for conductors #8AWG and larger

C. Equipment circuits shall be copper, where required by manufacturer's recommendations or direction.

D. Minimum Conductor Sizes:

1. Feeders and Branch Circuits: No. 12 AWG.
2. Class 1 Control Circuits: No. 14 AWG.
3. Class 2 Control Circuits: No. 16 AWG.

E. Unless indicated otherwise, power circuits shall be 2#12, 1#12G, ¾"C.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN or Type XHHW single conductors in raceway.

B. Fire Pump Service Entrance: Type THHN-THWN or Type XHHW, single conductors in raceway, installed below floor slab or installed in at least 3 inches of concrete, or 2-hour fire-resistive cable.

C. Emergency Feeder Circuits: Type THHN-THWN or Type XHHW, single conductors in raceway, installed below floor slab, installed in fully sprinkled spaces or installed in a minimum 2-hour fire rated system or shall be a 2-hour fire-resistive cable system.

D. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

E. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN or Type XHHW, single conductors in raceway.

G. Feeders installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

H. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

I. Branch Circuits Concealed in Inaccessible Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

J. Branch Circuits in Accessible Ceiling Spaces:
   1. Type THHN-THWN, single conductors in raceways, or
   2. Type MC Cable in lengths 6’-0” or less and for use as a master slave connection between light fixtures.

K. Branch Circuits Gypsum-Board Partitions: Type THHN-THWN, single conductors in raceways.

L. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

M. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

N. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

O. Class 1 Control Circuits: Type THHN-THWN, in raceway.

P. Class 2 Control Circuits: Type THHN-THWN, in raceway, Power-limited cable, concealed in building finishes (not allowed in exposed ceiling of finished spaces), or Power-limited tray cable, in cable tray.

Q. Motor branch circuits, which include a variable frequency drive (VFD): Provide VFD cable from the source overcurrent protection device to the motor. Shields shall be

maintained electrically continuous and shall be terminated to the building ground system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. For circuits that require a neutral conductor, provide a dedicated neutral back to the panelboard.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.

D. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

E. Do not install conductors supplied from different panelboards, distribution panels, or switchboards in same conduit or raceway, unless otherwise noted.

F. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

G. Install cables parallel and perpendicular to surfaces of structural members, and follow surface contours where possible.

H. Do not route cables directly through panelboards, switchboards, motor starting equipment and similar equipment, as part of the cable pathway.

I. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.

   a. Conductors to the Emergency or Standby Generator.

2. Perform each electrical, visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification, including but not limited to the following:
   a. Bolted connection resistance,
   b. Insulation resistance with respect to ground and adjacent conductors,
   c. Continuity verification,
   d. Phase verification,
   e. Resistance of parallel conductors.

3. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

3.7 VOLTAGE DROP

A. Voltage drop shall not exceed two percent for feeder conductors.

B. Voltage drop shall not exceed three percent for branch conductors. Refer to table below for maximum permitted branch conductor lengths at rated voltages for indicated OCP. Where lengths are exceeded due to revised routing, calculate the voltage drop

and provide the appropriate conductor size to achieve the maximum allowable voltage drop.

Voltage Configuration	#12 AWG 20 amp OCP	#10 AWG 20 amp OCP	#10 AWG 30 amp OCP	#8 AWG 40 amp OCP	#6 AWG 50 amp OCP
120V, single phase	56 feet	93 feet	62 feet	72 feet	91 feet
208V, single phase	97 feet	162 feet	108 feet	124 feet	159 feet
240V, single phase	112 feet	187 feet	125 feet	144 feet	183 feet
277V, single phase	129 feet	216 feet	144 feet	166 feet	211 feet
480V, single phase	225 feet	374 feet	249 feet	288 feet	367 feet
208V, three phase	112 feet	187 feet	100 feet	115 feet	133 feet
240V, three phase	103 feet	173 feet	125 feet	144 feet	183 feet
480V, three phase	259 feet	433 feet	288 feet	333 feet	424 feet

Note: Table assumptions include copper conductors at 80% load capacity, 1.0 power factor, 75ºC temperature rating, EMT conduit, and three percent voltage drop.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Rectangular bars of annealed copper, 24”L by 1/4”D by 4”H, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Manufacturers:
1. Thomas & Betts
2. Burndy

B. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

E. Compression Connectors: Irreversible, factory filled with an oxide inhibitor. Connectors must comply with IEEE837, UL467 and CSA22.2

GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: stranded unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, in MDF and IDF rooms, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
3. Provide No. 3/0 AWG minimum insulated copper grounding conductor in raceway from grounding bus to neutral bus service entrance equipment.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground or Encased in Concrete Connections: Welded or compression, except at test wells and as otherwise indicated.
3. Aboveground and exposed: Welded or compression connectors except at test wells and as otherwise indicated.
4. Connections to Ground Rods at Test Wells: Bolted connectors.
5. Connections to Structural Steel: Welded connectors.
6. Compression connectors shall be installed with the same manufactures die so that the die index matches the listed index on the connector. Connector must be fully crimped with a 14 ton or larger hydraulic tool so that the index number is indented on the connector.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating

sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from foundation.

E. Pad-Mounted Generators: Install two ground rods and ground ring around the pad. Ground generator housing and noncurrent-carrying metal items associated with generator by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at

equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data equipment rooms, MDF and IDF rooms, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 24-by-1/4-by-4-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Use exothermic-welded or compression connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods, unless documented otherwise, spaced at least one-rod length from each other and located at least the same distance for other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section “Underground Ducts and Raceways for Electrical Systems” and shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Wiring Devices:

1. Install a 6 inch (150mm) green insulated pigtail from grounding terminal of wiring device to device box and equipment grounding conductor.
2. For lighting fixtures, install insulated grounding conductor and terminate to terminal on lighting fixture housing.
3. For electric motors, install an insulated equipment grounding conductor in branch circuit serving each electric motors, and bond to motor frame.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart. Install tinned-copper conductor not less than No. 2/0 AWG for tap to building steel.

I. Structural Steel and Catwalks: Provide braided bonding jumpers at building expansion joints to make building steel electrically continuous. Bond catwalks to building steel with braided bonding jumpers. Terminate bonding jumpers with exothermic welds.

J. Transformer Secondary Neutrals:

1. Provide No. 2 AWG minimum insulated copper grounding conductor, in raceway from grounding electrode system to transformer housing. Terminate to transformer XO connection.
2. Provide No. 3/0 minimum insulated copper grounding electrode conductor from transformer XO connection to building steel. Exothermically weld to building steel.
3. Looping grounding conductors from transformer to transformer shall not be allowed.

K. Cable Tray: Provide bonding jumpers to make cable tray electrically continuous throughout. Provide No. 4 AWG minimum insulated copper grounding conductor in raceway from grounding electrode system to cable tray system, bonded to cable tray.

L. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems (Adjustable and Fixed Length): Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer’s standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16 inch-diameter holes at a maximum of 8 inches o.c. in at least 1 surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube and Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti, Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1,NECA 101, and the NEC for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where it's Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with clamps approved for the application by an agency acceptable to the authorities having jurisdiction.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

F. Adjustable length slotted steel supports shall be clamped to a fixed length, per manufacturer’s instructions to maintain weight support restrictions recommended by the manufacturer.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components, include plans, elevations, sections, details and attachments to other work:

1. Custom enclosures and cabinets.

1.5 COORDINATION

A. Create Coordination Drawings for use in raceway installation.

1. Create conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   a. Structural members in the paths of conduit groups with common supports.
   b. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

B. Qualification Data: For professional engineer and testing agency.

C. Source quality-control test reports.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work limited to, the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Thomas & Betts

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: ANSI C80.3.

G. FMC: Zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) locations. Comply with UL 886.
2. Fittings for EMT: set screw type.
3. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with the provided raceways as required for complete system.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Thomas & Betts; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
   1. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with the provided raceways as required for complete system.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   1. Cooper B-Line, Inc.
   2. Hoffman.
   3. Legrand Cablofil
   4. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 , unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Small sizes (4 inches by 4 inches and smaller) shall be hinged type with fastening device. Larger sizes shall be provided with a screw-cover and gasket.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   1. Hoffman.
   2. Lamson & Sessions; Carlon Electrical Products.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Legrand Wiremold
   b. Panduit Corp

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Enduro Systems, Inc.; Composite Products Division.
   b. Hubbell Incorporated; Wiring Device-Kellems Division.
   c. Lamson & Sessions; Carlon Electrical Products.
   d. Panduit Corp.
   e. Legrand Wiremold

C. Surface Aluminum Raceways: Two-piece construction, manufactured of extruded anodized aluminum with texture and color selected by Architect from manufacturer's standard colors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Enduro Systems, Inc.; Composite Products Division.
   b. Hubbell Incorporated; Wiring Device-Kellems Division.
   c. Lamson & Sessions; Carlon Electrical Products.
   d. Panduit Corp.
   e. Legrand Wiremold

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.

11. Thomas & Betts Corporation.
12. Legrand Wiremold
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1, one piece cold drawn type, welded boxes are not acceptable.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes Cast or sheet metal**,** fully adjustable, rectangular.

F. Non-metallic Floor Boxes: Nonadjustable round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, with gasketed cover.

I. Dividers: Provide listed dividers inside multi-gang boxes where required to separate phases.

J. Metal barriers to separate wiring of different systems and voltages exceeding 150V.

K. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic [finished inside with radio-frequency-resistant paint].

L. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit, IMC, or RNC, Type EPC-40-PVC.

2. Concealed Conduit, Aboveground: Rigid steel conduit, IMC , or RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: Rigid steel conduit, IMC or EMT.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:

   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.

3. Concealed in Ceilings and Interior Walls and Partitions: Rigid steel conduit, IMC or EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid steel conduit or IMC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, non-metallic in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Do not install aluminum conduits in contact with concrete.

F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

G. Conduits shall be routed inside the building, in lieu of exposed across the roof, unless indicated otherwise.
   1. [Roof support for Tray and conduits: Provide a roof support system similar to Cablofil Cablo-Port. The support system shall be
      a. Sunlight, UV and weather resistant and shall use a rubber base in contact with the roof,

b. Non Penetrating: Fastening system shall not penetrate roof membrane or use glues which are incompatible with the roofing material.
c. Height and angle adjustable in the field,
d. Provided with reflective strips,
e. Composed of recycled materials.]

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 8 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Install raceways parallel to building lines.

D. Install raceway expansion fittings at building expansion joints, parallel to building lines.

E. Complete raceway installation before starting conductor installation.

F. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

G. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

J. Raceways Embedded in Slabs:

1. Conduits embedded in slabs shall not be larger than 1-inch diameter. Multiple parallel embedded conduits shall be spaced a minimum of 4-inches on center.
2. Run conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
3. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Provide insulating and grounding bushings at junction boxes, outlet boxes, and cabinets for conduits one-inch and larger in diameter.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

O. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
4. Conduit ends shall be provided plastic bushings.

P. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

Q. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg. F, and that has straight-run length that exceeds 25 feet.

1. Install-expansion joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location.

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 degree F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 degree F temperature change.
    c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 degree F temperature change.
    d. Attics: 135 degree F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight-run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

R. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

S. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

T. Set metal floor boxes level and flush with finished floor surface.

U. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing planks 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Refer to Specification 26 0500 “Common Work Results for Electrical” for sleeve and sleeve-seal installation instructions.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Coordinate installation of PVC coated conduit with factory authorized representative.
3. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes cable trays and accessories.

1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Cable tray shall be stored indoors. Protect cable tray from scratching and marring of finish. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chalfant Manufacturing Company.
2. Cooper B-Line, Inc.
3. Cablofil
4. MPHusky.
5. Legrand

2.2 MATERIALS AND FINISHES

A. Sizes and Configurations: Cable Trays shall be aluminum ladder tray in IDF / MDF rooms, and steel wire basket tray elsewhere with NEMA Class 8B and NEMA Class 12B load rating. Refer to Drawing Notes for specific requirements for sizes and configurations.

1. Wire mesh or Ladder

2. Wire Basket wire mesh diameter - Minimum to meet requirements as specified including loading and grounding.

B. Cable Trays, Fittings, and Accessories: Complying with NEMA VE 1, or NEMA FG1.

1. Zinc Plated after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.

2. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, ASTM F 1136, hardware.

3. Aluminum

4. Fiberglass

C. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with chromium-zinc, ASTM F 1136, splice-plate fasteners, bolts, and screws.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure.
   1. Place supports so that spans do not exceed maximum ratings. Derate load ratings to compensate for ambient temperature per the manufacturer's recommendations.
   2. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
   3. Support bus assembly to prevent twisting from eccentric loading.
   4. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
   5. Locate and install supports according to NEMA VE 2.

D. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

E. Make changes in direction and elevation using standard fittings.

F. Make cable tray connections using standard fittings.

G. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

I. Workspace: Install cable trays with enough space to permit access for installing cables.

J. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.2 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

D. In existing construction, remove inactive or dead cables from cable tray.

3.3 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.

4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray. Test entire cable tray system for adequate bonding; the maximum allowable resistance shall be 1 ohm.

B. Report results in writing.

3.5 PROTECTION

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks and in single duct runs.
2. Handholes and boxes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, and boxes.

B. Shop Drawings for Precast or Factory-Fabricated Underground Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Grounding details.
5. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
6. Joint details.

C. Shop Drawings for Factory Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

E. Qualification Data: For professional engineer and testing agency.

F. Source quality-control test reports.

G. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances into manholes, handholes and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Concrete Products Company
2. Carder Concrete Products.
3. Christy Concrete Products.
4. Elmhurst-Chicago Stone Co.
5. Oldcastle Precast Group.
6. Riverton Concrete Product; a division of Cretex Companies, Inc.
7. Utility Concrete Products, LLC.
8. Utility Vault Co.
9. Wausau Tile Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, **“ELECTRIC” or “TELEPHONE”**.
4. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

   a. Extension shall provide increased depth of 12 inches.
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors or frames and cover of handholes, but close enough to corners to facilitiate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom; unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering. **“ELECTRIC” or “TELEPHONE”**.
6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. Hubbell Power Systems, Quazite.
e. NewBasis.

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc., a division of Oldcastle Precast.

2.5 PRECAST MANHOLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Concrete Products Company
2. Carder Concrete Products.
3. Christy Concrete Products.
4. Elmhurst-Chicago Stone Co.
5. Oldcastle Precast Group.
6. Riverton Concrete Products; a division of Cretex Companies, Inc.
7. Utility Concrete Products, LLC.
8. Utility Vault Co.
9. Wausau Tile, Inc.

B. Comply with ASTM C 858, and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Division 03 Section “Cast-in-Place Concrete”.

C. Structural Design Loading: As specified in Part 3 “Underground Enclosure Application” Article.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify test by the manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables; RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank, unless otherwise indicated.

F. Underground Ducts for Telephone, Communications or Data Circuits; RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

G. Underground Ducts Crossing Driveways and Roadways**:** RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and other Deliberate Traffic Paths: Precast concrete. AASTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO BH 17, H-20, Polymer concrete, DCTE 77, Tier 15, Fiberglass enclosures with polymer concrete frame and cover, SCTE 77, Tier 15, or Fiberglass-reinforced polyester resin, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10, Polymer concrete units, SCTE 77, or Tier 8, Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 structural load rating.
4. Units subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Manholes: Precast or cast-in-place concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 12.5 feet**,** both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 3-1/2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.

8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section “Earth Moving” for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 31 Section “Earth Moving”.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section “Earth Moving”.
6. Install ducts with a minimum of 3-1/2 inches between ducts for like services and 6 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches above all direct-buried ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.

2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section “Cast-in-Place Concrete”.

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below frost line. 42” below grade.
4. Handhole Covers: In paved areas and trafficways, set surface with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in

G. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07 Section “Bituminous Dampproofing”. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

K. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depth of ducts, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from ½-inch sieve to NO. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line. 42” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits, according to enclosure manufacturer’s written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving**,** and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
   1. Concrete: 3000 psi,28-day strength, complying with Division 03 Section “Cast-in-Place Concrete” with a troweled finish.
   2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

E. When identifying room numbers on labels or directories, coordinate with the Owner's final room numbering system, as the architectural room numbers are generally arbitrary and may not be final.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.

E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. More than 600V Warning: “DANGER – HIGH VOLTAGE – KEEP OUT.”
4. 480V Warning: “480 VOLTS.”
5. Phase Color-Coding of 208Y/120V panelboards: “PHASE A - BLACK, PHASE B RED, PHASE C BLUE, NEUTRAL WHITE, GROUND GREEN.”
6. Phase Color-Coding of 480Y/277V panelboards: “PHASE A - BROWN, PHASE B ORANGE, PHASE C YELLOW, NEUTRAL GRAY, GROUND GREEN.”

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.

1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):

   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

      1) Primer: Exterior concrete and masonry primer.
      2) Finish Coats: Exterior semi-gloss acrylic enamel.

2. Exterior Concrete Unit Masonry:

   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.

      1) Block Filler: Concrete unit masonry block filler.
      2) Finish Coats: Exterior semi-gloss acrylic enamel.

3. Exterior Ferrous Metal:

a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior ferrous-metal primer.
2) Finish Coats: Exterior Semi-gloss alkyd enamel.

4. Exterior Zinc-Coated Metal (except Raceways):

a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior zinc-coated metal primer.
2) Finish Coats: Exterior Semi-gloss alkyd enamel.

5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):

a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior concrete and masonry primer.
2) Finish Coats: Interior Semi-gloss alkyd enamel.

6. Interior Concrete Unit Masonry:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.

1) Block Filler: Concrete unit masonry block filler.
2) Finish Coats: Interior Semi-gloss acrylic enamel.

7. Interior Gypsum Board:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior gypsum board primer.
2) Finish Coats: Interior Semi-gloss acrylic enamel.

8. Interior Ferrous Metal:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior ferrous-metal primer.
2) Finish Coats: Interior Semi-gloss acrylic enamel.

9. Interior Zinc-Coated Metal (except Raceways):

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior zinc-coated metal primer.
2) Finish Coats: Interior Semi-gloss acrylic enamel.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with snap-around labels or stenciled legend. Repeat legend at 10-foot maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A: Identify with orange snap-around label or stenciled legend adjacent to each junction box, pull box, and electrical enclosure.

D. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands, or stenciled legend:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

E. Power-Circuit Conductor Identification: For primary and secondary conductors No. 4 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape, marker tape, or write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

F. Branch-Circuit Conductor Identification: Use marker tape or write-on tags in each junction or pull box. Identify each ungrounded conductor according to source and circuit number.

G. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source and circuit number.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs or metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
3. Equipment More Than 600 V: Apply to door or cover of equipment including, but not limited to, the following:
   a. Electrical switchgear.
4. Panelboards rated 208Y/120V or 480Y/277V: Apply phase color-code identification label to door or cover of equipment in including the following:
   a. Panelboards.
   b. Power Panels.
   c. Distribution Panels.
   d. Switchboards.
5. Equipment Rated 480 V: Unless otherwise indicated, apply to door or cover of equipment. Apply to inside door or cover of flush panelboards and similar equipment in finished spaces.
6. All power distribution equipment: Apply arc flash labels required by code or other sections of the Specification.

K. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high. For single-gang motor starting switches, use 3/8-inch high letters on 3/4-inch high by 2.25-inch wide label; for two-gang motor starting switches, use 3/8-inch high letters on 3/4-inch high by 4 inch wide label
b. Outdoor Equipment: Engraved laminated acrylic, melamine label, or stenciled legend 4 inches high.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Electrical substations.
f. Emergency system boxes and enclosures.
g. Disconnect switches.
h. Enclosed circuit breakers.
i. Motor starters.
j. Push-button stations.
k. Power transfer equipment.
l. Contactors.
m. Remote-controlled switches, dimmer modules, and control devices.
n. Battery inverter units.
o. Power-generating units.
p. Master clock and program equipment.
q. Intercommunication and call system master and staff stations.
r. Fire-alarm control panel and annunciators.
s. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
t. Monitoring and control equipment.
u. Terminals, racks, and patch panels for signal and control functions.

M. Electrical Energy Source Identification Labels: On each unit of equipment, install a unique source and circuit designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manuals. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system.

1. Labeling Instructions:

   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 3/8-inch high letters on 3/4-inch high label; where 2 lines of text are required, use labels 1.5 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label or stenciled legend.
   c. Outlet, Device, Pull and Junction Boxes: Apply source and circuit to back of device box cover and to front of pull and junction box covers with indelible ink.

2. Equipment to be Labeled:

   a. Panelboards.
   b. Electrical switchgear, switchboards, and distribution panels.
   c. Transformers.
   d. Electrical substations.
   e. Emergency system boxes and enclosures.
   f. Disconnect switches.
   g. Enclosed circuit breakers.
   h. Motor starters.
   i. Power transfer equipment.
   j. Contactors.
   k. Central battery inverter units.
   l. Power-generating units.
   m. Technology (voice and data) equipment racks and cabinets.
   n. Master clock and program equipment.
   o. Fire alarm control panel and power supplies.
   p. Security and intrusion-detection control panels.
   q. Uninterruptible power supply equipment.
   r. Wiring devices boxes.
   s. Junction and pull boxes.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device. Where used on electrical equipment and enclosures also use screws to fasten in place.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Fasten signs and labels to electrical equipment and enclosures with screws.

G. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 6 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208Y/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.

3. Colors for 480/277-V Circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Gray.
   e. Ground: Green.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

I. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

K. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

L. Branch and Feeder Circuit Load Identification Labels: On each overcurrent protective device, install unique load designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual.
   1. Labeling Instructions:
      a. Panelboard Circuit Directories: Provide type-written or laser printed circuit directory on heavy card stock. Arrange in two columns with odd numbered circuits on left and even numbered circuits on right. Include panelboard identification and installation date. Indicate spare circuit breakers: “SPARE”. Install in metal frame with clear plastic cover. Coordinate with the Owner’s final room numbering system.
      b. Overcurrent Protective Devices Installed in Distribution Panels and Switchboards: Engraved, laminated acrylic or melamine labels. Unless otherwise indicated, provide a single line of text with 3/8-inch high letters on 3/4-inch high label; where 2 lines of text are required, use labels 1.5 inches high.

M. Independent Support Wire: Where independent support wires are permissible and utilized for securing electrical raceways, cable assemblies, boxes, cabinets, or fittings within ceiling cavities, they shall be distinguishable from ceiling support wires by color, tagging, or other effective means.

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC FLASH HAZARD STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current, overcurrent protective device coordination, and arc flash hazard studies.

B. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

C. Electrical equipment shall be labeled with the arc flash hazard information based on the results of the arc flash hazard study.

D. As much as possible, the overcurrent protective device settings shall be to keep the arc flash hazard at any point in the system no greater than level 2. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Report
1. Submit the fault current study report to the Engineer for review, prior to ordering the electrical distribution equipment.
   a. Provide a tabulation document, as part of the submittal, which compares and identifies discrepancies between, the study results and the proposed electrical distribution equipment.
   b. Highlight designed overcurrent protective devices which have interrupting ratings lower than the
      1) Calculated 1/2-cycle symmetrical fault current or the
      2) Calculated 1/2-cycle asymmetrical fault current, as appropriate.

C. Product Certificates:

1. For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
2. For arc flash hazard calculations computer software program certifying compliance with IEEE 1584.

D. Qualification Data: For coordination-study and arc flash specialist.

E. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.
4. Arc flash hazard level report labels as defined in NFPA 70 and NFPA 70E.
5. Electronic Program Files
   a. Provide the Owner with all software program files created for the Overcurrent Protective Device Coordination and Arc Flash Hazard Study at the end of the project, after all revisions and updates have been incorporated. Provide files on CD or flash drive. Files shall include:
      1) One Line Diagrams created with the software.
      2) Short circuit calculations input data and results.
      3) Source data for each power source used in the calculation including but not limited to:
         a) Utilities,
         b) Generators,
         c) Motors,
         d) DC sources.
      4) Overcurrent protective device coordination input data and results including time current curve data for each device used in the calculation.
      5) Protection curve data for each cable, bus, transformer and electric machine used in the calculation
      6) Arc flash hazard study input data and calculation results
      7) Arc flash hazard labels created, for the project, for each piece of equipment.
6. It shall be assumed that the files provided reflect the calculations of the power distribution system as installed at the point of substantial completion of the project and any power distribution system alterations of the system will require re-evaluation of the system by a qualified engineer.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study and Arc Flash Hazard Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 1584 for arc flash hazard calculations.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

1. EDSA Micro Corporation.
2. ESA Inc.
3. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots. The program shall generate signage indicating arc flash data that shall be installed on the equipment.

1. Optional Features:

    a. Arcing faults.
    b. Simultaneous faults.
    c. Explicit negative sequence.
    d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination and arc flash hazard studies only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination and arc flash hazard studies:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination and arc flash hazard studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Generator kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    f. Busway ampacity and impedance.
    g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types, and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes RMS symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes RMS symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in RMS symmetrical amperes at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Medium-voltage controller.
3. Motor-control center.
4. Distribution panelboard.
5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.

1. Transformers:
   a. ANSI C57.12.22.
   b. ANSI C57.12.40.

c. IEEE C57.12.00.
d. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 241 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Selective Coordination: Overcurrent protective devices shall coordinate so that the device closest to the fault operates to clear the fault while leaving upstream devices closed. Where this is not possible the engineer shall be notified prior to ordering the power distribution equipment. Practicalities shall be considered, including:
1. Where selective coordination will cause an increased hazard, discussions with the engineer shall be initiated.
2. Series devices which will not benefit from selective coordination can be ignored.

G. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

H. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH HAZARD CALCULATIONS

A. Perform calculations using an approved computer software program. Prepare signage and install on all equipment as defined by NFPA 70E.

1. Calculate maximum energy available at each location.
2. Indicate required PPE equipment level.

B. Comply with IEEE and NFPA 70E.

C. Provide tabular report indicating the following information at each piece of equipment.

1. Flash Protection Boundary (in inches).
2. System voltage.
3. Hazard Risk Category.
4. Available Fault Current (in kA).
5. Incident Energy level at 18 inches in CAL/CM^2.
6. Required PPE level and brief description of PPE.
7. Shock Hazard Approach Boundaries in inches for Limited, Restricted, and Prohibited.
8. Equipment ID.
9. Date.

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor and indoor photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relays.

B. Related Sections include the following:
1. Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For all occupancy sensors and light level sensors:

1. Include plans detailing manufacturer recommended occupancy sensor types, locations, and aiming. The manufacturer shall consider room configurations, furniture configurations, and other room conditions to optimize for full room coverage.
2. Interconnection diagrams showing field-installed wiring.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Occupancy sensors shall be tested to meet the NEMA WD7.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Basis-For-Design Product: Subject to compliance with requirements, provide Intermatic ET70415CR or a comparable product by one of the following:

1. Paragon Electric Co.; Invensys Climate Controls.
2. Square D; Schneider Electric.
3. TORK.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPDT.
2. Contact Rating: 20-A ballast load, 120-277-V ac.
3. Programs: 4 channels; each channel shall be individually programmable with a minimum of 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays. Program data shall be stored with non-volatile memory for the life of the time switch without the need for battery back-up.
4. Astronomic Time: All channels.
5. Battery Backup: For schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Intermatic, Inc.
2. Lithonia Lighting; Acuity Lighting Group, Inc.
3. Cooper Controls, Inc.
4. Paragon Electric Co.; Invensys Climate Controls.
5. Square D; Schneider Electric.
6. TORK.
7. Watt Stopper (The).

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 10-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. Eaton Electrical Inc; Cutler-Hammer Products.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Cooper Controls, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Watt Stopper (The).

B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photo resistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.

4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead band adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

C. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2.4 INDOOR OCCUPANCY SENSORS

A. Wall mounted occupancy sensor single switch type.

B. Wall or ceiling mounted dual, (passive infrared with ultrasonic or microphonic) or single technology as indicated below.

C. Infrared Wall-Switch Sensors (Type “OCA”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper WS-200 or comparable product by one of the following:

a. Cooper Controls
b. Sensor Switch, Inc.
c. Philips-Lightolier Controls

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

D. Dual-Technology Ceiling or Wall Mounted Sensors (Type “OCB”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper DT-200 or comparable product by one of the following:

a. Cooper Controls, Inc.
b. Sensor Switch, Inc.
c. Philips-Lightolier Controls

2. Description: Combination passive-infrared and ultrasonic type, adjustable time delay up to 30 minutes, adjustable sensitivity, 90-degree field of view, with single-pole, double-throw isolated relay, and with a minimum coverage area of 2000 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

E. Dual-Technology Ceiling or Wall Mounted Sensors (Type “OCC”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper DT-300 or comparable product by one of the following:

   a. Cooper Controls, Inc.
   b. Sensor Switch, Inc.
   c. Philips-Lightolier Controls

2. Description: Combination passive-infrared and ultrasonic type, adjustable time delay up to 30 minutes, adjustable ultrasonic sensitivity, 360-degree field of view, with an integral single-pole, double-throw isolated relay, and with a minimum coverage area of 1000 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

F. Infrared Small-Room Ceiling-Mounted Sensors (Type “OCD”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper WPIR or comparable product by one of the following:

   a. Cooper Controls, Inc.
   b. Sensor Switch, Inc.
   c. Philips-Lightoilier Controls

2. Description: Passive-infrared type, adjustable time delay up to 30 minutes, 90-degree field of view, with a minimum coverage area of 300 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

G. Infrared Medium-Room Ceiling-Mounted Sensors (Type “OCE”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper CI-200 or comparable product by one of the following:

   a. Cooper Controls, Inc.
   b. Sensor Switch, Inc.
   c. Philips-Lightoilier Controls

2. Description: Passive-infrared type, adjustable time delay up to 30 minutes, 360-degree field of view, an integral single-pole, double-throw isolated relay, and with a minimum coverage area of 500 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. .Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

H. Infrared Large-Room Ceiling or Wall Mounted Sensors (Type “OCF”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper CX-100 or comparable product by one of the following:

a. Cooper Controls, Inc.
b. Sensor Switch, Inc.
c. Philips-Lightoilier Controls

2. Description: Passive-infrared type, adjustable time delay up to 30 minutes, adjustable sensitivity, 90-degree field of view, an integral single-pole, double-throw isolated relay, and with a minimum coverage area of 2000 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. .Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

I. Ultrasonic Small-Room Ceiling-Mounted Sensors (Type “OCG”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper WT-600 or comparable product by one of the following:

a. Cooper Controls, Inc.
b. Sensor Switch, Inc.
c. Philips-Lightoilier Controls

2. Description: Ultrasonic type, adjustable time delay up to 30 minutes, adjustable sensitivity, 180-degree field of view, an integral single-pole, double-throw isolated relay, and with a minimum coverage area of 600 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. .Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

J. Ultrasonic Medium-Room Ceiling-Mounted Sensors (Type “OCH”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper WT-1100 or comparable product by one of the following:

a. Cooper Controls, Inc.
b. Sensor Switch, Inc.
c. Philips-Lightoilier Controls

2. Description: Ultrasonic type, adjustable time delay up to 30 minutes, adjustable sensitivity, 360-degree field of view, an integral single-pole, double-throw isolated relay, and with a minimum coverage area of 1100 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. .Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

K. Ultrasonic Large-Room Ceiling-Mounted Sensors (Type “OCK”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper WT-2200 or comparable product by one of the following:

a. Cooper Controls, Inc.

b. Sensor Switch, Inc.
c. Philips-Lightoilier Controls

2. Description: Ultrasonic type, adjustable time delay up to 30 minutes, adjustable sensitivity, 360-degree field of view, an integral single-pole, double-throw isolated relay, and with a minimum coverage area of 2200 sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

L. Ultrasonic Corridor-Configuration Ceiling-Mounted Sensors (Type “OCM”):

1. Basis-of-Design Product: Subject to compliance with requirements, provide The Watt Stopper WT-2250 or comparable product by one of the following:

a. Cooper Controls, Inc.
b. Sensor Switch, Inc.
c. Philips-Lightoilier Controls

2. Description: Ultrasonic type, adjustable time delay up to 30 minutes, adjustable sensitivity, 360-degree field of view over 90 linear feet, an integral single-pole, double-throw isolated relay, and with a minimum coverage pattern of 10’x90’ sq. ft. Provide power packs or accessories as necessary to control 120V or 277V rated loads. Provide an additional single-pole, double-throw isolated relay for HVAC control system interface.

2.5 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. GE Industrial Systems; Total Lighting Control.
4. Hubbell Lighting.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Square D; Schneider Electric.
7. Watt Stopper (The).

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.6 EMERGENCY SHUNT RELAY

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. The Bodine Company, Inc.
2. Lighting Control and Design, Inc.
3. LVS, Inc.
4. Nine 24, Inc.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 or 277V as required.

2. Automatic maximum illumination function. Unit shall signal the lighting control system dimmer driver to full output upon switchover to the alternate source during loss of normal power.

3. Emergency lighting test function shall be provided to maintain the selected light fixtures energized for 5 seconds after the manual or automatic light switch disconnects the light fixtures on the same switch leg.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR BASIS-OF-DESIGN

A. The Drawings show a Wattstopper basis-of-design and only indicate potentially suitable occupancy sensor types and locations. The manufacturer shall examine the plan spaces and provide the most suitable occupancy sensor(s) for each space based on room and furniture configurations and other room conditions. Occupancy sensor location plan drawings shall be required as submittals for approval by the Architect/Engineer. The Contractor's Bid shall include all extra wiring and components for a fully functional occupancy control system; extra components may include power packs, slave packs, form C packs, relays, switch packs, and mounting brackets.

3.2 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Adjust sensor sensitivities and timers to optimize performance.

B. Occupancy sensors shall be located to:
   1. Be able to detect minor movement,
   2. Not operate nuisance switching due to ambient airflow or passerby traffic.
   3. Minimize damage from room function. Provide a protective wire cage on sensors installed in gymnasiums and locker rooms.

3.3 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 260923

SECTION 260943 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes manually operated lighting controls with relays and control module.

B. Provide a Lighting Control Concept which meets the requirements of ASHRAE 90.1-2013.

C. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multipole contactors.

D. Sequence of Operation

1. Refer to the drawings for project specific scenes and control functions.
2. Upon a signal from the fire alarm system all light fixtures shall come up to full brightness.
3. Where power supplied to emergency egress light fixtures is from an alternate external source such as an inverter or an engine generator, upon loss of normal power the light fixtures shall come up to full brightness.

1.3 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. BAS: Building automation system.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

F. PC: Personal computer; sometimes plural as "PCs."

G. RS-485: A serial network protocol, similar to RS-232, complying with TIA/EIA-485

H. NFPA 70 - National Electrical Code; National Fire Protection Association.

I. NEMA - National Electrical Manufacturers Association

J. FCC emission standards

K. UL - Underwriters Laboratories, Inc. Listings

L. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air Handling Spaces.

M. UL 20 - General Use Switches, Plug Load Controls

N. UL 924 - Standard for Emergency Lighting and Power Equipment

O. ULC - Underwriter Laboratories of Canada Listings

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Lighting Control System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, occupancy sensors, switches, and accessories that suit the required lighting and electrical system parameters. Design/engineer/create the architecture for the light controls system to meet the operation requirement in the lighting control matrix. Provide proper coverage for all areas with occupancy type sensors.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.5 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Catalog sheets and specifications.
   2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   3. Storage and handling requirements and recommendations.
   4. Installation instructions.

B. Shop Drawings: Wiring diagrams for the various components of the System specified including:
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
   2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.
   3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
   4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

D. Closeout Submittals:
   1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
   2. Operation and Maintenance Manual:
      a. Include approved Shop Drawings and Product Data.
      b. Include Sequence of Operation, identifying operation for each room or space.
      c. Include manufacturer's maintenance information.
      d. Operation and Maintenance Data: Include detailed information on device programming and setup.
      e. Include startup and test reports.

E. Software and Firmware Operational Documentation:

   1. Software operating and upgrade manuals.
   2. Program Software Backup: Format shall be digital media complete with data files with ability to be re-loaded by the owner without manufacturer’s assistance.
   3. Device address list.
   4. Printout of software application and graphic screens.

F. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Maintenance manuals shall include a matrix of tasks required of the owner, with time frame, to properly maintain the system and to keep it in working order.

H. Warranty certificate reflecting the special warranty specified in this Specification section.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

E. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.7 COORDINATION

A. Coordinate lighting control components to form a fully functional integrated interconnection of compatible components.
   1. Match components and interconnections for optimum performance of lighting control functions.
   2. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

B. Coordinate lighting control components specified in this Section with components specified in Division 26 Section "Panelboards."

1.8 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:
   1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
   2. Review the specifications for low voltage control wiring and termination.
   3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
   4. Discuss requirements for integration with other trades.

C. Inspect and make notes of job conditions prior to installation:
   1. Record minutes of the conference and provide copies to all parties present.
   2. Identify all outstanding issues in writing designating the responsible party for fol-

low-up action and the timetable for completion.

3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure of software input/output to execute switching or dimming commands.
   b. Failure of modular relays to operate under manual or software commands.
   c. Damage of electronic components due to transient voltage surges.

2. Warranty Period: Manufacturer shall provide a 5-year limited warranty on products within this installation, except where otherwise noted, ***and*** consisting of a one for one device replacement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by
   Acuity nLight Lighting Controls (Basis of Design)
   Cooper Touché Lighting Controls

2.2 SYSTEM REQUIREMENTS

A. System General: Provide a Lighting Control System complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings, including the lighting control matrix. If a conflict is identified, between the Drawing and this Specification, contact the Engineer for clarification prior to proceeding.
   1. Space Control Requirements: Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality as indicated in the lighting control matrix.

B. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.

C. Interface: System shall be compatible with the provided room scheduling system and Auditorium control system.

2.3 POWER DISTRIBUTION COMPONENTS

A. Modular Relay Panel: Comply with UL 508 (CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.

1. Cabinet: Steel with hinged, locking door.

   a. Barriers separate low-voltage and line-voltage components.
   b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
   c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.

2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.

   a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
   b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts and drivers.
   c. Endurance: 50,000 cycles at rated capacity.
   d. Mounting: Provision for easy removal and installation in relay cabinet.

B. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels or field-mounting surge suppressors that comply with Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for Category A locations.

2.4 MANUAL SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary-contact, low-voltage type.

1. Color shall be white.
2. Integral green LED pilot light to indicate when circuit is on.
3. Internal white or red LED locator light to illuminate when circuit is off.

B. Wall-Box Dimmers: Comply with Division 26 Section "Wiring Devices."

C. Wall Plates: Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."

D. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 24 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2.

2.6 WALL OR CEILING MOUNTED OCCUPANCY/VACANCY SENSORS

A. Sensors shall be dual technology type (PIR and Ultrasonic or microphonic) include the following:
   1. HVAC control relay.
   2. Calibration and pushbutton configuration for the following variables:
      a. Sensitivity: 0-100 percent in 10 percent increments
      b. Time delay: 1-30 minutes in 1 minute increments
      c. Test mode: Five second time delay
      d. Detection technology: PIR, Dual Technology activation and/or re-activation.
      e. Walk-through mode
   2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included.
   3. Programmable control functionality including:
      a. Each sensor may be programmed to control specific loads within a local network.
      b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
      c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
      d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
         1. Ultrasonic/Microphonic and Passive Infrared
         2. Ultrasonic/Microphonic or Passive Infrared
         3. Ultrasonic/Microphonic only
         4. Passive Infrared only
         5. Independently configurable sensitivity settings for passive infrared and Ultrasonic/Microphonic technologies for both Normal (NH) and After Hour (AH) time periods.

4. Device Status LEDs including
   a. PIR detection
   b. Ultrasonic/Microphonic detection
   c. Configuration mode
5. Assignment of any occupancy sensor to a specific load within the room without wiring or special tools.
6. Assignment of local buttons to specific loads within the room without wiring or special tool
7. Manual override of controlled loads
8. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

B. Object information shall be available for the following objects:
   1. Detection state
   2. Occupancy sensor time delay
   3. Occupancy sensor sensitivity, PIR and Ultrasonic

2.7 WALL SWITCH OCCUPANCY SENSORS

A. Occupancy Sensors shall include the following:

1. HVAC control relay.
2. Calibration and pushbutton configuration for the following variables:
   a. Sensitivity: 0-100 percent in 10 percent increments
   b. Time delay: 1-30 minutes in 1 minute increments
   c. Test mode: Five second time delay
   d. Detection technology: PIR, Dual Technology activation and/or re-activation.
   e. Walk-through mode
   f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included.
3. Programmable control functionality including:
   a. Each sensor may be programmed to control specific loads within a local network.
   b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
   c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
   d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      1) Ultrasonic and Passive Infrared
      2) Ultrasonic or Passive Infrared
      3) Ultrasonic only
      4) Passive Infrared only
      5) Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time period

3. Device Status LEDs including
    a. PIR detection
    b. Ultrasonic detection
    c. Configuration mode

4. Assignment of any occupancy sensor to a specific load within the room without wiring or special writing tools.
5. Assignment of local buttons to specific loads within the room without wiring or special tools
6. Manual override of controlled loads.
7. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

B. Object information shall be available for the following objects:
1. Detection state
2. Occupancy sensor time delay
3. Occupancy sensor sensitivity, PIR and Ultrasonic
4. Button state
5. Switch lock control
6. Switch lock status

C. Two-button wall switch occupancy sensors, when connected to a single relay dimming room or fixture controller, shall operate in the following sequence as a factory default:
1. Left button
    a. Press and release - Turn load on
    b. Press and hold - Raise dimming load
2. Right button
    a. Press and release - Turn load off
    b. Press and hold - Lower dimming load

D. Low voltage momentary pushbuttons shall include the following features:
1. Load/Scene Status LED on each switch button with the following characteristics:
    a. Bi-level LED
    b. Dim locator level indicates power to switch
    c. Bright status level indicates that load or scene is active
2. The following button attributes may be changed or selected using a wireless configuration tool:
    a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
    b. Individual button function may be configured to Toggle, On only or Off only.
    c. Individual scenes may be locked to prevent unauthorized change.
    d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
    e. Ramp rate may be adjusted for each dimmer switch.
    f. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.

2.8 WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration, as noted on drawings. Wall switches shall include the following features:
   1. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
   2. Configuration LED on each switch that blinks to indicate data transmission.
   3. Load/Scene Status LED on each switch button with the following characteristics:
      a. Bi-level LED
      b. Dim locator level indicates power to switch
      c. Bright status level indicates that load or scene is active
      d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
   4. Programmable control functionality including:
      a. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
   5. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. Multiple wall switches may be installed in a room by simply connecting them to the network. No additional configuration shall be required to achieve multi-way switching.

C. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.
   1. Individual button function may be configured to Toggle, On only or Off only.
   2. Individual scenes may be locked to prevent unauthorized change.
   3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
   4. Ramp rate may be adjusted for each dimmer switch.
   5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.

2.9 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.
   1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
   2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 footcandles (fc).
3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. One RJ-45 port for connection to DLM local network.
14. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness. Extended

tube photosensors accommodate mounting materials from 0.62”-1.25” thickness. Mounting brackets are compatible with J boxes and wall mounting.

15. Any load or group of loads in the room can be assigned to a daylighting zone
16. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
17. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Closed loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.

D. Open loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.

E. Dual loop digital photosensors shall include the following additional features:

1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this con
2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON

and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.

4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
6. Device must include extendable mounting arm to properly position sensor within a skylight well.

2.10 DIGITAL ROOM CONTROLLERS

A. Provide low voltage module (tied into local room controller) providing contacts for HVAC systems to signal occupied mode.

B. Digital controllers for lighting automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room controllers shall be provided to match the room lighting control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
4. Device Status LEDs to indicate:
   a. Data transmission
   b. Device has power
   c. Status for each load
   d. Configuration status
5. Quick installation features including:
   a. Standard junction box mounting

b. Quick low voltage connections using standard RJ-45 patch cable

6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
   a. Turn on to 100%
   b. Remain off
   c. Turn on to last level
7. Each load shall be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off (Follow on and off)
   b. Manual-on/Auto-off (Follow off only)
8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. UL 2043 plenum rated
10. Manual override and LED indication for each load
11. Dual voltage (120/277 VAC, 60 Hz). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming).
12. Zero cross circuitry for each load
13. All digital parameter data programmed into an individual room controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.

B. On/Off/Dimming enhanced Room Controllers shall include:
   1. Real time current monitoring
   2. Multiple relay configurations
      a. One, two or three relays
      b. One or two relays
   3. Efficient 250 mA switching power supply
   4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
   5. One dimming output per relay
      a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting.
      b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers,

MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads.

c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or LED driver.

d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.

e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.

f. Calibration and trim levels must be set per output channel.

g. Devices that set calibration or trim levels per controller are not acceptable.

h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.

7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.

8. The following dimming attributes may be changed or selected using a wireless configuration tool:

   b. Establish preset level for each load from 0-100%

   c. Set high and low trim for each load

   d. Set lamp burn in time for each load up to 100 hours

9. Override button for each load provides the following functions:

   b. Press and release for on/off control

   c. Press and hold for dimming control

2.11 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
   1. 120/277 volts, 50/60 Hz, 20 amp ballast/driver rating

2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

PART 3- EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install wiring in raceways except where installed in accessible ceilings and gypsum board partitions. Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" Minimum conduit size shall be 1/2 inch.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

E. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

G. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components.

3.3 SENSOR BASIS-FOR-DESIGN

A. The Drawings show an nLight basis-for-design and only indicate potentially suitable occupancy/vacancy sensor types and locations. Examine the plan spaces and provide the most suitable sensor(s) for each space based on room configurations, furniture configurations and other room conditions. Sensor location plan drawings shall be provided as submittals for review by the Architect/Engineer. The Contractor's Bid shall include all extra wiring and components for a fully functional network lighting control system; extra components may include power packs, slave packs, form C packs, relays, switch packs, and mounting brackets.

3.4 SENSOR INSTALLATION

B. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Adjust sensor sensitivities and timers to optimize performance.

Occupancy sensors shall be located to:
Be able to detect minor movement,
Not operate nuisance switching due to ambient airflow or passerby traffic.

3.5 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls. Provide two four hour training sessions. The first session shall be within two weeks of the project substantial completion and the second shall be six months after the project substantial completion. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260943

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For transformers to include in emergency, operation and maintenance methods.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
3. ABB / GE.
4. Siemens Energy & Automation, Inc.
5. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Indoor Enclosures: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Outdoor Enclosures: Ventilated or totally enclosed, nonventilated, NEMA 250, Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: ANSI 61 gray.

F. Taps for Transformers Smaller Than 3 kVA: None.

G. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

H. Taps for Transformers: 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capacity to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Wall Brackets: Manufacturer's standard brackets.

M. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:

1. 9 kVA and Less: 37 dBA.
2. 30 to 50 kVA: 42 dBA value.
3. 51 to 150 kVA: 47 dBA value.
4. 151 to 300 kVA: 52 dBA value.
5. 301 to 500 kVA: 57 dBA value.
6. 501 to 750 kVA: 59 dBA value.
7. 751 to 1000 kVA: 61 dBA value.

2.4 VIBRATION MOUNTINGS

A. Description: Vibration isolators and mounting rails to isolate transformer from structure, reducing transmitted noise.

B. Vibration Isolators for Floor and Wall Mounted Transformers: Provide steel housed open spring isolators seated in rubber with provisions for leveling and bolting to mounting rails and concrete base or wall brackets.

C. Mounting Rails: Provide steel channels. To insure adequate stiffness, height of channel shall be a minimum of 8 percent of longest channel dimension.

D. Vibration Isolators for Suspended Transformers: Provide steel spring and rubber isolation hangers with provisions for bolting to trapeze hangers.

E. Vibration isolator manufacturer shall select units suitable for transformers indicated. Vibration isolator manufacturer shall determine quantity of units, but not less than four per transformer.

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section “Vibration and Seismic Controls for Electrical Systems”.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer’s written instructions, seismic codes applicable to Project and requirements in Division 26 Section “Vibration and Seismic Controls for Electrical Systems”.

C. Install distribution transformers 15 kVA and larger on vibration mountings.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Make connections to transformers using flexible metallic conduit of adequate length to absorb vibration and movement.

3.4 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Accessory components and features.
6. Identification.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
7. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Qualification Data: For qualified Installer.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. NFPA 70E Standard for Electrical Safety in the Workplace

C. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

D. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Comply with NEMA PB 2.

H. Comply with NFPA 70.

I. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:
   1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 104 deg F.
      b. Altitude: Not exceeding 2000 feet.

C. Interruption of Existing Electric Service:
   1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Construction Manager's written permission.
   4. Coordinate interruption of service with the utility.
   5. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. ABB / GE.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:
   1. Main Devices: Individually mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.

C. Nominal System Voltage: As denoted on Drawings.

D. Main-Bus Continuous: As denoted on Drawings.

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface. (Interior and exterior).

H. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

J. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

K. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

L. Pull Box on Top of Switchboard:
   1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
   2. Set back from front to clear circuit-breaker removal mechanism.
   3. Removable covers shall form top, front and sides. Top covers at rear shall be easily removable for drilling and cutting.
   4. Bottom shall be insulating; fire-resistive material with separate holes for cable drops into switchboard.
   5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

M. Buses and Connections: Three phase, four wire unless otherwise indicated.
   1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated aluminum or copper feeder circuit-breaker line connections.
   2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
   3. Ground Bus: 1/4-by-2-inch hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
   4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
   5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

N. Each switchboard assembly employed as service entrance equipment shall have a removable main bond bus link between the neutral and equipment ground bus work. It shall also include a barrier to separate incoming service conductors from feeder conductors.

O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc., Cutler-Hammer Business Unit.
   2. General Electric Company, GE Consumer & Industrial-Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D, a brand of Schneider Electric.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, third edition updated version, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
   1. Fuses, rated at 200-kA interrupting capacity.
   2. Fabrication using bolted compression lugs for internal wiring.
   3. Integral disconnect switch.
   4. Redundant suppression circuits.
   5. Redundant replaceable modules.
   6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
   7. LED indicator lights for power and protection status.
   8. Audible alarm, with silencing switch, to indicate when protection has failed.
   9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   10. Four-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 or 208Y/120-V, three-phase, four-wire circuits shall be as follows:
   1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120.
   2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
   3. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
   1. Line to Neutral: 400 V, 800 V from high leg.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 SVR for 240-V or 480-V, three-phase, three-wire, delta circuits shall be as follows:
   1. Line to Line: 2000 V for 480 V and 1000 V for 240 V.
   2. Line to Ground: 1500 V for 480 V and 800 V for 240 V.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.

   4. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller, let-through ratings less than NEMA FU1, RK-5.

   5. GFCI Circuit Breakers: Single-and two-pole configurations with Class A ground-fault protection. (6-mA trip).
   6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Zone-Selective Interlocking: Integral with electronic trip unit for interlocking ground-fault protection function.
      f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
      g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
      h. Auxiliary Contacts: Two SPDT switches with “a” and “b” contacts; “a” contacts mimic circuit-breaker contract, “b” contacts operate in reverse of circuit-breaker contacts.
      i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation, key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
   1. Fixed circuit-breaker mounting.
   2. Two-step, stored-energy closing.

3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time time adjustments.
   c. Ground-fault pickup level, time delay, and I^2t response.
4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

C. Fuses are specified in Division 26 Section “Fuses”.

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following
   1. NEMA EI 21.1 Instrument Transformers for Revenue Metering
   2. Potential Transformers: IEEE C57.13; 120 V, 60 Hz; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
   3. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
   4. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
   5. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:

   1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
   2. Switch-selectable digital display of the following:

      a. Phase Currents, Each Phase: Plus or minus 1 percent.
      b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
      c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
      d. Three-Phase Real Power: Plus or minus 2 percent.
      e. Three-Phase Reactive Power: Plus or minus 2 percent.
      f. Power Factor: Plus or minus 2 percent.
      g. Frequency: Plus or minus 0.5 percent.

h. Maximum kVA, kW and kVAR Demand, with demand interval selectable from 5 to 60 minutes: Plus or minus 2 percent.
i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.

3. Record and Save kVA, kW and kVAR Demand, with demand interval selectable from 5 to 60 minutes, plus or minus 2 percent, default set at 15 minutes.
   a. Record and save for retrieval, at the meter and the Building Management System (BMS), maximum demand values at 15-minute intervals, maximum, for a minimum of 12 months.
4. Communicate all values to the BMS via an ethernet connection and cable. Communication protocol shall be compatible with the BMS. Coordinate IP mapping with the BMS supplier.

5. Retrieval of all instantaneous and recorded values shall be accomplished at the meter and at the Building Management System (BMS).

6. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

D. Control Wiring: Factory installed, with bundling, lacing and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

2.7 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section “Vibration and Seismic Controls for Electrical Systems”.

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section “Enclosed Bus Assemblies”. Drawings indicate general arrangement of bus fittings and specialties.

B. Comply with requirements for terminating cable trays specified in Division 26 Section “Cable Trays for Electrical Systems”. Drawings indicate general arrangement of cable trays, fittings and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

C. SPD: Surge protective device.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.

b. Altitude: Not exceeding 2000 feet.

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section “Vibration and Seismic Controls for Electrical Systems”.

B. Enclosures: Flush- and surface-mounted cabinets. Comply with UL 67

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Service Equipment Label: Labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB / GE.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Mains: Refer to Drawings for Circuit breaker, Fused switch, or Lugs only.

D. Branch Overcurrent Protective Devices for Circuit Breaker Frame Sizes 125A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

F. Branch Overcurrent Protective Devices: Fused switches.

G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Refer to Drawings for Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

F. Doors: Provide each panel with a door in a door cover. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Current Technology, a subsidiary of Danaher Corporation.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Liebert Corporation.
5. Siemens Energy & Automation Inc.
6. Square D, a brand of Schneider Electric.

Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.

B. Doors: Provide each panel with a door in a door cover. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

C. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

D. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Buses:

1. Copper phase and neutral buses. 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

F. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, third edition updated version, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.

1. Accessories:

a. Fabrication using bolted compression lugs for internal wiring.
b. Redundant suppression circuits.
c. Redundant replaceable modules.
d. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
e. LED indicator lights for power and protection status.
f. Audible alarm, with silencing switch, to indicate when protection has failed.
g. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
h. Four-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA per phase.
3. Minimum single-impulse current ratings, using 8-by-20-microsecond waveform described in IEEE C62.41.2.

a. Line to Neutral: 70,000 A.
b. Line to Ground: 70,000 A.
c. Neutral to Ground: 50,000 A.

4. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 or 208Y/120-V, three-phase, four-wire circuits shall be as follows:

a. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120.
b. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
c. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic tip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms-sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short -time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses, lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section “Fuses”.
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Install floor-mounted distribution panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete".

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 26 Section “Vibration and Seismic Controls for Electrical Systems”.

E. Mount top of trim 90 inches above finished floor unless otherwise indicated. If necessary, lower mounting height to insure the operating handle of the top-most switch or circuit breaker, in on position, is not higher than 79 inches (2000 mm) above finished floor.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Where panelboards are located in finished spaces, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Where panelboards are located above raised floor space, stub four 1-inch empty conduits into raised floor space.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

1. For existing panelboards, replace existing directories with new to indicate new and existing circuits.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordinate Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Snap switches and wall-box dimmers.
4. Pendant cord-connector devices.
5. Cord and plug sets.
6. Floor service outlets
7. Poke-through assemblies
8. Service poles
9. Multioutlet assemblies.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: One for each type of device and wall plate specified, in each color specified.

C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Arrow Hart Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Legrand Pass & Seymour.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), HBL5352 (duplex).
c. Legrand Pass & Seymour; 5361 (single), 5362 (duplex).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; TR8300.
b. Hubbell; HBL8300SG.
c. Legrand Pass & Seymour; TR63H.

2. Description: Labeled to comply with NFPA 70.

C. USB Combination Receptacle: Provide duplex receptacle as specified above, along with two integral USB charging ports. Each USB port shall be rated 2.1A minimum at 5VDC, and shall be compatible with USB 2.0 & 3.0 devices.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper TR7746
b. Legrand Pass & Seymour TR5362USB

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; GF20.
b. Legrand Pass & Seymour; 2095.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Crouse-Hinds.
b. EGS/Appleton Electric.
c. Killark; a division of Hubbell, Inc.
d. Legrand Pass & Seymour

2.5 TWIST LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Arrow Hart Cooper; CWL520R.
   b. Hubbell; HBL2310.
   c. Legrand Pass & Seymour; L520-R.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R (or as indicated on Drawings), heavy-duty grade.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Arrow Hart Cooper; CWL520P, CWL520C with I-Grip Strain Relief

2. Description
   a. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
   b. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; AH1221 (single pole), AH1222 (two pole), AH1223 (three way), AH1224 (four way).
b. Hubbell; HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
c. Pass & Seymour; PS20AC1 (single pole), PS20AC2 (two pole), PS20AC3 (three way), PS20AC4 (four way).

2. Description: Industrial extra heavy-duty specification grade switches.

C. Illuminated Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; AH1221LT for 120/277V.
b. Hubbell; HBL1221IL for 120/277V.
c. Pass & Seymour; PS20AC1 for 120/277V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is “OFF”. Refer to “FINISHES” herein for color.

D. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; AH1221PL for 120 V and 277 V.
b. Hubbell; HPL 1221PL for 120 V and 277 V.
c. Pass & Seymour; PS20AC1-RPL for 120 V, PS20AC1-RPL7 for 277 V.

2. Description: Single pole, with red neon-lighted handle, illuminated when switch is “ON”.

E. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; AH1221L.
b. Hubbell; HBL1221L.
c. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; 1995.

b. Hubbell; HBL1557.
c. Pass & Seymour; 1251.

G. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart Cooper; 1995L.
b. Hubbell; HBL1557L.
c. Pass & Seymour; 1251L.

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

2.10 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- thick, satin-finished type 302 stainless steel in all areas unless indicated otherwise.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush flap-type, dual-service units suitable for wiring method used, except in kitchens use modular, above-floor, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Carpet Flange: Rectangular, die-cast aluminum with satin finish.

E. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

F. Voice and Data Communication Outlet: Standard, single-gang device opening capable of accepting 1-6 per duplex frame (by others). Provide finishing plate.

2.12 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Square D/ Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold Company (The).

2.13 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 12 AWG.

2.14 SERVICE POLES

A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

1. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communications cabling.
2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports, with pole foot and carpet pad attachment.
3. Finishes: Selected by the Architect/Engineer from manufacturer’s standard painted finish and trim combinations.

4. Wiring: Sized for minimum of five No.12 AWG power and ground conductors and a minimum of four, 4-pair, Category 5 voice and data communication cables.
5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
6. Voice and Data Communication Outlets: Blank insert with bushed cable opening. Provide trim plates.

2.15 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing
2. Wiring Devices Connected to Emergency Power System: Red.
3. Wiring Devices Connected to Technology Grade Panelboards: White unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Quick connect or push-in conductor type devices are not acceptable.
7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

J. Provide Tamper-Resistant type receptacles in all facilities frequented by children as described by NFPA 70, including:
1. Child Care Facilities, Daycare, Preschools, Elementary Education Facilities,
2. Business Offices, Corridors, Waiting Rooms and the like in Clinics, Medical and Dental Offices and Outpatient Facilities;

3. Assembly Occupancies (Transportation Waiting, Pools, Gymnasiums, Skating Rinks, Auditoriums)

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles and switches: Identify panelboard and circuit number from which served. Use durable wire marker on the back (inside) of the cover plate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value above five percent is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches and panelboards, switchboards and enclosed controllers, and motor-control centers.
2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factor to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.
2. Feeders: Class L, time delay for feeders over 600 amps, Class RK1, time delay for smaller feeders.
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK1, time delay.
5. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) where indicated by the Owner.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3 SUBMITTALS

A. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Operation and Maintenance Data: For enclosed switches to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's written permission.
4. Comply with NFPA 70E.

1.6 COORDINATION

A. Coordinate layout and installation of switches and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240-V or 600-V ac as required, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240-V or 600-V ac as required, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.
2. Multispeed controllers.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical

elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosed controllers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every ten installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB / GE.
2. Eaton Corporation; Cutler-Hammer Products.
3. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
4. Siemens/Furnas Controls.
5. Square D.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. The external operating mechanism shall be provided, from the factory, with the capability of locking the electrical contacts in the open position. The locking mechanism shall be key operated.

2. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with

heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

3. Minimum controller size shall be NEMA size 1.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.

2.3 MULTISPEED ENCLOSED CONTROLLERS

A. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:

1. Compelling relay to ensure that motor will start only at low speed.
2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
3. Decelerating relay to ensure automatically timed deceleration through each speed.

2.4 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7**C**.

2.5 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

2.6 FACTORY FINISHES

A. Finish: Manufacturer's standard gray paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Furnish and install phase-failure and undervoltage relays for all combination magnetic controllers controlling motors five horsepower or larger.

3.3 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters." Certify compliance with test parameters.

a. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
b. Test continuity of each circuit.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262913

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Natural Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Outdoor enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Design Calculations: Manufacturer software calculations demonstrating that the generator is properly sized as indicated below in Capacities and Characteristics.
3. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
4. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For installer and manufacturer.

D. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
4. Report of sound generation.
5. Report of exhaust emissions showing compliance with applicable regulations.
6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on

testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 250 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with ASME B15.1.

F. Comply with NFPA 37.

G. Comply with NFPA 70.

H. Comply with NFPA 99.

I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

J. Comply with UL 2200.

K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.
2. Relative Humidity: 0 to 100 percent.
3. Altitude: Sea level to 1000 feet.

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Baldor Generators
2. Caterpillar; Engine Div.
3. Generac Industrial
4. Kohler Co.; Generator Division.
5. Onan/Cummins Power Generation; Industrial Business Group.
   a. Basis-of-Design: Generac Industrial. Refer to Specification section 26 0010 and 01 62 00.00.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing. The design size indicated on the drawings is based on a Generac SG300; all manufacturers shall submit software calculations to the engineer demonstrating that the generator is properly sized for a single-step pick-up of the loads connected to ATS-LS, ATS-SB-1 and ATS-SB2 in three consecutive steps.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for a step load increase or decrease equal to 50% of the unit’s rating. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:
1. Natural Gas System:

a. Carburetor.
b. Secondary Gas Regulator.
c. Fuel-Shutoff Solenoid Valve.
d. Flexible Fuel Connectors.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for required cable length. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a

battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: Inside generator enclosure with charger enclosure as recommended by the manufacturer.

2.4 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Generator overload.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

F. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for

each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve and downstream emergency distribution overcurrent protective devices.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Auxiliary Contact: 10A (closing), 125V rated shall mimic breaker main contacts.
5. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof sound rated, steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. Sound rating shall be equivalent to a Cummins Level 2 rated enclosure.

B. Outdoor Enclosures and Exposed Components: Manufacturer's standard outdoor corrosion resistant pretreatment and compatible primer. Final Exterior color to be selected by the Architect at the time of submittal.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.8 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 DEBRIS SHIELD

A. Generator to be equipped with engine cooling air intake debris elimination solution.
   1. Shield shall wrap the perimeter of the generator to prevent debris from entering generator.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Full load run.
   3. Maximum power.
   4. Voltage regulation.
   5. Transient and steady-state governing.
   6. Single-step load pickup.
   7. Safety shutdown.
   8. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

   1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.
   1. Natural-gas piping, valves, and specialties for gas distribution are specified in Division 23 Section "Facility Natural-Gas Piping."

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection, except those indicated to be optional, for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches with bypass/isolation.
2. Remote annunciation systems.

B. Related Sections include the following:

1. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for automatic transfer switches for fire pumps.
2. Division 21 Section "Electric-Drive, Vertical-Turbine Fire Pumps" for automatic transfer switches for fire pumps.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches, and remote annunciators through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110.

I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Generac Power Systems
   2. Kohler Co.; Generator Division.
   3. Onan/Cummins Power Generation; Industrial Business Group.
   4. Emerson; ASCO Power Technologies, LP.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

   1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

J. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

M. Enclosures: General-purpose NEMA 250, Type [**1**] [**3R**] [**12**], complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:

1. Fully automatic make-before-break operation.
2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

    a. Initiation occurs without active control of generator.
    b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

H. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.

3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.6 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Division 26 Section "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

D. Elevator Signal: Where elevators are connected to the generator, provide a signal circuit from the associated transfer switch to each elevator controller. Circuit shall be as recommended by the elevator supplier, these Specifications and Drawings and associated codes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Interior lighting fixtures, lamps and drivers.
   2. Emergency lighting units.
   3. Exit signs.
   4. Lighting fixture supports.

B. Related Sections include the following:
   1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors UL 924 relays, and multipole lighting relays and contactors.
   2. UL 924 Standard for Emergency Lighting and Power Equipment
   3. Division 26 Specification section for dimming controls.
   4. Division 26 Section "Network Lighting Controls" for manual or programmable control systems with low-Voltage control wiring or data communication circuits.
   5. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. LED: Light Emitting Diode

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Photometry data for luminaire to include:
      a. Candlepower distribution diagram and chart
      b. Zonal lumen summary chart & luminaire efficiency percentage
      c. Delivered lumen data for LED luminaires
      d. Total luminaire wattage
   3. Emergency lighting units including battery and charger.
   4. Ballast or driver, including BF.
   5. Energy-efficiency data.
   6. Life, output, and energy-efficiency data for lamps or light sources.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
   1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturer's codes. Include manufacturer's name, wattage, CRI, life & color temperature.

E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1. Create Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   a. Lighting fixtures.
   b. Suspended ceiling components.
   c. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
   d. Ceiling-mounted projectors.
   e. Structural members to which suspension systems for lighting fixtures will be attached.
   f. Access panels.
   g. Other items in finished ceiling including, but not limited to the following:
      1) Air outlets and inlets.
      2) Speakers.
      3) Sprinklers.
      4) Smoke and fire detectors.
      5) Occupancy sensors.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Lighting Unit Batteries: Ten years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
   2. Warranty Period for Emergency LED drivers and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
   2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

C. Special Warranty for LED Sources and Drivers: Manufacturer's standard form, made out to Owner and signed by manufacturer agreeing to replace LED sources or drivers that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: Five year(s) from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Drivers: 1 for every 100 of each type and rating installed. Furnish a minimum of one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Comply with UL 1598.

C. UL 1598 This Standard applies to luminaires for use in non-hazardous locations

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components:
   1. Steel, minimum 22 gauge for troffers, unless otherwise indicated.
   2. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access:
   1. Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools.
   2. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
   3. Spring loaded cam latches.
   4. Designed and fabricated to include reinforcing to prevent warping.

G. All metal parts shall be painted after fabrication.

H. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

I. Provide integral accessible disconnecting means for LED luminaires.

J. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

2.3 LED SOURCES

A. Comply with ANSI/UL 1993-2009 AND ANSI/UL 8750-2008, “Light Emitting Diode (LED) for Use in Lighting Products”. Photometric testing data shall be in accordance with IESNA LM-79. Lumen maintenance depreciation measurements shall be in accordance with IESNA LM-80, while long term lumen maintenance estimations shall be in accordance with IESNA TM-21.

B. UL 1993 Self-Ballasted Lamps and Lamp Adapters

C. UL 8750 Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.

D. LED sources shall have a color temperature of 3500K and a minimum CRI of 80, with an R9 value of >50.

E. LED sources shall start and operate in 0°F to 40°F ambient.

F. LED sources shall be designed for ease of component replacement and end-of-life disassembly from room side. All internal components shall be assembled and pre-wired using modular electrical connections.

G. LED sources shall be RoHS compliant (Restriction of Hazardous Substances).

H. LED sources shall be binned to a 3 step MacAdam ellipse (SDCM: Standard Deviation Color Matching) of the 3500K Planckian Locus to ensure color consistency.

I. LED products must have a minimum 5 year warranty for replacement of all components, including LED board or driver.

2.4 DRIVERS FOR DIMMER CONTROLLED LED FIXTURES

A. 10% Dimmable Driver for LED Fixtures – Description: Electronic driver shall be designed for type and quantity of LED fixtures served and for full light output. Comply with NEMA SSL 1, UL 8750, ANSI C62.41, Category A and the following:

B. UL 8750 Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1. Dimming Range: 100% to 10% of rated lumens with continuous, flicker-free 0-10V dimming.

2. Operating Voltage: 120-277V at 50/60Hz.

3. Rated Lifetime: 50,000 hours at drive case temperature of 149 deg F.

4. Sound Rating: Class A.

5. Starting Temperature: Shall start the lamp(s) at 32°F or higher.

6. Total Harmonic Distortion Rating: Less than 20 percent.

7. Standby Power Consumption: Less than 1.0 watt.

8. Power Factor: 0.90 or higher.

9. Inrush Current: Less than 2 amps. Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure.

10. Transient Voltage Protection: Follow ANSI C62.41 to provide Category A rating or better.

11. Open circuit protected and short circuit protected.

12. LEDs turn on to any dimmed level without going to full brightness.

13. Nonvolatile memory restores all driver settings after power failure.

14. Turn-on time: Less than 1 second.

15. RFI Requirements: Labeled for radio frequency interference (RFI) requirements of FCC Title 47 Part 15.

C. 3-Wire Control, 1% Dimmable Driver for LED Fixtures – Description: Electronic driver shall be designed for type and quantity of LED fixtures served and for full light output. Comply with UL 8750, ANSI C62.41, Category A and the following:

1. Products:
   a. Lutron Hi-Lume A-Series L3D.
2. Dimming Range: 100% to 1% of rated lumens with continuous, flicker-free dimming.
3. Operating Voltage: 120-277V at 50/60Hz.
4. Output Power: 5 to 40 watts.
5. Rated Lifetime: 50,000 hours at drive case temperature of 149 deg F.
6. Sound Rating: Class A.
7. Starting Temperature: Shall start the lamp(s) at 32°F or higher.

8. Total Harmonic Distortion Rating: Less than 20 percent at 40 watts.
9. Standby Power Consumption: Less than 1.0 watt.
10. Power Factor: 0.90 or higher at 40 watts.
11. Inrush Current: Less than 2 amps. Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure.
12. Transient Voltage Protection: Follow ANSI C62.41 to provide Category A rating or better.
13. Open circuit protected and short circuit protected.
14. LEDs turn on to any dimmed level without going to full brightness.
15. Nonvolatile memory restores all driver settings after power failure.
16. Turn-on time: Less than 1 second.
17. Maximum Driver-to-LED Light Engine Wire Length: Less than 10 feet.
18. Driver Output: Provide constant current driver with pulse width modulation (PWM) dimming, constant current driver with constant current reduction (CCR) dimming, or constant voltage driver with pulse width modulation (PWM) dimming as required by the LED fixture manufacturer.

2.5 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. UL 924 Standard for Emergency Lighting and Power Equipment

C. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
   a. Battery: Sealed, maintenance-free, nickel-cadmium type.
   b. Charger: Fully automatic, solid-state type with sealed transfer relay.
   c. Operation: Relay automatically energizes lamp from battery when circuit Voltage drops to 80 percent of nominal Voltage or below. When normal Voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   f. Universal mounting unless a specific mounting is indicated.
   g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by a flashing red LED.

2.6 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

B. UL 924 Standard for Emergency Lighting and Power Equipment
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power supply circuit Voltage drops to 80 percent of nominal Voltage or below. Lamp automatically disconnects from battery when Voltage approaches deep-discharge level. When normal Voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Wire Guard: Where indicated on Drawings, provide heavy-chrome-plated wire guard protects lamp heads or fixtures.
   7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
   8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by a flashing red LED.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel.

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line Voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
   1. Fixtures with Same Dimensions As Ceiling Grid:
      a. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
      b. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independent of acoustical panel with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

C. Suspended Lighting Fixture Support:

D. Careful - The sway supports may not be aesthetically pleasing to the Owner
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Identify who will direct aiming requirements.

F. Adjust aimable lighting fixtures to provide required light intensities. Coordinate aiming requirements with [Owner] [Architect].

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

H. Clean lamps, lenses, and reflectors of all dirt, debris, paint, and finger prints prior to Substantial Completion of Work.

I. Lamps, ballasts and drivers shall be in working order at the time of Substantial Completion of Work.

J. Remote Mounting of drivers and Ballasts: Distance between the driver/ballast and the fixture shall not exceed that recommended by ballast manufacturer. Verify with manufacturers for maximum distances.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt normal power supply to demonstrate proper operation. Verify transfer from normal power to emergency source (battery, generator, etc) and retransfer to normal.

3.3 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide one visit to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior LED luminaires with drivers.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. LED: Light Emitting Diode type lamp/light source.

C. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
   a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products and include:

1) Candlepower distribution diagram and chart
2) Zonal lumen summary chart & luminaire efficiency percentage
3) Delivered lumen data for LED luminaires
4) Total luminaire wattage

6. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, and energy-efficiency data.
8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

C. Warranty: Provide certificate of warranty which complies with the special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IESNA standards, guidelines and recommended practices for the provided luminaires.

Comply with IEEE C2, "National Electrical Safety Code

D. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

B. Special Warranty for LED Sources and Drivers: Manufacturer's standard form, made out to Owner and signed by manufacturer agreeing to replace LED sources or drivers that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Exterior Lighting Fixture Schedule where titles below are column headings that introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

Retain first paragraph below if some lighting units or luminaires are indicated to have Type I, II, III, IV, or V distribution pattern in Exterior Lighting Fixture Schedule.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's paint factory-applied to factory-assembled and -tested luminaire before shipping.

2.3 LED SOURCES

A. Comply with ANSI/UL 1993-2009 AND ANSI/UL 8750-2008, “Light Emitting Diode (LED) for Use in Lighting Products”. Photometric testing data shall be in accordance with IESNA LM-79. Lumen maintenance depreciation measurements shall be in accordance with IESNA LM-80, while long term lumen maintenance estimations shall be in accordance with IESNA TM-21.

B. LED sources shall have a color temperature of 4000K (unless specified differently) and a minimum CRI of 70, with an R9 value of >0.

C. LED sources shall start and operate in 0°F to 104°F ambient.

D. LED sources shall be designed for ease of component replacement and end-of-life disassembly from room side. All internal components shall be assembled and pre-wired using modular electrical connections.

E. LED sources shall be RoHS compliant (Restriction of Hazardous Substances).

F. LED sources shall be binned to a 5 step MacAdam ellipse of the 3500K Planckian Locus.

G. LED products must have a minimum 5-year warranty for replacement of all components, including LED board or driver.

2.4 DRIVERS FOR LED FIXTURES

A. Driver for LED Fixtures – Description: Electronic driver shall be designed for type and quantity of LED fixtures served and for full light output. Comply with UL 8750, ANSI C62.41, Category A and the following:

1. Rated Lifetime: 50,000 hours at drive case temperature of 149 deg F.
2. Sound Rating: Class A.
3. Starting Temperature: Shall start the lamp(s) at 0°F or higher.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Standby Power Consumption: Less than 1.0 watt.
6. Power Factor: 0.90 or higher.
7. Inrush Current: Less than 2 amps. Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure.
8. Transient Voltage Protection: Follow ANSI C62.41 to provide Category A rating or better.
9. Open circuit protected and short circuit protected.
10. Nonvolatile memory restores all driver settings after power failure.
11. Turn-on time: Less than 1 second.
12. Driver Output: Provide constant current driver with pulse width modulation (PWM) dimming, constant current driver with constant current reduction (CCR) dimming, or constant voltage driver with pulse width modulation (PWM) dimming as required by the LED fixture manufacturer.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

A. Ground each light fixture using the equipment grounding conductor in the circuit supplying the fixture, per manufacturer's requirements.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

END OF SECTION 265600

SECTION 269999 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 01, Commissioning Requirements, applies to this section and will require the contractor participation in the commissioning process.

C. Division 01 Section “LEED Requirements.”

D. Specification sections indicating testing requirements for electrical systems or equipment.

1.2 SUMMARY

A. This Section includes testing general administrative and procedural requirements for electrical testing. Provide specific testing of electrical equipment devices, installations, and systems, as indicated in the Specifications and Drawings.

1.3 QUALIFICATIONS

A. The testing firm shall be a corporately independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The lead, on site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or the National Institute for Certification in Engineering Technologies (NICET) in Electrical Power Testing.

D. The testing firm shall only utilize full time technicians with the firm providing the testing services.

E. The Contractor shall submit proof of the above qualifications with bid proposal.

F. Acceptable Testing Firms:

1. Northern Electrical Testing; Phone (248) 689-8980.

2. Utilities Instrumentation Services ; Phone (800) 277-5740.
3. Emerson/High Voltage Maintenance Corporation; Phone (248) 305-5596.

1.4 PERFORMANCE REQUIREMENTS

A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.

B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests.
   1. Work shall be coordinated to safely expedite project scheduling.
   2. The testing firm shall notify the Owner's Representative, in writing, prior to commencement of any testing.

C. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Architect/Engineer. The Electrical Contractor shall correct all defects.

D. The testing organization shall maintain a written record of all tests and shall assemble and certify a final test report.

E. Safety and Precautions

   1. Safety practices shall include, but are not limited to, the following requirements:

      a. Occupational Safety and Health Act.
      b. Accident Prevention Manual for Industrial Operations, National Safety Council.
      c. Applicable state and local safety operating procedures.
      d. NETA Safety/Accident Prevention Program.
      e. Owner's safety practices.
      f. National Fire Protection Association - NFPA 70E.

      g. American National Standards for Personnel Protection.

   2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
   3. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.5 TEST INSTRUMENT CALIBRATION

A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy, meeting standards set by the National Institute of Standards and Technology (NIST).
2. Dated calibration labels shall be visible on all test equipment.
3. Maintain current records which show;
   a. Dated results of instruments' calibration and test procedures.
   b. Instrument calibration instructions and procedures for each test instrument.

B. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition to promote a safe working environment.
2. Metering equipment shall be suitable for the test being performed and be compatible with the electrical characteristics of the system under test.
3. Use of RMS measuring meters is recommended.
4. The accuracy of the field test metering equipment, used to check the calibration of the power system meter, shall be higher than that of the instrument being checked.
5. Accuracy of metering in test equipment shall be appropriate for the test being performed.

1.6 TEST REPORTS

A. A test report shall be generated for each piece of electrical equipment, device, installation, and system, as indicated in the Specifications and Drawings and shall include the following:

1. Check list of visual and mechanical inspections.
2. Test reports, including test values where applicable, for all required electrical tests.
3. Obvious indication, on the first page of the test report, where test results fall outside of the limits of recommended values.
4. Summary and interpretation of test results:
   a. Describe the problem in detail,
   b. Offer suggestions for solutions and correction.
5. Record of infrared scan and photos showing potential problem locations.
6. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 THERMOGRAPHIC SURVEY

A. Visual and Mechanical Inspection

1. Remove all necessary covers prior to scanning.
2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned

1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.
2. Coordinate the timing of the visit with the Owner's representative to perform the testing during peak operating hours.

C. Provide report indicating the following:

1. Problem area (location of "hot spot").
2. Temperature rise between "hot spot" and normal or reference area.
3. Cause of heat rise.
4. Phase unbalance, if present.
5. Areas scanned.

D. Test Parameters

1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3. Perform infrared surveys during periods of maximum possible loading,
4. Identify areas under test which are loaded to less than twenty percent (20%) of rated capacity.

E. Test Results

1. Identify temperature gradient issues per NETA standards. Identify where gradients fall into the following ranges:

   a. Temperature gradients of 3°C to 7°C indicate possible deficiency and warrant investigation.

b. Temperature gradients of 7°C to 15°C indicate deficiency; repair as time permits.
c. Temperature gradients of 16°C and above indicate major deficiency; repair immediately.

END OF SECTION 269999

SECTION 27 0000 – GENERAL TECHNOLOGY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes general administrative and procedural requirements. The following requirements are included to supplement the requirements specified in Division 1 Specification Sections.

B. Along with the drawings and details, these specifications establish the requirements for the new Mt. Hope School

C. The project consists of the following major systems:

1. Structured cabling system
2. Audiovisual systems
3. Security systems
4. PA system
5. Clock system

D. The project consists of the following alternates to be submitted in addition to the base bid:

1. **Alternate**: **Carehawk PA System**
   The base bid PA system is an Audio Enhancement Epic System using classroom sound amplification systems with amplifiers, speakers, etc. for non-classroom spaces. This alternate is to install a Carehawk PA system in lieu of the Audio Enhancement Epic System in classrooms. Classrooms will still require a sound-field amplification system but it does not need to be the Audio Enhancement Optimum System.

2. **Alternate**: **5-Year Warranty**
   The base bid is to include a 3-year manufacturer and contractor warranty on all equipment and installation related to the systems in this section. This alternate extends the manufacturer and contractor warranty to 5 years. Owner expects the contractors to resolve issues and replace defective equipment throughout the warranty period.

3. **Alternate**: **Surveillance Camera Analytics**
   The base bid video surveillance cameras do not need built-in analytics. This alternate adds analytic functionality to the cameras. At a minimum provide object tracking, object identification (eg: gender and clothing, vehicle type and color, etc.). Provide Hanwha P-Series, Avigilon H5 Series, or equivalent by Axis.

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1.3 GENERAL REQUIREMENTS

A. Bidders must submit a bill of materials with the proposal. BOM must list all major components, quantities, and extended price. BOM is provided for information only to assist in evaluating the various bid proposals. Bidder agrees to the scope of work outlined in the bid documents.

B. The bid documentation does not provide for every component or requirement of installation; however, it does establish minimum requirements for the system. The final solution shall be well documented within the bid proposal. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the work. Installation within a reasonable distance from the locations shown on the drawing will be performed without additional cost.

C. The submitting of a bid response implies that the Contractor understands the conditions under which the work must be conducted. Additional charges will not be allowed because of failure to make this examination or to include all materials and labor to complete the work.

D. If backend systems (power supplies, master clock, master PA console, etc.) need dedicated or hardwired electrical connections, each Contractor is to provide the requirements for their systems as part of the bid response. If the electrical requirements are not specifically called out in the bid response, the Contractor will subcontract to a licensed electrical contractor to complete the electrical work as part of the Contractor's cost.

E. Additional information provided with a bid response shall be used in the evaluation of bids, but do not replace the requirements established by the contract documents (project manual, drawings, specifications, etc.). The Technology Designer and Owner will not be responsible for reviewing equipment lists for completeness or conformance to the contract documents. Lists of material, bills of material, etc. submitted by the contractor do not replace the submittal requirements and do not replace the requirements established by the contract.

F. The Contractor shall provide the services necessary to engineer, procure, install, test, and certify the systems described in the bid documents conforming to manufacturer specifications and applicable industry standards.

G. All materials and equipment shall be furnished complete with all accessories normally supplied for a complete and operating system. All materials and equipment shall be new and shall be standard products in production and shall be of the manufacturer's current design. Any items with a known end of manufacture date will be specifically called out for approval before procurement. All equipment of the same or similar systems shall be by the same manufacturer.

H. The methods of implementation shall be in accordance with the latest issue of the various authorities including but not limited to:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. BICSI Building Industries Consulting Services International
4. EIA Electronics Industries Association
5. FCC Federal Communications Commission
6. ICEA Insulated Cable Engineers Association
7. IEEE Institute of Electrical and Electronics Engineers
8. ISO International Organization for Standardization
9. NEC National Electrical Code
10. NECA National Electrical Contractors Association

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11. NEMA National Electrical Manufacturer's Association
12. NFPA National Fire Protection Association
13. TIA Telecommunications Industry Association
14. UL Underwriters Laboratories, Inc.

I. Notify the Technology Designer before the bid period question deadline should any changes in bid documents be required to conform to recommended manufacturer guidelines or the applicable codes, rules, or regulations. After entering into Contract, make all changes required to conform to applicable guidelines, ordinances, rules, and regulations without additional expense to the Owner.

J. Any required permits, licenses, inspections, approvals, and fees for the work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations. Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

K. Contractor shall comply with all rules and regulations of local utility companies. Coordinate requirements with applicable companies supplying service and include the cost of all such items in proposal.

L. Each contractor is to provide any backboards and access panels necessary for their installation. Materials are to be fire-rated. Provide D-rings, spaced no greater than 12" apart, to support cables routed to and along backboards.

M. Each contractor is to use plenum rated cabling and accessories throughout the project.

N. Where not provided by the electrical contractor, each contractor is required to provide their own penetrations, sleeves, and cores with firestopping. Sleeves and cores shall have nylon bushings.

O. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL 1449. Install surge suppressors at the devices' power-line terminals. All surge suppression devices shall warranty protection of all downstream equipment.

P. Unit prices established for the project shall remain in effect throughout the duration of the contract.

1.4 DEFINITIONS

A. ADA: Americans with Disabilities Act.

B. AIA: American Institute of Architects.

C. FBO: Furnished By Others.

D. IR: Infrared.

E. MC: Main Cross-Connect. (Applies to MDF or Headend references).

F. OFE: Owner Furnished Equipment. (Applies to OFCI references)

G. POE: Power over Ethernet.

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H. RF: Radio Frequency.

I. TR: Telecommunications Room. (Applies to MDF or IDF references).

1.5 SUBMITTALS

A. All submittals shall be complete and organized by related items. Incomplete submittal packets will be returned unchecked. Any modifications to or deviations from the bid documents shall be specifically highlighted on the submittals. In addition to requirements specified in Division 1, include the following:

B. Lists of material, bills of material, etc. submitted by the contractor do not replace the submittal requirements and do not replace the requirements established by the contract documents. The Technology Designer and Owner will not be responsible for reviewing lists of material for completeness or conformance to the contract documents.

C. Copies of any professional licenses or certifications requested in the documents.

D. Product Data: For each product indicated in the specifications or included in the scope, provide a product data sheet in PDF format. Data sheets indicating multiple products must have the applicable product highlighted or marked.

E. Shop Drawings: Shop drawings are to be provided in both PDF and native electronic format (eg AutoCAD, Revit, Excel format, etc.).

F. Closeout documents will include a spreadsheet identifying system components, installed location, model number, serial number, label designation, and any other pertinent data. Submittals shall include spreadsheet format for approval.

1.6 QUALITY ASSURANCE

A. The Contractor and their Sub-Contractors shall be experienced in all aspects of the work and shall demonstrate direct experience on recent systems of similar type, complexity, and size.

1. Upon request, Contractor shall furnish for both the Contractor and all Sub-Contractors information on the corporation, project manager, and installers indicating recently completed projects, technical experience, and completed training.
2. The Contractor shall maintain consistent staffing for Project Management and lead installers throughout the project, except for illness or loss of personnel. The Technology Designer and Owner reserve the right to require staffing substitutions if deemed beneficial to satisfactory completion of the project.

B. The Contractor shall utilize equipment from manufacturers regularly engaged in the production of similar systems and components for a minimum of five (5) years.

C. The Contractor shall install in accordance with all applicable codes and standards, including federal, state, and local codes and authorities.

1.7 COORDINATION

A. Contractor is to coordinate with other construction and technology contractors.

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B. Contractors shall be responsible for coordinating their configuration with the Owner, access providers, and other integrators whose systems will interact. If problems occur during implementation or commissioning, all contractors will be responsible for ongoing/additional coordination regarding configuring, testing, and troubleshooting of related/ inter-related devices until a resolution acceptable to the Owner is achieved. This includes coordination with outside agencies such as telephone service providers and internet service providers when necessary

C. Coordinate layout, rough-in requirements, and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

D. Coordinate with the appropriate utility companies for installation and cutover.

E. Where multiple contractors will share a common pathway or faceplate, coordinate requirements and installation.

F. Contractor shall uncover Work as needed for review by the Owner, Technology Designer, Architect, Construction Manager, or contractors performing related work. Work uncovered for observation will be replaced at the Contractor's expense without change in the Contract Time or Contract Sum.

G. Where the cabling and A/V contractor(s) will be sharing a faceplate, the A/V contractor is to provide the faceplate and any blank modules. The faceplate must be able to accept the termination jack chosen by the data cabling contractor. Contractors shall coordinate all faceplate and termination requirements.

1.8 WARRANTY

A. All division 27 and 27 systems shall be provided with a three (3) year warranty unless noted otherwise in scope specific specification sections. Manufacturer and contractor warranties are to include the entire system (equipment, software updates, licensing, installation, etc.).

B. Unless a specification section has a specific requirement, manufacturer warranties for each component shall begin on the date that equipment is delivered from the manufacturer/supplier. The contractor warranty period shall begin at the date indicated on the certificate of substantial completion or the date of Owner acceptance (to be received in writing and approved by the Owner), whichever comes later.

C. Contractor is to provide:

1. Evidence of the manufactures warranty end date.
2. Procedures for warranty issues (e.g. phone number to call, warranty ID numbers, etc.)
3. Documentation for all manufacturer's warranties including the operating conditions required for the warranty.
4. Contractor's guarantee.

D. The manufacturer warranty shall include phone support and software assurance including patches, updates and version upgrades for both major and minor releases throughout the warranty period.

E. The Owner shall not be responsible for additional charges during the equipment warranty period. Labor, service charges, trip charges, etc. to configure and install equipment during the warranty period shall be included in the contractor's warranty.

F. Contractor is to register all equipment in the Owner's name, not the Contractor's. All manufacturer warranty and support must be available to the Owner directly and not required to channel through the Contractor, distributor, or other entity.

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G. When a manufacturer's warranty is provided, it is the Bidder's responsibility to make sure the manufacturer's records reflect the correct warranty period start date as established in the contract terms.

H. The contractor warrants the system to be free of product, workmanship, and configuration defects and will inspect and repair the system before the next school day (or within 48 hours during school breaks) during the warranty period at no additional cost to the Owner. The Contractor shall respond on site within four (4) hours notice, and without cost to the Owner, during this warranty period. Contractor agrees to correct system deficiencies and replace components that fail in materials or workmanship including deficiencies arising when used according to the manufacturer or Contractor's written instructions. No warranty or terms therein shall limit or be interpreted to limit remedies as provided by law.

I. Contractor will be responsible for repairing/replacing any aspect of the system unless a specific specification section states that the Owner will install replacement equipment.

J. Contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor is responsible for ensuring that no asbestos containing building materials (ACBM) are used and must certify to the Owner and Technology Designer that none was used.

B. Any equipment, software, system, etc. with time dependent functions (e.g. bell systems) shall automatically adjust for daylight saving time without human intervention.

2.2 MANUFACTURERS

A. Permit Competition. The name of a model, manufacturer or brand in this RFP shall not be considered as exclusive of other brands. Brands and models specified in this RFP are preferred. Owner expects all supplies, materials, equipment, or products bid by a Bidder to meet or exceed the specifications set forth in this RFP. Further, it is Owner's intent that this RFP permit competition. Accordingly, the use of any patent, proprietary name or manufacturer's name is for demonstrative purposes only and is not intended to curtail competition. Whenever any supplies, material, equipment or products requested in this RFP are specified by patent, proprietary name or by the name of the manufacturer, unless stated differently, such specification shall be considered as if followed by the words "or comparable equivalent," whether or not such words appear. Owner, in its sole and absolute discretion, shall have the right to determine if the proposed equivalent products/brands submitted by Bidder meet the specifications contained in this RFP and possess equivalent and/or better qualities. It is the Bidder's responsibility to notify Owner in writing if any specifications or suggested comparable equivalent products/brands require clarification by Owner prior to the Due Date for Bids. All Bid deviations from specifications must be noted on the Proposal Form.

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B. Base bid shall utilize manufacturers listed in the applicable specification sections. Contractor may include deviations as voluntary alternates in addition to the base bid, not in lieu of the base bid.

C. The Owner expects all supplies, materials equipment or products proposed by a Bidder to meet or exceed the Specifications set forth in the Bidding Documents. Further, it is the Owner's intent that the Bidding Documents permit competition. Accordingly, the use of any patent, proprietary name or manufacturer's name is for demonstrative purposes only and is not intended to curtail competition. Whenever any supplies, material, equipment or products requested in the Bidding Documents are specified by patent, proprietary name or by the name of the manufacturer, unless stated differently, such specification shall be considered as if followed by the words "or comparable equivalent," whether or not such words appear. The Owner, in its sole and absolute discretion, shall have the right to determine if the proposed equivalent products/brands submitted by Bidder meet the Specifications contained in the Bidding Documents and possess equivalent and/or better qualities. It shall be the Bidder's responsibility to notify the Owner in writing if any Specifications or suggested comparable equivalent products/brands require clarification by the Owner prior to the Due Date for Bid Proposals.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Failure or omission of the Contractor to examine the site or documents does not relieve the Contractor. No additional payment will be made to the Contractor for failure to comply.

C. Review building plans and installations to confirm outlet and conduit installation and location. Check outlets, conduits, raceways, cable trays, and other elements in the proposed pathways for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation in compliance with manufacturer requirements.

D. Device locations shown on drawings are diagrammatic only and may not represent intended location due to conflicts with other CAD symbols, room names, etc. Field verify conditions and coordinate device locations with other trades. Devices shall be installed to perform optimally for the usage and conditions of the space. Notify Barton Malow of conflicts that negatively affect performance prior to installation.

E. Contractor shall choose appropriate mounting method and materials for each location based on manufacturer's requirements, wall construction, building structure, etc.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 DEMOLITION [Not Used]

3.3 INSTALLATION

A. Equipment that extends more than 4” from the wall will be mounted above 80” above finished floor unless reviewed and approved by Technology Designer or Owner.

B. Consult with the Owner’s Representative as to the method of completing work to avoid interfering with the Owner’s operation. All systems shall remain operational and shall only be interrupted at times coordinated with the Owner’s Representative.

C. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans or specifications.

D. The Contractor shall be familiar with the site and the rooms to ensure a proper installation. The final installation methods are left to the discretion of the contractor in accordance with this specification, within standards of generally accepted workmanship, and in accordance with manufacturer’s recommended installation practices.

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E. The Contractor shall protect equipment and components during installation. Damage resulting from the Contractor's work shall be promptly replaced or repaired at the Contractor's expense.

F. The Contractor shall provide all lifts and temporary supports necessary to accomplish their installation.

G. The Contractor shall accomplish all cutting, removal and replacement of ceiling tile, drilling, coring and patching of walls, floors, casework, and ceilings required to complete their work. Contractor is responsible for replacing any damaged tiles and cleaning the ceiling grid upon completion of their work.

H. Contractor to ensure Owner and Technology Designer have reviewed above ceiling or concealed work before reinstalling ceiling tiles or other obstructions. If work is performed in occupied areas where ceiling tiles or other obstructions must be re-installed upon completion of work, Contractor will be required to remove and reinstall in selected areas for inspection by Owner or Technology Designer.

I. The Contractor, in accordance with all applicable codes, shall provide fire and smoke stopping through all partitions. Verify that penetrations of rated fire walls are made using products labeled for type of partition penetrated.

J. All cables within racks, cabinets, or enclosures will be cable wrapped with hook and loop tape (Velcro) at no greater than one-foot intervals. Cabling housed in wiring management shall be tied at no less than two-foot intervals.

K. Due to field conditions or other situations, installation locations may have to be relocated a reasonable distance from the plan location. Unless relocations, modifications and reengineering are consistently or substantially unfavorable to either the Contractor or the Owner, there will be no additional charge or credit for this work.

L. No additional compensation will be provided for moving installed equipment for reasons including, but not limited to:

1. Performance issues.
2. Failure to coordinate with other trades for existing conditions and renovations or new construction.
   a. All drawings (including Architectural, Mechanical, Electrical, etc.) are available for review at the jobsite.
3. Locations deviating from design drawings (unless approval has been obtained prior to installation).
4. Failing to follow manufacturer's recommendations.

M. The lack of permanent power does not relieve contractor of installation requirements as dictated in the specifications. If permanent power is not available, contractor must provide temporary power (e.g. UL approved extension cords) to complete installation, configuration, and testing of equipment (e.g. projectors, interactive whiteboards, etc.). Extension cords and/or other means of temporary power are to be removed immediately after the initial installation/configuration. At the time permanent power is completed, contractor to return to make final equipment connections and any necessary adjustments. Refer to the safety section of the project manual for guidelines of proper use with regards to temporary power.

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3.4 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Contractors working above ceiling or drilling are to bring their own vacuums unless the building custodian allows theirs to be used.

C. Contractor shall clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer.

3.5 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury, or damage. Equipment set in place must be provided with temporary protection.

B. Provide adequate storage for all equipment and materials delivered to the site. Owner shall not be required to provide secure storage but will attempt to accommodate the Contractor's requirements.

C. Contractor will be required to protect any Owner-Furnished-Contractor-Installed (OFCI) equipment and will be responsible for replacing any missing or damaged equipment.

3.6 IDENTIFICATION

A. Unless noted otherwise, use logical and systematic designations for facility's architectural arrangement and nomenclature.

B. Contractor is responsible for permanently identifying all major components used in the project. Component list, identification method, and nomenclature to be coordinated with and approved by the Technology Designer.

C. All cross-connecting cable shall be adequately tagged as "to" and "from."

3.7 FIELD QUALITY CONTROL

A. All ancillary accessories (e.g. remote controls, keys, etc.) shall be collected, identified by installation location, and turned over to the Owner. Coordinate delivery with Technology Designer to ensure appropriate signoffs are received.

B. The Owner and/or Technology Designer may designate an agent who may be present during testing and may provide additional testing to verify cabling installer results. The agent shall accept or reject the installation.

3.8 DEMONSTRATION AND STARTUP

A. All training and demonstration will be provided at no cost to the District.

B. Additional training requirements are listed in individual specification sections.

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3.9 DOCUMENTATION

A. For multi-phase projects, adequate documentation for completed work shall be submitted as each phase is completed to allow the owner and project team to utilize the system.

B. Provide progressive “as-builts” to the Owner as devices are installed, including MAC address, serial number information, and specific installed location. Provide this information to the Owner daily as necessary, through a collaborative software (ex. Google Sheets, or Office365) and format approved by the Owner and Technology Designer. Handwritten notes will not be accepted.

C. At the conclusion of the project (or major phase for multi-phase projects), all documentation is to be compiled into an organized, comprehensive package. Copies are to be submitted both in hard copy and electronic formats. CAD drawings shall be in AutoCAD or Revit format. The Contractor is responsible for any fees charged by the architect for providing CAD backgrounds.

D. Contractor responsible for all equipment registration per manufacturer’s instructions.

E. As-Built: In addition to requirements specified in Division 1, include the following:

1. As-built drawings are to reflect all changes between the bid documents and the final installation, including final location of all equipment, outlets, racks, penetrations, etc. inclusive of the base bid, implementation add/changes, and all change orders.
2. Drawings for systems showing location and cabinet/enclosure layout. Include all components identifying component manufacturer and model, serial numbers, and connections.
3. Cable tests, OTDR traces, etc. are to be provided in both hardcopy format as well as electronic format. Any software necessary to view the tests must be provided to the Owner.
4. Wiring and systems certification.
5. Certificate of manufacturer’s extended warranty, where applicable.
6. Spreadsheet identifying system components, installed location, model number, serial number, label designation, warranty expiration, and any other project-specific pertinent data. Spreadsheet format to be approved by Technology Designer.
7. Schematics shall be created in AutoCAD or Visio format. Handwritten drawings shall be accepted for draft or working copies only.
8. Drawings with floorplans shall be created in AutoCAD or Revit format. Handwritten drawings shall be accepted for draft or working copies only.
9. All as-built and other closeout documentation to be submitted as a PDF in addition to the native file format.

F. Maintenance Data:

1. Detailed operating instructions covering operation under both normal and abnormal conditions.
2. Routine maintenance procedures for system operation, customized for the installation.
3. Lists of spare parts and replacement components recommended being stored at the site.

END OF SECTION 27 0000

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SECTION 27 1000 – GENERAL CABLING REQUIREMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 General Technology Requirements
2. Any specification sections that include cabling and/or cabling installation.

1.2 SUMMARY

A. This Section includes general cabling requirements for contractors installing cabling within their scope of work.

B. Contractor is required to furnish and install cables and accessories in locations as shown on plan drawings, details, and specifications.

C. Scope of work includes all physical cable management hardware, including, but not limited to backboards, cable supports, raceway, and cable management required to complete the system.

D. Where adequate pathways are not provided by the electrical contractor, each Contractor is required to provide their own penetrations, sleeves, and cores with firestopping. Sleeves and cores shall have nylon bushings. Contractors are to control dust generated from penetrations, protect nearby equipment and surfaces from dust, and follow all OSHA regulations.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. All cable types
2. Terminations components for each system
3. Faceplates

B. Shop Drawings:

1. Include all labeling schemes for all systems such as station outlets, cable runs, patch panels, punchdown blocks, racks, etc.

C. Samples:

1. Sample outlet including faceplate, modules, and labeling.

D. Qualification Data:

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1. Include written confirmation from the manufacturer that the bidder is a certified installer for the structured cable plant solution.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Contractor must be certified by the manufacturer of the solution being installed.

B. Installation Supervision: Installation and testing shall be performed by BICSI Registered Installers or manufacturer certified installers, with a consistent supervisor who shall be present at all times when work of this section is performed.

C. Comply with all requirements of the 2017 NEC unless jurisdiction requires a different version. Cables must comply with temperature rating requirements including Table 725.144.

D. Comply with EIA/TIA 568B-2.1, EIA/TIA 569, and EIA/TIA 606.

1.5 COORDINATION

A. Coordinate layout and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

B. All Contractors utilizing a shared pathway shall be responsible for coordinating and ensuring that firestopping requirements are fulfilled. Any unused penetrations installed by the electrical contractor for future use shall be firestopped by the data cabling contractor.

C. All Contractors utilizing penetrations shall be present during electrical and fire marshal inspections with adequate firestopping material and shall immediately correct any issues identified during the inspections.

D. Each Contractor is to protect their own cables during installation. Rough cables are to be properly supported and not left on the floor. If conditions necessitate leaving cables Contractor is to put a note on the cables to reduce chance of damage by others and note cable location to controlling contractor.

E. Each Contractor to protect their cables in areas where ceilings will be painted to ensure cable sheath is not painted.

F. For projects where the structured cabling for access points, video surveillance cameras, etc. is being provided by a different contractor, the Contractor installing the equipment (access point, video surveillance camera, etc.) will be responsible for coordinating the cable locations with the structured cabling contractor. In general:

1. Equipment contractor is to extend the cable to the final equipment mounting location including penetrations, firestopping, waterproofing, raceway, etc. Equipment contractor to provide longer patch cables if needed to reach the mounted equipment location.

2. For areas where equipment will be mounted in accessible ceiling, cabling contractor is to run the cable to the center of the space for wireless access points or the general area where video surveillance cameras or other equipment are shown. Coil adequate cable to reasonably relocate the equipment within the space.

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3. For outdoor equipment, stairwells, equipment in open ceiling spaces to be mounted adjacent to accessible the accessible ceiling in an adjacent space (corridor, etc.) cabling contractor is to run the cable to the adjacent interior space. Equipment contractor is to create the penetration and extend cable to final equipment location, and seal the penetration as required for weatherproofing or firestopping.

4. For open ceiling areas where cabling will be routed away from the adjacent accessible ceiling (e.g. along the perimeter of the space or along the beams/trusses and dropped down to the equipment location in a gymnasium, natatorium, atrium, etc.), the cabling contractor is to run the cable near/above the equipment location. Equipment contractor is to extend cable to final equipment location.

1.6 WARRANTY

A. The contractor warrants the system to be free of defects of workmanship or products and will inspect and repair the system during the warranty period at no additional cost to the Owner. Contractor agrees to correct system deficiencies and replace components that fail in materials or workmanship including deficiencies arising when used according to the manufacturer or Contractor's written instructions No warranty or terms therein shall limit or be interpreted to limit remedies as provided by law

B. Contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

C. The data and voice structured cable plant shall be covered by the manufacturer's extended warranty (eg. Panduit Certification Plus System Warranty, Hubbell Premise Wiring Mission Critical Warranty and System Performance Guarantee, etc.).

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipment so they form an integrated system complying with TIA/EIA-568B. Match components and interconnections for optimum future performance.

B. The Contractor is to use plenum rated cabling and accessories throughout the project. All cables shall be continuous and free from splices.

2.2 FACEPLATES, CONDUIT, AND SURFACE-MOUNTED RACEWAYS

A. These general requirements apply to all contractor(s) unless more specific information is included in a particular contractor's specification sections (i.e. structured cabling, audiovisual cabling, etc.).

B. Where the data and audio/video contractor(s) will be sharing a faceplate, the video contractor is to provide the faceplate and any required blank modules. The faceplate must be able to accept

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the termination jack chosen by the data cabling contractor. Contractors shall coordinate all faceplate and termination requirements.

C. Coordinate faceplate requirements with the furniture installer, where applicable.

D. Each contractor shall provide and install blank faceplates / insert on any outlets provided by the electrical contractor for their potential technology use (video outlets, security outlets, data/voice general purpose telecommunication outlets, etc.).

E. Faceplate labels shall be secured to the faceplate (loose or removable labels on the screw covers are not permanent and not acceptable).

F. Each Contractor is responsible for all surface-mounted raceways and conduit for cabling not provided by the electrical contractor. Common potential locations requiring conduit for cables are described below:

1. Conduit for security cameras, wireless access points, audiovisual components, or general communications outlets installed outdoor or in large open spaces without drop ceilings (i.e. gymnasium, cafeteria).
2. Security cabling for access control systems and intrusion detection systems in vestibules, entrances, doorways, or other areas where cabling cannot be concealed.
3. Other public spaces where cabling cannot be concealed, and contractor could have reasonably known they existed.
4. In all other instances requiring surface-mounted raceways that the contractor could not have reasonably known about from construction coordination drawings (e.g. ceiling plans) or pre-bid walkthroughs made available to the contractor whether or not they participated, unit pricing will be utilized. Approval must be obtained prior to installation.

G. The following are general guidelines for raceways:

1. Surface-mounted raceway shall not be used unless the wall or other structure cannot be fished and cut into. Contractor to obtain approval prior to installing surface-mounted raceway in areas not already indicated on the drawings.
2. Surface-mounted raceways shall be sized appropriately for each installation following all manufacturers' guidelines.
3. Steel raceway (e.g. Legrand/Wiremold) shall be used in classroom and office areas. EMT conduit may be used in lieu of steel raceways in gymnasiums or other similar spaces and only after approval is received.
4. All surface-mounted raceways shall be steel construction (e.g. Legrand/Wiremold V700, V4000, etc.).
5. All steel raceways shall be ivory.

H. The following are general guidelines for faceplates:

1. For recessed boxes and surface-mounted faceplates, data faceplates shall be stainless steel with module frames or decora inserts. A/V faceplates may be plastic if necessary to provide the required A/V inserts.

2. Where single-channel surface-mounted raceway and boxes are used, faceplates shall match the raceway color.

3. Where dual-channel surface-mounted raceway is used (e.g. Legrand/Wiremold V4000), faceplate shall match the faceplates used in the existing installation.

4. Plastic faceplates are to be used where necessary to coordinate and match modular furniture systems.

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5. Blank faceplates are to be stainless steel. Blank inserts for dual-channel raceway shall match the faceplate type and color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Review building plans and installations to confirm outlet and conduit installation and location. Check outlets, conduits, raceways, cable trays, and other elements in the proposed pathways for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation in compliance with manufacturer requirements.

C. Contractors are to examine existing telecommunication rooms, equipment, cabinets, racks, etc. to ensure the conditions will not interfere with their installation. Contractors will be responsible for moving existing items where possible to allow for their installation (e.g. shifting patch panels, wire management, and equipment within a rack or cabinet; moving items on a backboard, etc. to make room for the new installation). If the rework requires re-ordering the existing items or removing wire management, review the layout with the Technology Designer and Owner.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether such items are specifically mentioned in the plans and specifications.

B. The Contractor shall be familiar with the site and the rooms to ensure a proper installation. The final installation methods are left to the discretion of the contractor in accordance with this specification, manufacturer's specifications, and within standards of generally accepted workmanship.

C. Contractor shall be familiar and install in accordance with all applicable codes and standards, including FCC, NEC (NFPA 70), EIA/TIA 568, 569 and 606, BICSI (Telecommunications Distribution Methods Manual, Current Edition), federal, state, and local building/fire codes.

D. All cable above the ceiling must be independently and properly supported to the building structure with hangers or cable tray independent from the ceiling grid or other support systems (e.g. cables shall not be run through trusses). Each contractor will provide all supports necessary for their work.

1. Separate supports are to be used for each type of cabling runs (e.g. data, fiber, video, PA, security, etc.).
2. Cable supports (e.g. J-Hooks) shall be wide enough to maintain required cable bend radius and to avoid pinch points on the corners of the support.
3. All cable hangers/supports shall be no more than 60" apart.
4. Each cable bundle shall include a maximum of 192 cables.

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5. Special care will be taken to avoid damage to ceiling grid, ceiling tiles, or other installed work. Cable “draped” across ceiling tiles is unacceptable.

E. Ensure all cables within cable trays are arranged to avoid individual cables supporting the weight of the cable bundle. Cable trays shall have appropriate bend radii for cable and fiber. Provide elbows, supports, and ties to assist in offloading the weight of the cable and adequately support the tray.

F. Support riser cables every floor and at the top of the run with cable grips. Limit number of four-pair data riser cables per grip to fifty (50).

G. Fiber optic cable shall be plenum rated armored cable.

H. Fill rates for all cable supports must not exceed the lesser of 50 percent, or as recommended by the manufacturer(s).

I. All wiring shall be protected from moving mechanical or physical contacts. All cabling shall be free from tension at both ends, as well as the length of each run.

J. Cables to be kept a minimum of 18” from power lines, fluorescent fixtures, or heat generating devices. All cross-connecting cable shall meet or exceed the transmission characteristics for the cable used in the adjoining segments.

K. All cabling shall be bundled and properly secured and terminated in the telecommunication room cabinet. Cables must be properly supported and separated to avoid crushing or cinching by supports, protective covers, doors, etc. All cables within wire management cabinets will be cable wrapped with Velcro cable ties at no greater than one-foot intervals. Velcro tie-wraps only are to be used.

L. For general communications outlets, Contractor to provide additional 10' of cabling coiled above nearest accessible ceiling at each drop and 10’ of cable at each telecommunication room. Unless noted otherwise, specialized systems (i.e. security and wireless) shall have 20’ of cable coiled above the ceiling at each drop and 10’ of cable at each telecommunication room. The additional lengths of cable shall be included in distance calculations. Cable routing within the telecommunication closet is to be approved by the Technology Designer before beginning termination.

M. In general, adhesives and non-mechanical fastening methods of installation will not be accepted. All conduit, cable and raceway installation support must be mechanically fastened to walls, decks, slab, structure, etc.

N. Install parallel to building lines, follow surface contours, and support the cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables.

O. All horizontal cabling terminations shall be provided with sufficient additional cabling to permit re-termination within the cabinet. The additional lengths of cable shall be included in distance calculations. Service loops shall be irregularly coiled to avoid electromagnetic or antenna effects.

P. All connections of twisted wiring shall be made in such a way as to minimize the extent in which each twisted pair is unraveled at the point of its physical termination. No more than 0.5 inches of exposed untwisted pairs shall be present at these locations.

Q. Provide sufficient pulling lubrication for all underground cable pulls. Do not exceed the manufacturers tension requirements for any installation.

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R. Exposed wiring will not be accepted unless approved in writing by the Technology Designer. Cabling shall be in the wall, above the ceiling, or in conduit (or raceways if approved by Technology Designer) designed for the application. A difficult installation will not be sufficient to avoid the requirement for non-exposed wiring.

1. Contractor to install conduit in exposed areas along cable pathway. Raceway can be used for the vertical segment transitioning to the outlet location (e.g. from ceiling space down wall to outlet). Conduit in exposed areas are to be painted to match surrounding conduits/ceiling color.
2. Exposed wiring will be acceptable in crawl spaces.
3. Exposed wiring will be acceptable in high bay gymnasiums if the cables are run along a joist and hidden from view. Cables must be concealed from the wall to the joist.
4. No exposed cabling will be allowed in natatoriums.
5. No exposed cabling will be allowed in architecturally significant spaces, such as a media center or entrance lobby.
6. In instances greater than 15’ requiring conduit that the contractor could not have reasonably known about from available drawings (e.g. ceiling plans) or pre-bid walkthroughs made available to the contractor whether or not they participated, the contractor may request reimbursement for the installation. Approval must be obtained prior to installation.

S. In unheated crawl spaces, contractor is to install the cable at least four feet (4’) from the exterior wall mounted securely to the slab or structure.

3.3 UNDERGROUND INSTALLATION

A. Prior to beginning any underground work, Contractor shall contact MISS DIG, local utility survey staff, and utility companies for the location of all existing underground services and provide, if requested, documentation of such contact to Barton Malow Company. If necessary, Contractor shall pay for appropriate layout and locating of all existing utilities, and stake said utilities.

B. Utilities and/or other services which are shown, or not shown but encountered, shall be protected by the Contractor from any damage arising or resulting from work, unless or until they are abandoned. If the utilities or services are damaged from Contractor’s work, Contractor shall notify the Technology Designer immediately. Contractor shall repair any damage and restore the utilities and services to an equal or better condition than that which existed prior to the damage within four (4) hours. If the Contractor does not repair the work or the Owner or Barton Malow considers the damage unresolved in a timely manner, repairs will be made at Contractor expense.

C. Contractor shall provide and maintain proper shoring and bracing during its excavation, to protect from collapse or movement, or other type of damage until such time as they are to be removed, incorporated into the new Work or can be properly backfilled upon completion of the work and inspections.

D. Contractor shall photograph and document the environment immediately before beginning work, upon exposing any utilities, and after work and/or repair is completed. Barton Malow shall review the work and/or repairs before any work is buried.

E. Contractor will be responsible for all liabilities, damages, expenses, lawsuits or claims arising or resulting from such damage and will defend, hold harmless and indemnify Owner and Barton Malow from any claims or lawsuits or other expenses.

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3.4 IDENTIFICATION

A. In addition to requirements in this Article, comply with TIA/EIA-606.

B. Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors. All rack fields, devices, components, etc. shall be tagged with appropriate designations on the front and rear of the equipment. All devices are to be installed and labeled in a sequential, logical order.

C. Adhesive labels shall meet the legibility, defacement, and adhesion requirements specified in UL969 for indoor use. Cable labels shall have a durable substrate, such as vinyl, suitable for wrapping. Labeling practices shall be consistent across the installation.

D. Cable runs shall be machine labeled within 1” of each termination. All cabling and fiber optics are to be tagged in a consistent manner, approved by the Technology Designer.

E. Fiber Optic Safety Installation. Label all fiber optic junction boxes and termination points with "fiber-optic cable - lasers in-use - possible eye injury" warnings inside and outside of the location.

F. At junction boxes, label with a description of the cable, termination location, and strand count.

3.5 FIELD QUALITY CONTROL

A. Contractor will provide cabling acceptance testing. Agent of owner may provide additional testing and cable acceptance. Contractor is responsible for correcting any instances of test failures.

B. Indicate and interpret test results for compliance with performance requirements of installed systems. All test results shall be marked as “Pass” or “Fail”.

C. All test results must be provided in both hard copy and electronic format.

D. Contractor is responsible for correcting any instances of marginal test results or test failures.

3.6 DOCUMENTATION

A. As-Built Documentation:

1. Include scaled drawings reflecting all changes between the bid documents and the final installation, including final location of all telecommunication rooms, equipment, cable paths, outlets, etc.
2. Drawings shall include all cable routing, outlet locations, and outlet labels.
3. Drawings shall be created in AutoCAD or Revit format. Handwritten drawings shall be accepted for draft or working copies only.

END OF SECTION 27 1000

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SECTION 27 1116 – RACKS AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements

1.2 SUMMARY

A. This section includes specifications and requirements for racks and cabinets to be used throughout the technology project.

B. Refer to appropriate drawings and specification sections for cabinet types, quantities, and locations.

C. Server cabinets shall be provided by the Owner, installed by the structured cabling contractor.

1.3 DEFINITIONS

A. For general requirements the term “cabinet” refers to cabinets, relay racks, etc.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Cabinet or Rack
2. Wire Management
3. Cabinet Accessories

B. Shop Drawings: Include dimensioned plan and elevation views of telecommunications equipment rooms, with each individual component labeled. Show cabinet assemblies, workspace requirements, and access requirements.

1.5 COORDINATION

A. Coordinate layout and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

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B. The cabling contractor will provide cabinets and racks in telecommunication rooms. The A/V contractor will provide the cabinets associated with the A/V systems. The Owner and/or other technology contractors will utilize these cabinets for their installation and adequate space is to be factored into the cabinet layouts (Owner-furnished source equipment, security equipment, fiber optic WAN, public address, master clock, etc.).

C. Coordinate telecommunication room and cabinet layouts with related contractors.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. All materials shall be installed with matching color and quality to ensure a high-quality finished installation. Unless noted otherwise or approved in writing by Technology Designer, all materials shall have a black finish.

B. All lockable cabinets are to be keyed alike. Contractor to coordinate keying with Technology Designer.

C. For each cabinet or rack section:

1. Provide one rack mounted surge suppression outlet power strip and/or vertical power strip as appropriate.
2. Provide rack-grounding termination.

2.2 RACKS

A. General Requirements:

1. Racks shall be 4-post, high-grade black anodized-aluminum with front and back standard 19” EIA mounting screw holes.
2. Minimum height 84".
3. Contractor will provide 6” wide, duct-style vertical wiring management with removable protective covers on both sides of each rack.

B. Manufacturer:

1. Hubbell
2. Ortronics
3. Panduit
4. Approved Equal

2.3 WALL MOUNTED CABINET

A. General Requirements:

1. Cabinets are to be a minimum of 24” wide and 48” high (unless noted otherwise on drawings), black painted steel, with final depth confirmed with verification of equipment size and front cabling requirements. Assume 30” deep for pricing if depth is unknown at bid time.
2. Lockable scratch-resistant tinted glass front door and standard rear door.

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3. Cabinet enclosures shall be field-reversible (Left or Right) hinged
4. Entire unit shall swing at each door to permit front and rear equipment and cabling access.
5. All cables running to the cabinet will be installed in either raceway or conduit.

B. Manufacturer:

1. Hoffman Accessplus II or EWMW
2. Approved equivalent

2.4 RACK AND CABINET COMPONENTS

A. Power Strip / PDU

1. Manufacturer standard nine (9) minimum outlet or greater receptacle strip rated at 20A minimum with surge suppression plug, and circuit breaker. Contractor to supply proper power strip for voltage supplied
2. Unit shall be provided with rack bolting.

B. Cable Ties

1. Cable ties shall be plenum rated.
2. Cabinet and rack ties shall be Velcro-type ties

2.5 SPARES

A. Provide spare of the following spare equipment and/or parts

1. Provide one (1) box of mounting bolts or screws for each type of cabinet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether such items are specifically mentioned in the plans and specifications.

B. The Contractor shall be familiar with the site and the rooms to ensure a proper installation. The final installation methods are left to the discretion of the contractor in accordance with this specification, manufacturer's specifications, and within standards of generally accepted workmanship.

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C. The contractor shall protect equipment and components during installation and clean all equipment before owner acceptance using methods and materials recommended by the manufacturer.

D. All units shall be aligned and perpendicular to adjacent walls.

E. Racks and cabinets are to be properly installed and secured to handle equipment load. The racks shall be bolted to floor, cable tray, and/or wall for added rigidity. Adjacent cabinets shall be bolted together at the top and bottom at both the front and rear of the units.

F. Provide independent circuit grounding recommended by manufacturer. Grounding is to be consistent with ANSI/TIA/EIA 607 and NEC requirements as a minimum. Each contractor to connect their cabinets to a single-point ground which is connected to the building ground system via #6 AWG green insulted copper grounding conductor.

G. Contractor to adjust side mounting rails to optimize front and rear cabinet clearances. No less than three inches of clearance must be provided between the equipment and the cabinet door for cabling.

H. Equipment Mounting Positions (From Top):

1. WAN fiber panel (where applicable)
2. LAN fiber panel
3. Alternating patch panels and switches
4. Power Strip
5. UPS
6. Verify phone gateway, master clock system, PA, etc. location if mounted in cabinets

END OF SECTION 27 1116

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SECTION 27 1300 – BACKBONE AND OUTDOOR CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements
3. 27 1116 – Racks and Cabinets
4. 27 1500 – Data and Voice Horizontal Cabling

1.2 SUMMARY

A. Extent of the cabling systems work is indicated by the drawings and schedules, and is hereby defined to include, but not by of limitation, the provisions of:

1. Backbone cables between the telecommunication rooms.
2. Indoor/outdoor station cabling
3. Campus backbone cabling between buildings.
4. All termination blocks, outlets/jacks, patch panels, patch cords, etc.
5. Termination, cross connect, and patching.

B. The data cabling infrastructure shall compliant with EIA/TIA standards under T568B-2.1. Campus voice, fiber optic, data and video infrastructure shall be implemented compliant with applicable standards.

C. Data cables shall be routed so as not to exceed 90 meters in length. Notify the Technology Designer before bid period question deadline, established at the pre-bid meeting, should any changes in bid documents be required to conform to this limitation. After entering into Contract, Contractor shall provide Technology Designer-approved solution to meet the 90-meter requirement without additional expense to the Owner.

D. Provide coordination and installation in accordance with standards, rules, regulations and requirements of utilities, ROW owners, state, county, cities, villages, townships, municipalities, and any other authority having jurisdiction.

1.3 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. ER: Equipment Room

C. HH: Handhole

D. MC: Main Cross-connect [Applies to references to MDF]

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E. MMF: Multimode fiber

F. SMF: Single-mode fiber

G. TR: Telecommunication Rooms [Applies to references to IDF]

H. TP: Transition point

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Cable
2. Terminations (Patch panels, punchdown blocks, etc.)

B. Samples:

1. Proposed labeling format.

C. Qualification Data:

1. Include written confirmation from the manufacturer that the bidder is a certified installer for the cable plant solution.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have on-staff personnel certified by the cable solution manufacturer.

B. Installation Supervision: Installation and testing shall be performed by BICSI Registered Installers or manufacturer certified installers, with a consistent supervisor who shall be present at all times when work of this section is performed.

1.6 COORDINATION

A. Coordinate cables installed in this section with the Owner and phone, data, security, network, etc. contractors whose equipment will be using the cabling.

1.7 WARRANTY

A. Contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. The cable plant shall be covered by the manufacturer's warranty (eg. Panduit Certification Plus System Warranty, Hubbell Premise Wiring Mission Critical Warranty and System Performance Guarantee, etc.).

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PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipment so they form an integrated system complying with TIA/EIA standards. Match components and interconnections for optimum future performance.

B. Contractor is to use plenum rated cable and cabling accessories throughout this installation.

2.2 MANUFACTURERS

A. The following are acceptable manufacturers for general equipment within this section, unless noted otherwise for any product. Any deviations must be approved in writing by the Technology Designer before installation.

1. Indoor/Outdoor UTP Voice/Data Cable
   a. Berk-Tek
   b. Belden
   c. Commscope
   d. General
   e. Hitachi
   f. Lucent
   g. Mohawk
   h. Superior Essex
2. Fiber Optic Cable
   a. Berk-Tek
   b. Belden
   c. Commscope
   d. Draka Comteq
   e. General
   f. Legrand Infinium Quantum
   g. Lucent
   h. Siecor
   i. Tyco
3. Patch Panels, Faceplates, Station Terminations, Jacks, other Accessories
   a. Cable manufacturer
   b. Hubbell
   c. Panduit

2.3 INDOOR/OUTDOOR DATA STATION CABLING

A. Cable Standards:

1. Cable is to be continuous, Category 6 compliant UTP cable rated for indoor and outdoor underground in-duct installations.
2. Plenum-rated required when cabling indoors extend beyond 50’ from the building entry location.
3. Cable shall have an UV-resistant sheath and a core of solid-copper conductors, dual insulated with foam skin and plastic, surrounded by a gel-filling compound.

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4. Cabling shall be certified as a complete system with other components required herein to achieve manufacturer's cabling system extended warranty.

B. Manufacturer:

1. Hitachi Cable Drybit Category 6 Indoor-Outdoor Cable
2. Approved equivalent

C. Termination standards:

1. Contractor shall install lightning protectors in telecommunication room for each data/voice cable.
2. Terminate at station location in "biscuit box" in nearest accessible ceiling or as recommended by station equipment manufacturer/installer.

2.4 FIBER OPTIC CABLING BACKBONE

A. Cable Standards:

1. Indoor backbone cable is to be continuous, armored, plenum-rated, tight-buffered multimode fiber optic cable.
   a. In lieu of armored cable, contractor can request to provide innerduct for the entire cable pathway. Fiber optic cable shall be installed in orange, plenum-rated innerduct. Maximum fill is 40%.
2. Outdoor backbone cable is to be continuous, single armored dry buffer, loose-tube ITU G.652D single-mode fiber optic cable rated for aerial and underground applications.
   a. Cable is to be Corning SMF-28e+ or equivalent
   b. Any facilities in which the termination point is greater than 50' from the location the fiber enters the building will be fusion spliced to plenum rated cable in a wall-mounted fiber optic splice enclosure. Utilize indoor fiber optic standards for the remaining portion of the work modifying applicable language for single-mode installations to reflect cable type and yellow sheathing.
3. Each fiber must be individually jacketed.
4. Call shall have EIA/TIA -598 color coding for fiber optic cable.
5. All multi-mode fiber is to be OM4. Use single mode fiber for distances exceeding 500m and all outdoor applications.
6. All pig tails and patch cables are to match the type of fiber optic cable installed.
7. All fiber is to be fusion spliced; no field terminations or mechanical splices will be accepted.
8. Indoor cable sheath and accessories are to follow the following color designation:

a.	OM3	Aqua
b.	OM4	Violet
c.	Singlemode	Yellow

B. Termination Standards:

1. Provide 19" rack mounted (sized as necessary, 72-port maximum) optical fiber termination panels with cable strain relief and slack storage. Provide breakout and storage of 5' of cable. Size the patch panel for an additional space for 12 future terminations.
2. LC terminations are to be used, or as required by the equipment manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Contractor shall be familiar and install in accordance with all applicable codes and standards, including FCC, NEC (NFPA 70), EIA/TIA 568, 569 and 606, BICSI (Customer-Owned Outside Plant Design Manual, current edition), BICSI (Telecommunications Distribution Methods Manual, current edition), federal, state, and local building/fire codes.

B. Installation must be in accordance with applicable utility company standards.

C. Contractor to follow the applicable grounding and bonding requirements.

D. Contractor to provide additional cabling coiled above ceiling at both the workstation locations and in telecommunication rooms. The additional lengths of cable shall be included in distance calculations. Cable routing within the telecommunication closet is to be approved by the Owner's Representative before beginning termination.

E. Fiber optic cables shall be marked with warning labels every twenty feet (20').

3.3 UNDERGROUND INSTALLATIOIN AND BUILDING ENTRANCE REQUIREMENTS

A. Prior to beginning any underground work, Contractor shall contact MISS DIG, local utility survey staff, and utility companies for the location of all existing underground services and provide, if requested, documentation of such contact to the CM. If necessary, Contractor shall pay for appropriate layout and locating of all existing utilities, and stake said utilities.

B. Contractor to install new underground pathway and conduit between the building(s) and outdoor equipment location.

C. Provide conduit and sealed junction box at all exterior wall penetrations designed to maintain the required bend radii. All entrances into the building will be properly water and fire stopped. Penetrations through exterior walls will be core or drilled hole, and finished with adequate seal and weatherproofing. Chiseling of bricks or portions of bricks is not acceptable. Filling penetrations with expanding foam insulation is not acceptable.

D. Provide a minimum 2" conduit (or as shown on the drawings) with material appropriate to the installation. All joints shall be cleaned, coupled, connected, and sealed to prevent infiltration of water.

E. Provide and install a trace wire in each underground segment.

F. Provide underground handholes where required. The top of the handhole shall be stamped or etched "Communication" or manufacturer's equivalent. Install the handholes with ¼ inch of the

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final ground level, at a distance of no greater than 300' apart. Handholes shall also be installed whenever the combination of elbows and bends totals greater that 180 degrees. Handhole sizes shall be based on NEC Article 314.16 and Article 315.28; however larger than 4'x4'x4' shall not be used without written approval.

G. Contractor may utilize a directional bore or trench to install the conduit. Conduits to be installed to a minimum of 36" below grade. Installation shall follow OSHA requirements.

H. Compact all backfilled materials and level site. Restore remainder of topsoil for grass installations and re-sod restored excavation. Any concrete or asphalt damage shall be restored. Backfill excavation and trenches with compacted sand to 1' below grade and provide warning tape. Restore remainder of topsoil for grass installations. Compact crushed stone/sand for concrete/asphalt installations and restore to original condition.

I. Any installation in a public right of way, easement, or public roadways or other property not owned by the Owner shall be restored in accordance with property owners' or governing agency regulations and requirements. If no regulations govern, as a minimum restore to a condition similar to pre-installation quality.

J. Utilities and/or other services which are identified, or not identified but encountered, shall be protected by the Contractor from any damage arising or resulting from work, unless or until they are abandoned. If the utilities or services are damaged from Contractor's work, Contractor shall notify the Technology Designer immediately. Contractor shall repair any damage and restore the utilities and services to an equal or better condition than that which existed prior to the damage within four (4) hours. If the Contractor does not repair the work or the Owner or Barton Malow considers the damage unresolved in a timely manner, repairs will be made at Contractor expense.

1. Contractor shall photograph and document the environment immediately before beginning work, upon exposing any utilities, and after work and/or repair is completed. Barton Malow shall review the work and/or repairs before any work is buried.
2. Contractor will be responsible for all liabilities, damages, expenses, lawsuits or claims arising or resulting from such damage and will defend, hold harmless and indemnify Owner, Barton Malow Builders, c2ae, and Christman Construction from any claims or law suits or other expenses.

K. Contractor shall provide and maintain proper shoring and bracing during its excavation, to protect from collapse or movement, or other type of damage until such time as they are to be removed, incorporated into the new Work or can be properly backfilled upon completion of the work and inspections.

L. Unless specifically noted on the drawings as a direct-buried installation, underground installations shall be in conduit.

3.4 HANDHOLE REQUIREMENTS

A. Provide underground handholes as needed to facilitate the installation and future servicing of the backbone cables.

B. Provide Quazite underground handhole enclosures rated to 15,000 lbs.

C. The top of the handhole shall be stamped or etched "Fiber Optic Cabling" or manufacturer's equivalent.

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D. Install the handholes at final ground level, at a distance of no greater than 1,000' apart. Handholes shall also be installed whenever the combination of elbows and bends totals greater that 180 degrees.

E. Handhole sizes shall be based on NEC Article 314.16 and Article 315.28; however larger than 2'x2'x2' shall not be used without written approval.

F. Conduits are to sweep up through the bottom of the handhole with the handhole bottom filled with gravel.

G. Install a ground rod in each vault or handhole and connect to wire electrode.

3.5 INSIDE CABLE INSTALLATION

A. Contractor is to follow the requirements established in section 27 1000.

B. If the termination location is greater than 50' from the building point of entrance, or as required by applicable codes, cable will be fusion spliced to plenum rated cable in a wall-mounted fiber optic splice enclosure. Point of entrance is the point within the building where the cable emerges from an external wall, from a concrete floor slab, or from rigid metal conduit or intermediate metal conduit connected to an electrode by a grounding conductor in accordance with NEC 2014 800.100 and 800.2.

C. Due to field conditions or other situations, installation locations may have to be relocated a reasonable distance from the plan location. Unless relocations, modifications and reengineering are consistently or substantially unfavorable to either the contractor or the owner, there will be no additional charge or credit for this work.

D. The contractor shall be familiar with the site and the rooms to ensure a proper installation. The final installation methods are left to the discretion of the contractor in accordance with this specification and within standards of generally accepted workmanship.

E. If non-armored fiber is approved for use, fiber optic cable shall be installed in orange, plenum-rated innerduct. Maximum fill is 40%.

F. Ensure all cables within cable trays are arranged to avoid individual cables supporting the weight of the cable bundle. Cable trays shall have appropriate bend radii for cable and fiber. Provide elbows, supports, and ties to assist in offloading the weight of the cable and adequately support the tray.

3.6 IDENTIFICATION

A. In addition to requirements in this Article, comply with TIA/EIA-606-A

B. The cable run shall be machine labeled or legibly hand labeled with indelible ink within 1" of termination. Final termination at the distribution frame is also to be appropriately tagged. All cabling and fiber optics are to be tagged in a consistent manner.

C. Fiber Optic Safety Installation. Label all fiber optic junction boxes and termination points with "fiber-optic cable - lasers in-use - possible eye injury" warnings inside and outside of the location.

D. At junction boxes, label with a description of the cable, termination location, and strand count.

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3.7 FIELD QUALITY CONTROL

A. The UTP installation is to be tested to the current EIA/TIA TSB Channel Performance Testing Standard, or equivalent as approved by the Technology Designer.

1. Cables are to be tested with a Fluke OmniScanner2, or equivalent by Agilent or Wavetek, using the correct software version and adapter for the cable installation or as required for manufacturers warranty program.
2. Cables are to be tested consistently with the tester in the MC, and the injector at the remote TR.

B. Document for each pair as well as the worst margin the following test results:

1. Cable identification (Building and Circuit ID)
2. Test date
3. Cable length (ft.)
4. Wiremap
5. Delay (ns)
6. Skew (ns)
7. Resistance (Ohms)
8. Attenuation
9. NEXT
10. ELFEXT
11. Return Loss
12. PSNEXT
13. PSELFEXT

C. Optical Time Domain Reflectometer (OTDR) testing is required on all terminated fiber optic cables. The operator of the test equipment must be properly trained and have experience in the operation of this equipment and interpreting and certifying test results. While preterminated, factory-certified cables may be installed; the contractor must provide a field verifiable method of determining attenuation, continuity, bandwidth, etc. Contractor is to provide an OTDR test of each fiber spool before installation to verify fiber is not damaged upon delivery.

D. Any cables that do not meet the minimum performance criteria established by the standards or manufacturer shall be corrected or replaced at no additional cost to the Owner. If the copper backbone cable contains more than one (1) percent bad pairs, remove and replace entire cable.

3.8 DEMONSTRATION

A. Contractor shall train the Owner on the layout of the backbone cabling system including the pathways, termination methods, and interconnections.

3.9 DOCUMENTATION

A. As-Built Documentation:

1. Include scaled drawings documenting the final installation, including final location of all telecommunication rooms, cable paths, etc.
2. Drawings shall be created in AutoCAD or Revit format. Hand written drawings shall be accepted for draft or working copies only.
3. Include photographs of the completed fiber splice trays for each telecommunication closet location.

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B. Cable Testing

1. Cable test results are to be provided electronically (PDFs) organized by building and telecommunication room.
2. Contractor is to review fiber/OTDR test results with Owner and annotate a sample test result indicating key indicators.

C. Underground Conduit Labeling

1. For each underground conduit used, Contractor is to label both ends of the **conduit** identifying where the conduit runs (e.g. “Fiber to Press Box”)

D. Warranty

1. Provide certificate of manufacturer’s extended warranty for the cabling system.

END OF SECTION 27 1300

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SECTION 27 1500 – DATA AND VOICE HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements
3. 27 1116 – Racks and Cabinets
4. 27 1300 – Backbone Cabling

1.2 SUMMARY

A. This Section includes general cabling requirements for contractors installing structured data or voice cabling within their scope of work.

B. The cabling infrastructure shall be implemented as a data solution compliant with EIA/TIA standards under T568B-2.1. Fiber optic, security, and audiovisual infrastructure shall be implemented compliant with applicable standards.

C. Extent of the cabling systems work is indicated by the drawings and schedules, and is hereby defined to include, but not by of limitation, the provisions of:

1. Horizontal cables to the telecommunication rooms.
2. All termination blocks, outlets/jacks, patch panels, patch cords, etc.
3. Termination, cross connect, and patching.

D. Data cables shall be routed so as not to exceed 90 meters in length. Notify the Technology Designer before bid period question deadline, established at the pre-bid meeting, should any changes in bid documents be required to conform to this limitation. After entering Contract, Contractor shall provide Technology Designer-approved solution to meet the 90-meter requirement without additional expense to the Owner.

E. Color Coding:

1. The following chart describes the cable type/color for the primary structured cabling systems defined in this spec section.

System	Cable Type	Distributio n Cable	Patch Cable (Station)	Patch Cable (Closet)	Jack Color
Data	CAT 6	Blue	Black	Blue	Orange
Analog	CAT 6	Grey	N/A	Grey	Grey
Wireless	CAT 6A	Yellow	N/A	Orange	Yellow
Security	CAT 6	Green	N/A	Green	Green
Audiovisual	CAT 6	Black	Black	Black	Black

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F. Patching:

1. This Contractor is responsible for patching to all switches. Switches will be provided, by others, equal to the number of data ports. Provide **Category 6** patch cables. Quantity shall match the total number of data cables installed.

2. Patch cables shall be the minimum lengths necessary to patch one-for-one while utilizing the wire management. Technology Designer to approve patching method before installation.

3. Do NOT patch unused patch panel ports.

4. Patch cables shall NOT have boots

5. Patch cable manufacturer shall be consistent with the patch panel and jack manufacturer.

G. Contractor shall provide and install horizontal cable tray in each telecommunication room. Unless noted otherwise, cable tray will start at the edge of the room where incoming cables are fed, provide cable support for all racks, and be secured to the walls.

1.3 DEFINITIONS

A. ER: Equipment Room

B. MC: Main Cross-connect [Applies to references to MDF]

C. TR: Telecommunication Rooms [Applies to references to IDF]

D. PoE: Power over Ethernet

1.4 SUBMITTALS

A. Prior to ordering, confirm colors of horizontal cables, patch cables, and jacks.

B. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Cable
2. Faceplates
3. Terminations (Patch panels, jacks, etc.)
4. Patch cables (Identify lengths, colors, and quantities)

C. Samples:

1. Faceplate with proposed labeling format.

D. Qualification Data:

1. Include written confirmation from the manufacturer that the bidder is a certified installer for the cable plant solution.

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1.5 QUALITY ASSURANCE

A. Installer Qualifications: Contractor must be certified by the manufacturer of the solution being installed.

B. Layout Responsibility: Preparation of Shop Drawings by an RCDD.

C. Installation Supervision: Installation and testing shall be performed by BICSI Registered Installers or manufacturer certified installers, with a consistent supervisor who shall always be present when work of this section is performed.

D. Comply with EIA/TIA 568B-2.1, EIA/TIA 569, and EIA/TIA 606.

1.6 COORDINATION

A. Coordinate cables for door entry, video surveillance, wireless infrastructure, etc. with the contractor who will be installing the equipment for termination location and method.

1.7 WARRANTY

A. Contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. The cable plant shall be covered by the manufacturer's warranty for a minimum of fifteen (15) years (e.g. Panduit Certification Plus System Warranty, Hubbell Premise Wiring Mission Critical Warranty and System Performance Guarantee, etc.).

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipment so they form an integrated system complying with TIA/EIA-568-B. Match components and interconnections for optimum future performance.

B. One manufacturer must be used for all termination jacks, patch panels, and patch cables.

C. Contractor is to use plenum rated cable and cabling accessories throughout this project.

D. All Category 6A cables will be UL limited power (LP) rated.

2.2 MANUFACTURERS

A. The following are acceptable manufacturers for general equipment within this section, unless noted otherwise for any product. Any deviations must be approved in writing by the Technology Designer before installation.

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1. Voice and Data Cable
   a. Berk-Tek
   b. Belden
   c. Commscope
   d. General
   e. Liberty Wire & Cable
   f. Lucent
   g. Mohawk
   h. Superior Essex
   i. Approved Equal
2. Patch Panels, Faceplates, Station Terminations, Jacks, other Accessories
   a. Hubbell
   b. Panduit
   c. Approved Equal

2.3 DATA CABLE AND TERMINATIONS

A. Cable Standards:

1. Cabling shall be contiguous, plenum rated **Category 6/6A**, four-pair UTP cable compliant with EIA/TIA 568B-2.1 standards.
2. Cable shall be solid copper.
3. Cabling shall be certified as a complete system with other components required herein to achieve manufacturers cabling system extended warranty.

B. Termination Standards:

1. Terminations shall be **Category 6/6A** compliant modular, T568B RJ-45 jacks.
2. Video surveillance, wireless access point, or other equipment terminations shall be modular T568B RJ-45 jacks in a plenum-rated biscuit box located in the nearest accessible ceiling or junction box to the end device. Alternatively contractor can use a modular plug terminated link (i.e. direct connect) that meets the ANSI/TIA-568-C.2 clause 6.3 requirements. If a modular plug terminated link (MPTL) is used, testing must be performed with the appropriate channel adapter.

2.4 INDOOR/OUTDOOR DATA STATION CABLING

A. Cable Standards:

1. Cable is to be continuous, Category 6/6A (6A for wireless) compliant UTP cable rated for indoor and outdoor installations between two environmentally protected points, including underground pathways.
2. Use in areas with thermal or chemical exposure.
3. Plenum-rated required when cabling indoors extend beyond 50’ from the building entry location.
4. Cable shall have an UV-resistant sheath and a core of solid-copper conductors, dual insulated resistant to chemical, moisture, and thermal exposure.
5. Cabling shall be certified as a complete system with other components required herein to achieve manufacturer’s cabling system extended warranty.

B. Manufacturer:

1. Hitachi Cable Drybit Indoor-Outdoor Cable
2. Super Essex with FEP Jacket CMP Indoor/Outdoor

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3. Approved equivalent

C. Termination standards:

1. Contractor shall install lightning protectors in telecommunication room for each data/voice cable.
2. Terminate at station location in “biscuit box” or as recommended by station equipment manufacturer.

2.5 PATCH PANEL DISTRIBUTION FRAME TERMINATIONS

A. Standards:

1. Patch panels must be Category 6/6A, 19”, 48-port patch panels with T568B terminations.
2. Provide patch panels for all cables installed plus eight (8) open ports in each telecommunication room for future use.
3. Patch panels shall have a rear strain relief bar to organize cables and maintain appropriate bend radius.
4. Data cables shall be terminated sequentially. If terminated on the patch panels, cables installed for building systems (fire alarm phone line, security phone line, pay phones, etc.) shall be terminated together in the last patch panel positions and its use labeled on the patch panel.

2.6 FACEPLATES AND MODULE FRAMES

A. Faceplates shall be sized to accommodate the raceway, back box, or floorbox for each location with adequate modules for the required jacks.

B. All faceplates shall be Decora style stainless steel. Utilize smooth metal 302/304 stainless steel for all faceplates. Blank plates shall be sized to fit box without Decora cutout.

1. Exception: Plastic module frames shall be used where necessary to match installation of other contractors.

C. Faceplate labels shall be secured to the faceplate (loose or removable labels on the screw covers are not permanent and not acceptable).

2.7 CABLE TRAY

A. General Requirements:

1. Contractor may utilize cable tray or ladder rack.
2. Cable tray shall have a black finish to match cabinets within each telecommunication room.

B. Size:

1. Cable tray shall be sized so that there is no more than 30% fill at the completion of the project.
2. Provide 12” wide minimum in intermediate telecommunication rooms.
3. Provide 18” wide minimum in the main telecommunication room.

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C. Cable tray supports shall be adequately sized to accommodate a minimum of 5 times the weight of the maximum cable fill and tray plus 300 lbs. and as per the manufacturer's recommendations.

2.8 PATCH CABLES

A. Provide Category 6 8-conductor patch cables for use within telecommunication rooms. Provide one for every data cable installed throughout the project. Patch cables shall be the minimum lengths necessary to patch while utilizing the wire management. Technology Designer to approve patching method. Refer to the cable color chart.

B. In addition to the patch cables to be used in the telecommunication rooms, provide Category 6 8-conductor patch cables for the owner's use at the station end in the following lengths and colors. Provide one for every data cable installed throughout the project.

Min. Length	Color	Quantity
6 ft	blue	40%
15 ft	**black**	40%
20 ft	blue	20%

C. Patch cable manufacturer shall be consistent with the patch panel and jack manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Review all closet layouts with Technology Designer prior to installation.

B. Contractor shall be familiar and install in accordance with all applicable codes and standards, including FCC, NEC (NFPA 70), EIA/TIA 568, 569 and 606, BICSI (Telecommunications Distribution Methods Manual, current edition), federal, state, and local building/fire codes.

C. Contractor shall limit cable bundles for cable runs, cables in telecommunication rooms, and penetrations to:

1. Cat 5e 52 cables
2. Cat 6 64 cables
3. Cat 6A 74 cables

D. Contractor to provide additional cabling coiled above ceiling at both the workstation locations and in telecommunication rooms. The additional lengths of cable shall be included in distance calculations. Cable routing within the telecommunication closet is to be approved by the Owner's Representative before beginning termination.

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E. At station locations, terminate all 8 conductors on all jacks, regardless of data or telephone use.

F. Ensure all cables within cable trays are arranged to avoid individual cables supporting the weight of the cable bundle. Cable trays shall have appropriate bend radii for cable and fiber. Provide elbows, supports, and ties to assist in offloading the weight of the cable and adequately support the tray.

G. Service loops for Cat 6A cables are to be installed in an S-configuration and not a circular loop.

3.3 IDENTIFICATION

A. In addition to requirements in this Article, comply with TIA/EIA-606-A.

B. Each termination module shall be labeled with a white, wrap-around self-adhesive label. Use Panduit MINI-COM® Module Port Identification Self-Adhesive Labels, or equivalent.

C. Each label shall identify the telecommunication room, patch panel and patch panel port. For example: 1-A-34 would refer TR-1, patch panel A, port 34.

D. Data cable patch panels shall be labeled sequentially with letter designations A, B, C, etc.

E. Patch panel ports used for mounted devices (wireless access points, surveillance cameras, displays, etc.) will be labeled with the device name (e.g. AP-09 for access point 9, CAM-07 for surveillance camera 7, etc.).

F. In addition to the faceplate label, each cable is to be labeled behind the faceplate and patch panel with a machine generated wrap-around self-adhesive label that matches the port label on the patch panel and faceplate.

G. Each rack is to be labeled with the IDF/MDF designation (e.g. IDF-1, IDF-2) utilizing permanent adhesive labels. Labels shall be at least 2” high and should be located in the lower right-hand corner of the backboard.

3.4 FIELD QUALITY CONTROL

A. The installations must be tested and certified as compliant for Category 6/6A Gigabit connectivity. The installation is to be tested to the current EIA/TIA TSB Channel Performance Testing Standard, or equivalent as approved by the Technology Designer. For workstation locations without a patch cable, use a 10’ cable at for testing purposes.

1. Cables are to be tested with a Fluke Versiv Cable Certifier, or equivalent by Agilent or Wavetek, using the correct software version and adapter for the cable installation or as required for manufacturers warranty program.
2. Cables are to be tested consistently with the tester in the telecommunication room, and the injector at the workstation termination locations.
3. Testing will be performed after faceplates have been secured to the raceway/wall/floorbox.

B. Document for each pair as well as the worst margin the following test results:

1. Cable identification (Building and Circuit ID)
2. Test date
3. Cable length (ft.)

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4. Wiremap
5. Delay (ns)
6. Skew (ns)
7. Resistance (Ohms)
8. Attenuation
9. NEXT
10. ELFEXT
11. Return Loss
12. PSNEXT
13. PSELFEXT

C. Any cables that do not meet the minimum performance criteria established by the standards or manufacturer shall be corrected or replaced at no additional cost to the Owner.

3.5 DOCUMENTATION

A. As-Built Documentation:

1. Include scaled drawings reflecting the final installation, including final location of all telecommunication rooms, equipment, cable paths, outlets, etc.
2. Drawings shall include all cable routing, outlet locations, and outlet labels.
3. Provide pictures of all cabinets where equipment, patch panel, and labeling is visible.
4. Drawings shall be created in AutoCAD or Revit format. Handwritten drawings shall be accepted for draft or working copies only.

B. Cable Testing

1. Cable test results are to be provided in hard copy format as well as a PDF organized by building and telecommunication room.

C. Warranty

1. Provide certificate of manufacturer's extended warranty for the structured cabling system.

END OF SECTION 27 1500

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SECTION 27 4000 – GENERAL A/V SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements
3. 27 1116 – Racks and Cabinets

1.2 SUMMARY

A. This Section includes general requirements for any contractor performing the following AV work:

1. Gym audio system
2. Cafeteria audiovisual system
3. Music Room audio system

1.3 SYSTEM REQUIREMENTS - GENERAL

A. All faceplates shall be stainless steel with silkscreen labels. Confirm labels prior to production.

B. All A/V cabling shall be professional grade and sized appropriately for each installation. If signal degradation occurs as the result of cable selection/installation, it will be replaced at no additional cost to the owner.

C. All A/V connectors shall be professional grade. If signal degradation occurs as the result of connector selection/termination, it will be replaced and re-terminated at no additional cost to the owner.

D. The contractor is responsible for providing any signal amplification necessary to ensure a completely functional and professional installation whether such items are specifically mentioned in the plans or specifications.

E. The contractor is responsible for all patch cables required to ensure a completely functional and professional, turn-key solution.

F. A/V schematics, plans, details, etc. are for conceptual purposes only. Final design to be provided by contractor and approved by Technology Designer. Notify the Technology Designer before bid period question deadline, established at the pre-bid meeting, should any changes in bid documents be required to meet the design concept. After entering the Contract, Contractor shall provide a Technology Designer-approved solution to meet design concept.

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G. Equipment that extends more than 4” from the wall will be mounted above 80” above finished floor unless reviewed and approved by Technology Designer or Owner.

1.4 DEFINITIONS

A. **CEC:** Consumer Electronics Control

B. **CVBS:** Composite Video, Blanking, and Sync

C. **EDID:** Extended Display Identification Data

D. **HDCP:** High-Bandwidth Digital Content Protection

E. **KSV:** Commonly called an HDCP ‘key’. A unique ID for each HDMI sink that must be sent to HDCP-enabled sources for the sinks to receive content.

F. **Source:** AV equipment connected to the inputs of the AV switching system

G. **Sink:** AV equipment connected to the outputs of the AV switching system (i.e. displays, audio processors)

H. **Video Timing:** a combination of resolution and refresh rate (i.e. 1920x1080@60)

1.5 SUBMITTALS

A. Product Data: For each type of product purposed, provide the manufacturer’s product data sheet in both hard-copy and electronic (PDF) formats including dimensions and data on features, performance, electrical characteristics, ratings, and finishes. Data sheets indicating multiple products must have the applicable product highlighted or marked.

B. Additional Data: For all mounting hardware and accessories, provide manufacturer’s recommendations for all mounting methods and materials. Include locations for each type of mount used in the project.

C. Preliminary A/V Schematics

1. General Requirements:

   a. Submit in both hard-copy (11 X 17 or half size prints) and electronic (Visio or AutoCAD 2008 or higher) formats.
   b. Label all devices with manufacturer part name and number. A supplementary spreadsheet with device information may be submitted in lieu of labeling every component in the schematic.
   c. Show all Inputs/Outputs for every component. Mark unused inputs/outputs as “spare.”
   d. Show connector types for all terminations.

2. Required Schematics:

   a. Audio flow for each system
   b. Video flow for each system
   c. Control flow
   d. Mounting methods (dimensioned)

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e. Faceplate layouts

1.6 COORDINATION

A. The contractor is responsible for coordination with electricians as needed, structured cabling contractors as needed and attending job site meetings.

1.7 WARRANTY

A. The contractor warrants the system to be free of defects of workmanship or products and will inspect and repair the system within twenty-four (24) hours during the warranty period at no additional cost to the Owner. The Contractor shall respond on site within four (4) hours notice, and without cost to the Owner, during this warranty period. Contractor agrees to correct system deficiencies and replace components that fail in materials or workmanship including deficiencies arising when used according to the manufacturer or Contractor's written instructions No warranty or terms therein shall limit or be interpreted to limit remedies as provided by law

B. All equipment shall be provided with a **minimum three (3) year warranty** unless noted otherwise. The warranty period shall begin at the date indicated on the certificate of substantial completion or the date of Owner acceptance (to be received in writing and approved by Barton Malow), whichever comes later.

C. The contractors' installation warranty on all AV systems shall be **three (3) year** from the time of installation acceptance as approved by the Technology Consultant and the Owner.

D. The warranty shall include phone support, software assurance, firmware updates, and any other special warranties.

E. The Owner shall not be responsible for additional charges during the installation warranty period. Labor, service charges, trip charges, etc. to configure and install equipment during the warranty period shall be included in the contractor's warranty.

F. The contractor is to provide documentation for all manufacturer's warranties including the operating conditions required for the warranty.

G. The contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

A. Laser projector and electric screen with Sound Systems

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2.2 AV CABLES

A. General Requirements

1. HDMI cables and adapters are to be hi-speed HDMI cables Certified to pass complete EDID information
2. Throughput of at least 10.2 Gbps and designed for 4k@60Hz
3. Patch cables for user equipment are to be rated by manufacturer as “flexible” (example: Kramer C-MHM/MHM series).
4. Provide strain relief as necessary or as recommended by manufacturer for utilized cable distance.
5. Distances:
   a. For distances up to 35’ use a 24AWG HDMI cable (patch cables <15’ can be 26 AWG)
   b. For distances >35’ use a HDMI Fiber cable or an active Cat 6 HDMI extender.

B. Manufacturers:

1. Covid USA
2. Crestron
3. Extron
4. Kramer
5. Liberty Wire & Cable
6. Monoprice Cabernet Series
7. Approved Equal

2.3 AUDIO VIDEO SWITCHING

A. General Requirements

1. The AV switching system shall support at least 6.75Gbps of data transfer on each input and output to support 1080p 36-bit (Deep) Color video resolutions without compression.
2. The AV switching system shall support 8 channel audio.
3. The AV switching system shall support audio breakaway from video.
4. The AV switching system shall have less than 5us of latency from AV input to AV output.
5. The AV switching system shall downmix multi-channel audio into 2-channel audio so that the same audio content may be routed to both multi-channel and 2-channel sinks.
6. The AV switching system shall be able to dither between standard and deep color video signals on each input and output.
7. The AV switching system shall support the following AV signal inputs:

   a. HDMI 1.3a

B. The AV switching system shall transcode the AV signals to a single signal type for distribution.

2.4 AUDIO VIDEO DISTRIBUTION

A. General Requirements

1. The AV distribution system shall use multimode fiber or shielded twisted pair for AV signal distribution.
2. The AV distribution system shall route AV signals from any input to any output with less than 1ms of latency.

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3. The twisted pair structured cabling used to carry the AV signals shall be shielded.
4. The twisted pair structured cabling used to carry the AV signals shall be specified to 1.2GHz of bandwidth or greater.

2.5 EDID MANAGEMENT

A. General Requirements

1. The AV switching system shall allow configuration of the EDID presented to sources on each AV input.
2. Each input on the AV switching system shall be configured independently.
3. The AV switching system shall by default present an EDID to each input that includes only the video timings and audio formats common all sinks connected to the outputs.

2.6 HDCP MANAGEMENT

A. General Requirements

1. The AV switching system shall support HDCP 2.3 or greater.
2. The AV switching system shall detect the number of KSVs supported by each source.
3. The AV switching system shall not send a source more KSVs than it supports.
4. The AV switching system shall cache the KSVs from each connected sink.
5. The AV switching system shall authenticate all cached KSVs with each source up to the source's KSV limit, so that authentication does not need to be re-started each time content is routed to a new output.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review mounting locations before installation. Coordinate locations with the electrical, mechanical, and architectural contractors and mitigate conflicts with other devices and boards.

B. Coordinate mounting height/locations with existing conditions and mount to avoid covering existing devices or devices to be installed during construction.

C. The contractor shall notify Construction Manager and Technology Designer of any conflicts before installation.

3.2 INSTALLATION

A. Install all components according to manufacturer's guidelines. Provide raceway as required for the installation to conceal cables.

B. Provide wire management and cable wrap to manage and conceal cables between the wall and source. Submit cable wrap color for approval prior to installation.

C. Install safety cable for all ceiling-mounted equipment. Safety cable shall be connected to building steel and must be independent of any ceiling grid or accessories.

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3.3 DOCUMENTATION

A. As-Built Documentation:

1. Spreadsheet by building identifying installed components, location (architectural room number and owner's room number), model number, serial number, and any other pertinent data. Spreadsheet format to be approved by Technology Designer. For network-enabled projectors, include the MAC address and IP address.
2. The number of HDCP KSVs Keys supported by each source
3. The video timing, HDCP use and audio format of each source when operating.
4. The video timings and supported audio formats for each connected sink
5. The video timings and supported audio formats presented in the EDID to each source – the preferred video timing shall be indicated.
6. Schematic diagram indicating equipment and interconnections.

    a. Audio flow for each system
    b. Video flow for each system
    c. Control flow for each system
    d. Rack layouts

7. Contractor to turn over electronic version of source code for all control system programming. Provide both compiled and un-complied code.

B. Manufacturer's Instructions: Provide complete installation, set-up and maintenance instructions.

END OF SECTION 27 4000

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SECTION 27 4116 – CLASSROOM AV SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements

1.2 SUMMARY

A. This Section includes general requirements for:

1. Interactive displays and soundfield amplification systems. Contractor to provide all equipment, materials, mounts, cabling, etc. for complete systems.

2. The soundfield amplification system will be used as the public address system in the classrooms. Refer to the public address system specification section for requirements for non-classroom spaces (corridors, offices, etc.).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, provide the manufacturer's product data sheet in electronic (PDF) format including dimensions and data on features, performance, electrical characteristics, ratings, and finishes. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Interactive flat panel display.
2. Cable and connectors.
3. Mounts.
4. Mobile carts.
5. Sound-field amplification system.

B. Samples

1. Faceplate with all components and labels.
2. HDMI patch cable.

1.4 QUALITY ASSURANCE

A. AV schematics, plans, details, etc. are for conceptual purposes only. Final design to be provided by contractor and approved by Technology Designer. Notify the Technology Designer before bid period question deadline established at the pre-bid meeting should any changes in the bid documents be required to meet the design concept. Once bids have been received,

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contractor will be responsible for providing a solution approved by the Technology Designer for meeting the design concept.

B. All AV cabling shall be professional grade and sized appropriately for each installation. If signal degradation or image issues occur as the result of cable or adapter selection/installation, it will be replaced at no additional cost to the owner.

C. All AV connectors shall be professional grade. If signal degradation or image issues occurs or as the result of connector selection/termination, it will be replaced and re-terminated at no additional cost to the owner.

D. Contractor is responsible for providing any signal amplification and transmission necessary to ensure a completely functional and professional installation whether or not such items are specifically mentioned in the plans or specifications.

E. Contractor is responsible for all patch cables required to ensure a completely functional and professional, turn-key solution.

PART 2 - PRODUCTS

2.1 INTERACTIVE FLAT PANEL DISPLAY

A. General Requirements:

1. Model: 75” Clevertouch Impact 2 unless size is noted differently on drawings
2. Warranty: Minimum 5 years
3. MDM: Minimum 5 years license (Radix or Manufacturer’s equivalent)
4. Connectivity: HDMI and USB to the teacher’s computer
5. Accessories: Five (5) spare of each accessory that come with each display (e.g. stylus, eraser, etc.)
   Include a cleaning cloth with each display
6. The unit will be mounted to facilitate cleaning and maintenance

B. In addition to the remaining specifications, contract, and manufacturer’s requirements Contractor is responsible for the following:

1. Mount the display and ancillary equipment to facilitate cleaning and maintenance while concealing cabling and equipment that are mounted behind the display.
2. Provide appropriate wall bracing where needed.
3. Use black cable wrap to conceal any visible cables either from the front or side of the display.
4. Provide 10’ audiovisual patch cables for each display unless noted otherwise on the drawings. Provide black mesh cable wrap for AV cables and integrate data cable or other cables provided by others into the cable wrap.
5. Where shown on drawings provide proper over the board bracket and wire management to properly secure and support the unit and associated installation.
6. Contractor to work with Owner to create a master display with customized display settings, district-standard apps, user settings, etc. Contractor to then setup all boards similarly.
7. All displays are to be installed with sources connected consistently. For example, if the instructor’s computer is connected to HDMI 1 in the prototype rooms then HDMI 1 is to be used for the remaining instructor’s computer connections.

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8. Contractor will ensure display is on the network, named according to the district standard, enrolled in the management solution, with the latest or approved software version installed on each display.
9. Contractor is to connect display to the instructor's computer and ensure both video and USB are functioning correctly.
10. After reviewing standard classroom accessories the Owner and Technology Designer, Contractor should anticipate gathering, organizing, and delivering some accessories to the Owner in a central location, while leaving other accessories secured to the display.
11. At the completion of each room installation, Contractor is to provide photos of each installation including:
    a. Display with the Android module shown on the display
    b. Display connected to the instructor's computer, with the room number written using the display interactivity
    c. Photo of the inputs showing consistent input usage
    d. Photo of the side of the display showing the mount and cable management.

C. Software:

1. Built-in screen mirroring from Chrome, iOS, Mac OS, Windows, and Android.
2. Minimum 5 years MDM license (Radix or Manufacturer's equivalent)
3. Management software that includes as a minimum:
    a. Maintain and inventory of equipment by location, name, serial number, and software version. Group displays by building.
    b. Change device settings remotely
    c. Remotely shut down or restart individual displays or groups of displays
    d. Install apps
    e. Remotely update Android and device firmware
4. Standard software included with the equipment purchase.
5. For any software requiring licensing, include 5 years of licensing as part of base bid allowing the software to be used by all staff and students.

D. Installation Height:

1. Install so the bottom of the display screen at it's lowest position (for height adjustable mounts) is 23" aff.

E. Base Bid Manufacturers:

1. Clevertouch Impact 2

2.2 HEIGHT ADJUSTABLE WALL MOUNT

A. General Requirements

1. Provide ability for users to raise and lower the display manually without any tools.
2. Include any accessories, extension arms, etc. required for the display.
3. Vertical shift: Minimum 15.5" with ability to remain secure in any vertical position
4. Load capacity: Rated for the weight of the display, ancillary AV equipment, plus 50 lbs.
5. Motorized: No
6. Contractor is to adjust for ease of operation, and for leveling the display.

B. Acceptable Manufacturers

1. Display manufacturer

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2. Balance Box
3. Chief Fusion Dynamic
4. Peerles

2.3 MOBILE FLAT PANEL DISPLAY CART

A. General Requirements

1. Screen Size Compatibility: 65” – 86”
2. Weight Capacity: Weight of the display plus 100 lbs.
3. Color: Black power coat finish
4. Mounting Pattern Compatibility: match interactive display
5. Orientation: Landscape
6. Height Adjustable: No
7. Locking casters: Yes (minimum 2 locking)
8. Center of Display to Floor/Table Range: 50 – 70”
9. Computer Shelf: No
10. Power Strip: Provide electrical outlet strip with cord wrap
11. Cord Management: Provide cord wrap for HDMI and USB cables
12. Contractor to place fluorescent tape on the top of the cart legs.

B. Manufacturers

1. Peerless SR598
2. Copernicus
3. Approved equivalent

2.4 HDMI/USB EXTENDER

A. General Requirements

1. Provide HDMI and USB extenders to connect the interactive flat panel display to the instructor’s computer.
2. HDMI: HDBaseT 4K minimum with HDCP compliance
3. USB: as required for the connected equipment
4. Instructor faceplate will have one HDMI and one USB input
5. Contractor will use plenum, shielded, pre-terminated (not field terminated), **black** Category 6 cabling for the connection between transmitter and receiver unless the manufacturer recommends using a different cable (e.g. non-shielded cable or Cat 6A cable, etc.).
6. Terminate the cable in a biscuit box secured behind the display.
7. Contractor is to modify the existing raceway/outlet or supply a surface mounted back box where necessary for the installation.
8. Mount the receiver in a serviceable location behind the display, yet concealed from audience view. Where possible, locate on the side of the display furthest from the door. Utilize cable management or cable wrap to conceal the remaining cables.

B. Manufacturers:

1. Liberty Digitalix DL-1H1A1U-WPKT-W HDBaseT 2.0 with Decora wall plate transmitter, receiver, and power supplies.
2. Audio Enhancement Wall Plate and Receiver
3. Hall Research Wall Plate and Receiver

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2.5 SOUND-FIELD AMPLIFICATION

A. Standard Classroom System

1. Audio Enhancement Optimum System with Integrated XD Receiver
2. Audio Enhancement MS-600 amplifier/receiver
3. Audio Enhancement WBA-602 with call and emergency buttons
4. One (1) teacher microphone and charger
5. One (1) handheld student wireless microphone and charger
6. (4) classroom speakers appropriate to the ceiling type
7. MS-600 auxiliary input connected to the interactive display's audio out port thru the in-wall conduits.
8. Minimum 3-year manufacturer's warranty

B. Accessories to include in the base bid:

1. Include five (5) additional teacher microphones.
2. Include five (5) handheld student wireless microphones in the base bid

C. Manufacturers **[Base Bid]**:

1. Audio Enhancement Optimum

D. Manufacturers **[PA Alternate]**:

If these systems are selected the instructional wall conduit layout will need to change to allow the amplifier to be mounted behind the interactive display

1. Audio Enhancement Optimum or Sentinel
2. Lightspeed Technologies
3. Front Row

2.6 CEILING SPEAKERS

A. In rooms with accessible suspended ceiling tiles speakers shall be recessed-mounted with white grilles.

B. In classrooms with open ceilings provide white WS-09 wall speakers and mount horizontally from the roof beams. Review prototype installation with the Owner, CM or Barton Malow before proceeding.

C. In rooms with open ceilings with no roof beams provide white WS-09 wall speakers and mount to the walls or roof structure as appropriate.

2.7 AV CABLES

A. HDMI cables and adapters are to be hi-speed HDMI cables meeting or exceeding the following:

1. Contractor is to test the cables with the Owner's equipment and must demonstrate a 4K image at 50Hz or higher.
2. Certified to pass complete EDID information
3. Throughput of at least 18 Gbps and designed for 4K@60 4:4:4.
4. Patch cables for user equipment are to be rated by manufacturer as "flexible".

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5. Provide strain relief as necessary or as recommended by manufacturer for utilized cable distance.
6. Distances:
   a. For distances up to 25’ use a 24AWG HDMI cable (patch cables <15’ can be 26 AWG)
   b. For distances >25’ use an active Cat 6 HDMI extender or active fiber HDMI cables.

B. Manufactures:

   a. Comprehensive AV/IT Series
   b. Crestron
   c. Extron
   d. Kramer

2.8 FACEPLATES AND MODULE FRAMES

A. Faceplates shall be sized to accommodate the raceway, back box, or floorbox for each location with adequate modules for the required jacks.

B. The following are general guidelines for faceplates:

1. For recessed boxes and surface-mounted faceplates, data faceplates shall be stainless steel with module frames or decora inserts. A/V faceplates may be plastic if necessary to provide the required A/V inserts.
2. Where single-channel surface-mounted raceway and boxes are used, faceplates shall match the raceway color.
3. Where dual-channel surface-mounted raceway is used (e.g. Wiremold V4000), faceplate shall match the faceplates used in the existing installation.
4. Plastic faceplates are to be used where necessary to coordinate and match modular furniture systems.
5. Blank faceplates shall be stainless steel.
6. Blank inserts for dual-channel raceway shall match the faceplate type and color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review mounting locations before installation. Coordinate locations with the electrical, mechanical, and architectural contractors and mitigate conflicts with other devices and boards.

B. Coordinate mounting height/locations with existing conditions and mount to avoid covering existing devices or devices to be installed during construction.

C. Contractor shall notify Technology Designer of any conflicts before installation.

3.2 MATERIAL HANDLING

A. Contractor shall have a representative onsite to receive delivery of Owner-furnished equipment and verify equipment quantities. Any quantity deviations or items damaged on delivery shall be noted to the Owner in writing immediately following delivery.

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B. Contractor shall sign for all equipment that will be installed under their contract and shall be responsible for the equipment until the complete room systems are substantially complete and transferred to the Owner. Contractor will be responsible for coordinating replacement equipment for any items non-functioning upon delivery, and will replace any equipment missing or damaged during installation.

C. Contractor will be responsible for storing equipment until the equipment can be installed. Owner may be able to provide space in a central location for a portion of the Contractor's equipment. Contractor is responsible for transporting the equipment between the storage space and the individual buildings.

D. Contractor is responsible for any equipment stored on premise. The Owner shall not be responsible for theft or damage to any equipment prior to Owner's acceptance of equipment after it is fully installed and operational.

E. Contractor is responsible to remove packing materials and general debris from the site. The Owner's trash cans and dumpsters are not to be use used except for minor debris cleanup. Contractor is responsible for arranging dumpster drop off and pickup if they choose to use a dumpster as opposed to removing the materials from the site. Any dumpster locations and delivery/pickup times are to be coordinated with the Owner to avoid conflicts with parking, activities, or student drop off / pick up times.

3.3 INSTALLATION

A. Contractor shall choose appropriate mounting method and materials for each location based on manufacturer's requirements, wall construction, building structure, etc.

B. Coordinate equipment location with electrical contractor. Location shown on drawings is approximate; contractor may shift slightly to avoid obstructions (lights, overhead mechanical, etc.) however location must accommodate the interactive display and marker boards.

C. Equipment that extends more than 4" from the wall will be mounted a minimum of 80" above finished floor unless reviewed and approved by Technology Designer or Owner.

D. Install all components according to manufacturer's guidelines. Provide raceway as required for the installation to conceal cables.

E. Provide wire management and cable wrap to manage and conceal cables between the wall and source. Submit cable wrap color for approval prior to installation.

F. Amplifiers or other electronics that have AC line voltage power requirements can not be mounted above the ceiling.

G. Install safety cable for all ceiling equipment supported by the building steel.

H. Contractor is to register all equipment on behalf of the Owner.

3.4 DEMONSTRATION / COMMISSIONING

A. Contractor will setup a prototype classroom with all of the cabling, equipment, and connectors found in a typical classroom. Contractor will demonstrate functionality to the Owner and Technology Designer prior to installing the remaining spaces.

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1. The prototype classroom will be setup in time to allow the Owner to test additional equipment in the space.
2. If the construction schedule does not allow a prototype to be setup in a classroom, contractor will utilize all cabling, equipment, and connectors to setup a prototype of the connectivity in a separate space for approval of components. Contractor will still review a typical physical installation before completing all spaces.

B. Demonstration:
1. Contractor to provide one 2-hour overview of the equipment for the pilot classroom teachers.
2. Contractor to provide one 1-hour overview for the classroom soundfield system. This training will occur after the Owner moves into the building.
3. Contractor to provide training on the Epic system as requested by the administration and office staff.

3.5 AS-BUILT DOCUMENTATION

A. Provide spreadsheet by building identifying installed components for the interactive displays and soundfield systems. Spreadsheet format to be approved by Technology Designer. Include:

1. Location (architectural room number and owner's room number)
2. Manufacturer and model name
3. Model number
4. Display size
5. Serial number (display and Android module)
6. IP address and MAC address for networkable equipment
7. Other pertinent data for the specific equipment.

B. Provide schematic diagram of final AV systems reflecting any changes approved during implementation. Include:

1. Audio flow for each system
2. Video flow for each system

C. Provide complete manufacturer's installation, set-up and maintenance instructions.

D. Provide evidence that all equipment has been registered with the manufacturer on behalf of the owner.

3.6 SPARES

A. Repeated from sections above

1. Five (5) teacher microphones
2. Five (5) handheld student microphones
3. Five (5) spare of each accessory that come with each display (e.g. stylus, eraser, etc.)

END OF SECTION 27 4116

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SECTION 27 4119 –MULTIPURPOSE AV SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 270000 – General Technology Requirements
2. 271000 – General Cabling Requirements
3. 271116 – Racks and Cabinets
4. 274116 – Classroom AV Systems

1.2 SUMMARY

A. Refer to system schematic drawings.

B. General requirements for the Cafeteria AV system:

1. Provide a wall-mount system cabinet with integrated equipment rack.
2. Provide power distribution within the equipment rack for all rack-located devices. Power shall remain ON at all times to support immediate use of the system.
3. Provide rack accessories as necessary for a complete and clean installation, including but not limited to:
   a. Blank plates
   b. Cable management
   c. Thermal management (rack fans)
   d. Drawer (2U)
4. Provide a control system, inclusive of a 7” (minimum) touch screen controller (“controller”) wall-mounted on the platform, to manage and control features of the system as described herein.
5. Provide the following audio devices / connections:
   a. An audio digital signal processor (“DSP”) to manage audio signals described herein.
   b. Two (2) wireless microphone channels to support the following microphones:
      1) Channel 1 – Handheld & Bodypack with lapel microphone
      2) Channel 2 – Handheld & Bodypack with headset microphone

      The type of microphone being used with each channel shall be selectable on the controller, triggering appropriate gain structure in the DSP.

      Each channel shall have individual level and mute control on the controller.
   c. Two (2) wired handheld microphones with 25’ cables for use at any (4) wired microphone input. Each wired microphone input shall have individual level and mute control on the controller.
   d. Media player with source selection and relevant playback controls (by source) on the controller, as well as individual level and mute control on the controller.
   e. Monitor output locations, each having individual level and mute control on the controller.

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f. Two (2) channel amplifier to provide power to speakers with master volume and mute control on the controller.
g. Two (2) vertical line array speakers to provide stereo sound reinforcement.
h. Public address system receiver with control signal tie to DSP that mutes local audio system during page / announcement.
i. Assisted listening system, inclusive of:
   1) Required signage
   2) Transmitter
   3) Two (2) receivers
   4) Two (2) hearing loops
   5) Two (2) earpieces

   Provide Unit pricing for additional receiver, hearing loop, and earpiece.

6. Provide the following video devices:
   a. A video matrix switcher to manage video signals (and accompanying audio / control signals where applicable) / connections as described herein. Source selection with automation (where applicable) on the controller.
      It is intended that the projector and interactive flat panel (IFP) can mirror each other (with mirroring selected on the controller) using any available source.
   b. (3) HDMI over HDBaseT transmitters for auxiliary input locations V1 & V3, and feed from the IFP display.
      1) Refer to Classroom AV specifications for Interactive Flat Panel (IFP) requirements.
      2) Provide 86” IFP with height adjustable mount
   c. HDMI over HDBaseT receiver for IFP display.
   d. Video projector, HDBaseT video and control.
   e. Projection screen, fixed-frame.
   f. Interactive flat panel display, HDMI and control over HDBaseT receiver, local HDMI & USB input, owner furnished / contractor installed (OFCI) digital signage player.

C. General requirements for the Gymnasium AV system:

1. Provide a wall-mount system cabinet with integrated equipment rack.
2. Provide power distribution within the equipment rack for all rack-located devices. Power shall remain ON at all times to support immediate use of the system.
3. Provide rack accessories as necessary for a complete and clean installation, including but not limited to:
   a. Blank plates
   b. Cable management
   c. Thermal management (rack fans)
   d. Drawer (2U)
4. Provide a control system, inclusive of a 7” (minimum) touch screen controller (“controller”) rack-panel-mounted in the AV cabinet, to manage and control features of the system as described herein.
5. Provide the following audio devices / connections:
   a. An audio digital signal processor (“DSP”) to manage audio signals described herein.
   b. Two (2) wireless microphone channels to support the following microphones:
      1) Channel 1 – Handheld & Bodypack with lapel microphone
      2) Channel 2 – Handheld & Bodypack with headset microphone

      The type of microphone being used with each channel shall be selectable on the controller, triggering appropriate gain structure in the DSP.
      Each channel shall have individual level and mute control on the controller.
   c. Two (2) wired handheld microphones with 25’ cables for use at any (4) wired microphone input. Each wired microphone input shall have individual level and mute control on the controller.

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d. Auxiliary audio connections (2), each having individual level and mute control on the controller.
e. Media player with source selection and relevant playback controls (by source) on the controller, as well as individual level and mute control on the controller.
f. Monitor output locations (2), each having individual level and mute control on the controller.
g. Two (2) channel amplifier to provide power to speakers with master volume and mute control on the controller.
h. Two (2) vertical line array speakers to provide stereo sound reinforcement.
i. Public address system receiver with control signal tie to DSP that mutes local audio system during page / announcement.
j. Assisted listening system, inclusive of:
   1) Required signage
   2) Transmitter
   3) Two (2) receivers
   4) Two (2) hearing loops
   5) Two (2) earpieces

   Provide Unit pricing for additional receiver, hearing loop, and earpiece.

D. General requirements for the Music Studio AV system:

1. Provide an 86” interactive flat panel (IFP) display.
2. Provide a floor-standing system cabinet with integrated equipment rack.
3. Provide power distribution within the equipment rack for all rack-located devices. Power shall remain ON at all times to support immediate use of the system.
4. Provide rack accessories as necessary for a complete and clean installation, including but not limited to:
   a. Blank plates
   b. Cable management
   c. Thermal management (rack fans)
   d. (2) Drawer (2U)
5. Provide a control system, inclusive of a 7” (minimum) touch screen controller (“controller”) table-top-mounted atop the system cabinet, to manage and control features of the system as described herein.
6. Provide the following audio devices / connections:
   a. Digital mixer.
   b. Two (2) wireless microphone channels to support the following microphones:
      1) Channel 1 – Handheld & Bodypack with lapel microphone
      2) Channel 2 – Handheld & Bodypack with headset microphone

      The type of microphone being used with each channel shall be selectable on the controller, triggering appropriate gain structure in the DSP.

      Each channel shall have individual level and mute control on the controller.
   c. Two (2) wired instrument microphones suspended from the ceiling.
   d. Recorder.
   e. Apple iPad – configured per Owner – for control of the Mixer & Recorder via app’s.
   f. Media player with source selection and relevant playback controls (by source) on the controller.
   g. Two (2) channel amplifier to provide power to speakers.
   h. Two (2) surface-mount cabinet speakers to provide full-range stereo sound reinforcement.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, provide the manufacturer’s product data sheet in both hard-copy and electronic (PDF) formats including dimensions and data on

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features, performance, electrical characteristics, ratings, and finishes. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. A/V distribution equipment (amplifier, equalizers, etc.)
2. Speakers
3. Microphones
4. Projectors, Flat Panels
5. Projection Screens
6. Control system components
7. Cable and connectors
8. Mounts and mounting accessories
9. Cable management and cable wrap including color selection

B. A/V Schematics

1. General Requirements:

   a. Label all devices with manufacturer part name and number
   b. Show all Inputs/Outputs for every component. Mark unused inputs/outputs as "spare"
   c. Show connector types for all terminations

2. Required Schematics:

   a. Audio flow for each system (schematic)
   b. Video flow for each system (schematic)
   c. Device layout and speaker coverage (plan).

1.4 QUALITY ASSURANCE

A. Installers must be certified by the manufacturer for the equipment being installed.

1.5 WARRANTY

A. The contractor warrants the system to be free of defects of workmanship or products and will inspect and repair the system within twenty-four (24) hours during the warranty period at no additional cost to the Owner. The Contractor shall respond on site within four (4) hours' notice, and without cost to the Owner, during this warranty period. Contractor agrees to correct system deficiencies and replace components that fail in materials or workmanship including deficiencies arising when used according to the manufacturer or Contractor's written instructions No warranty or terms therein shall limit or be interpreted to limit remedies as provided by law

B. All equipment shall be provided with a **three (3) year warranty** unless noted otherwise. The warranty period shall begin at the date indicated on the certificate of substantial completion or the date of Owner acceptance (to be received in writing and approved by Barton Malow), whichever comes later.

C. The warranty shall include phone support, software assurance, firmware updates, software version upgrades, and any other special warranties.

D. The Owner shall not be responsible for additional charges during the equipment warranty period. Labor, service charges, trip charges, etc. to configure and install equipment during the warranty period shall be included in the contractor's warranty.

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E. Contractor is to provide documentation for all manufacturer's warranties including the operating conditions required for the warranty.

F. Contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. All A/V cabling shall be professional grade and sized appropriately for each installation. If signal degradation occurs as the result of cable selection/installation, it will be replaced at no additional cost to the owner.

B. All A/V connectors shall be professional grade. If signal degradation occurs as the result of connector selection/termination, it will be replaced and re-terminated at no additional cost to the owner.

C. Contractor is responsible for providing any signal amplification necessary to ensure a completely functional and professional installation whether such items are specifically mentioned in the plans or specifications.

D. Contractor is responsible for all patch cables required to ensure a completely functional and professional, turn-key solution.

E. Contractor shall have experienced programming staff to properly configure and tune specified control, audio, and video equipment per manufacturer guidelines and equipment capabilities.

F. A/V schematics, plans, details, etc. are for conceptual purposes only. Final design to be provided by contractor and approved by Technology Designer. Notify the Technology Designer before bid period question deadline, established at the pre-bid meeting, should any changes in bid documents be required to meet the design concept. After entering the Contract, Contractor shall provide a Technology Designer-approved solution to meet design concept.

2.2 AUDIO DIGITAL SIGNAL PROCESSOR

A. Manufacturers:
1. Biamp
2. Symetrix
3. Q-SYS
4. Approved equal

2.3 MIXER

A. Soundcraft UI16 or approved equal.

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2.4 WIRELESS MICROPHONES

A. General Requirements

1. Provide dual channel wireless microphone system in rack that will provide both Handheld and Lapel type wireless microphones.
2. Both units must operate simultaneously.
3. Include all rack mounting hardware and required antennas for receiver in rack. RF Output Level = 10 - 30 mW (dependent on frequency version)
4. Provide Antenna distribution as needed and required for a complete system
5. Provide Double AA rechargeable batteries and 110v wall charger. One minimum 4-port wall charger for every (8) batteries. One set of batteries for all mics, plus one spare set for all mics.

B. Manufacturers:

1. Audio Technica System Pro10
2. Shure SLX124/85/SM58
3. Approved equal

2.5 WIRED HANDHELD MICROPHONE

A. General Requirements:

1. Type: Dynamic
2. Polar Pattern: Cardioid
3. Frequency Response: 50 to 15,000 Hz
4. Connector: 3-Pin Male XLR
5. Switch: Yes

B. Manufacturers:

1. Shure
2. Audio Technica

2.6 MEDIA PLAYER

A. Tascam CD-400U or approved equal.

2.7 RECORDER

A. Tascam SS-R250N or approved equal.

2.8 WIRED INSTRUMENT MICROPHONE

A. Shure SM137 or approved equal.

2.9 AMPLIFIER

A. General Requirements

1. Solid-state (Class D)
2. Front panel controls
3. Rated for 2 to 8 ohms in Stereo mode

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4. Frequency response: 20 Hz to 20 kHz at 1W (4-Ohms)
5. Protection against shortened, open or mismatched loads, overloaded power supplies, and excessive temperature
6. Power output based on need plus 20% overhead

B. Manufacturers:
1. Biamp
2. Crestron
3. Crown
4. Extron
5. LEA Professional
6. QSC

2.10 VERTICAL LINE ARRAY SPEAKERS

A. General Requirements

1. Constant Beamwidth 2-way line array speaker
2. Switchable vertical pattern coverage 45 degrees wide to 25 degrees narrow
3. Frequency Range: Within minus 10 dB from 60 to 20,000 Hz.
4. Nominal Impedance: 8-Ohm
5. Power capacity: 500w (2000W peak) 2hrs; 350w (1400W peak) 100hrs
~~4.~~6. System Sensitivity 2.83V @1m; 92dB to 98dB (narrow to broad)
~~5.~~7. JBL CBT 70J-1 or approved equal

B. Manufacturers

1. Electro-Voice
2. JBL
3. TOA

2.11 CABINET SPEAKERS (Gymnasium)

A. General Requirements

1. 3-way
2. 120 x 110 degree HF coverage
3. Frequency Range: 38-17kHz
4. Nominal Impedance: 4-Ohm
5. Power capacity: 500W Continuous
~~4.~~6. JBL Control 30 or approved equal

B. Manufacturers

1. Electro-Voice
2. JBL
3. TOA

2.12 CABINET SPEAKERS (Music Studio)

A. General Requirements

1. 3-way
2. 110 x 85 degree HF coverage
3. Frequency Range: 37-18kHz

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4. Nominal Impedance: 8-Ohm
5. Power capacity: 300W Continuous
~~4.~~6. JBL Control 29AV-1 or approved equal

B. Manufacturers

1. Electro-Voice
2. JBL
3. TOA

2.13 VIDEO MATRIX SWITCHER

A. General Requirements
1. HDMI input(s) and output(s)
2. HDBaseT input(s) and output(s)
3. Stereo audio output
4. Compatible HDBaseT transmitters and receivers with in-wall (wall plate) and surface-mount form factors
5. Capable of powering remote HDBaseT transmitters and receivers
6. Capable of routing video, audio, and control signals over HDBaseT
7. Capable of routing up-to Progressive 4K UHD (3840x2160) at 30Hz, 4:2:2
8. IP controllability for source and destination selection; ability to route any input to any or all inputs simultaneously without loss

B. Manufacturers
1. Crestron
2. Extron
3. Atlona
4. Approved Equal

2.14 PROJECTOR

A. Epson EB-PU1008B with ELPLU03S lens or approved equal.

2.15 PROJECTOR MOUNT

A. Chief WMA1S or approved equal.

2.16 PROJECTION SCREEN (FIXED)

A. Da-Lite UTB Contour 24543 or approved equal.

2.17 AV CABINET (WALL)

A. Middle Atlantic DWR series or approved equal.
1. Include rear rack rail
2. Include fans
3. Include accessories as described herein

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2.18 AV CABINET (FLOOR)

A. Middle Atlantic Slim 5 series or approved equal.
   1. Include side panels and top
   2. Include leveling feet
   3. Include locking back panel with fans
   4. Include accessories as described herein

2.19 AV CABLES

A. General Requirements
   1. HDMI cables and adapters are to be hi-speed HDMI cables Certified to pass complete EDID information
   2. Throughput of at least 10.2 Gbps and designed for 4k@60Hz
   3. Patch cables for user equipment are to be rated by manufacturer as “flexible”. (example: Kramer C-MHM/MHM series).
   4. Provide strain relief as necessary or as recommended by manufacturer for utilized cable distance.
   5. Distances:
      a. For distances up to 35’ use a 24AWG HDMI cable (patch cables <15’ can be 26 AWG)
      b. For distances >35’ use an active Cat 6 HDMI extender.

B. Manufacturers:
   1. Cables 2 Go
   2. Covid USA
   3. Crestron
   4. Extron
   5. Kramer
   6. Monoprice Cabernet Series
   7. Approved Equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review mounting locations before installation. Coordinate locations with the electrical contractor and mitigate conflicts with other devices.

B. Coordinate mounting height/locations with existing conditions and mount to avoid covering existing devices or devices to be installed during construction.

C. Contractor shall notify Technology Designer of any conflicts before installation.

3.2 INSTALLATION

A. Contractor shall choose appropriate mounting method and materials for each piece of equipment and location based on manufacturer’s requirements, wall construction, building structure, etc.

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B. Install all components according to manufacturer's guidelines.

C. Provide raceway as required for the installation to conceal cables.

D. Provide wire management and cable wrap to manage and conceal cables between the wall and source. Submit cable wrap color for approval prior to installation.

E. Provide wire management and cable wrap to manage and conceal cables between the wall and source.

F. Install safety cable for all ceiling and wall mounted equipment supported by the building steel and be independent of any ceiling grid or accessories.

G. Contractor to test and balance all speakers and equipment settings to tune to the system for each space.

H. Coordinate location with electrical contractor. Location shown on drawings is approximate; contractor may shift slightly to avoid obstructions (lights, overhead mechanical, etc.) however location must accommodate the interactive display and marker boards.

I. Mounting height shall be reviewed with Owner for each room configuration. In rooms where an existing chalkboard or markerboard is to remain, the bottom of the display shall be located immediately above the chalkboard/markerboard rail.

3.3 PROGRAMMING

A. Meet with Owner and Technology Designer to discuss the requirements and expectations for the control system functionality and interface. The contractor to propose interface based on the Owner's needs and should anticipate modifying the proposed solution based on Owner feedback.

B. EDID Strategy

1. Create an EDID strategy where issues arise with differing native display resolutions and source equipment.

2. Document EDID parameters and turn over to the owner as an as-built deliverable.

C. Commissioning

1. After the rollout of the programming graphics and logic, programmer will run through each system with Barton Malow and the Owner to verify functionality and ensure each system functions to the Owner's requirements. Issues with function will be documented and corrected in a timely fashion.

2. After the initial verification, the Owner may make up to 2 functionality/usability revision requests within 12 months which will be accommodated at no additional cost, unless additional hardware or licensing is required to activate a requested feature. A revision shall consist of both the logical and graphical changes required to achieve the requested functionality. This does not include correcting functionality issues found after users begin using the systems regularly, which is a workmanship warranty issue.

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3. Contractor to thoroughly test all systems and take corrective actions prior to scheduling demonstrations.

3.4 DEMONSTRATION

A. Contractor to commission the system with the Owner and/or Designer to verify operation and setup prior to user training.

B. Contractor to provide an overview of the system functionality and adjustments for the building staff.

C. Contractor to adjust the system based on Owner feedback after space is used for classes and sporting events.

3.5 DOCUMENTATION

A. As-Built Documentation:

1. Spreadsheet by building identifying installed components, location, model number, serial number, and any other pertinent data. Spreadsheet format to be approved by Technology Designer.
2. Schematic diagram indicating equipment and interconnections.

B. Control Diagrams

1. Provide flow diagrams that list out what function each button executes. (Example: Power ON turns on projector, fires relay to lower screen, switches system to stage input plate.)
2. Contractor to turn over electronic version of source code for all control system programming. Provide both compiled and un-complied code.

C. Manufacturer's Instructions: Provide complete installation, set-up, and maintenance instructions.

END OF SECTION 27 4119

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SECTION 27 5116 – PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements

1.2 BASE BID

A. Base bid is to install an Audio Enhancement EPIC system using the classroom Optimum soundfield systems along with amplifiers, speakers, etc. for areas without classroom soundfield (e.g. corridors, kitchen, offices, etc.) to create a comprehensive PA system.

B. Include EPIC headend server, EPIC System Kiosk for the main office, and configure for paging from the office as well as call and emergency buttons from classrooms initiating communication with the office.

C. Contractor is to load building map into the system and configure for individual zones to be selected for paging and highlighted during all call/emergency communications.

1.3 ALTERNATE

A. Bid Alternate is to install a CareHawk 1000 system to provide PA functionality separate from the classroom soundfield systems.

B. Include call and emergency buttons in each area with a soundfield system to initiate communication with the office.

C. Include MapAssist system. Contractor is to load building map into the system and configure for individual zones to be selected for paging and highlighted during all call/emergency communications.

D. The drawings show the base bid speaker locations. Contractor will also need to include a ceiling-mounted classroom speaker in each space with a soundfield system including conduit from the hallway to the center of the room for the speaker similar to the wireless access point conduit locations, and a conduit and box at 48” for the call button.

E. Integrate the new Mt. Hope system into the existing Carehawk system installed at multiple buildings.

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1.4 SUMMARY

A. PA system shall provide paging, emergency signal sounding, and time-event signals (bell system) to selectable zones (interior and exterior).

B. PA system is to be network-accessible allowing for administration from any computer on the Owner's network, paging at a remote-building, and multi-building pages for emergency announcements.

C. Provide bell system schedule through browser-based system. Contractor to obtain the standard daily bell schedule and the bell schedule for pre-programmed non-standard days (e.g. half day, early release, etc.) and create the initial bell schedules in the system.

D. Provide ports, installation, and configuration to integrate with the access control system to play pre-recorded messages during building lockdown.

E. Include a push-to-talk microphone in the main office on the receptionist desk configured for the All-Call paging zone.

F. The system will play pre-recorded messages and tones when initiated from the administrative software or from an alert sent from an external system. Contractor to work with Owner to record all initial messages.

G. The system will be configured to play recorded music (MP3) or music from other electronics through an aux port.

H. Configure system to synchronize time with the master clock system.

I. PA system shall allow for talkback from each classroom. Provide a preannounce tone over speakers before two-way communication is enabled.

J. PA system shall be integrated with the phone system allowing announcements from authorized users to be made from any handset. Announcements shall be active until the user terminates the session by hanging up the handset.

K. Provide a microphone in the main office for all-call announcements in addition to the phone system integration.

L. Include a tones for emergency situations or drills (e.g. tornado drill).

M. PA system will have separate zones for the following areas. Speakers in support spaces can be part of the zone the support space is associated with (e.g. kitchen, servery, kitchen office, food storage areas, etc. can all be included in the cafeteria zone).

1. All Call (all interior speakers)
2. Emergency (all interior + exterior speakers)
3. All exterior speakers
4. Each Instructional Space (classrooms, computer labs, media center, etc.)
5. Cafeteria
6. Gymnasium

1.5 DEFINITIONS

A. PA: Public Address

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1.6 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Speakers (ceiling, surface mount, horn, etc.)
2. Microphone
3. Cable

B. Shop Drawings: For each drawing indicated, provide in hard-copy and electronic (PDF) formats.

1. Include a composite floorplan identifying speaker locations and zone assignments.

C. Qualification Data: Include written confirmation from the manufacturer that the Contractor is an authorized factory agent or distributor for the submitted products.

1.7 QUALITY ASSURANCE

A. Comply with the requirements of NFPA 70.

B. The Contractor shall install in accordance with all applicable codes and standards, including federal, state, and local codes and authorities.

1.8 COORDINATION

A. Coordinate layout, rough-in requirements, and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

B. For new-wall construction, provide speaker backboxes to the contractor identified by the Construction Manager for installation.

C. Coordinate the telephone integration with the telephone contractor or with the Owner’s telephone service company.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. The PA system equipment shall be wall-mounted or rack-mounted in the MDF.

B. Provide a UPS to maintain full system functionality between a power outage and the generator restoring power.

C. Integrate with existing Shoretel IP telephone system to allow paging from existing handsets, and paging over existing speakerphones.

1. Provide FXO to FXS connection or SIP trunk to SIP Station handoff as required for interconnection.
2. Coordinate interface and connection with Owner’s telephone system service provider

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3. PA system Contractor is responsible for installing the cable between the 2 systems.

D. Provide bell system schedule through a browser-based system. Provide and configure the initial school year bell calendar including holidays and non-typical days.

E. Synchronize time with the Master Time System. System shall automatically adjust for daylight savings time.

F. The PA system shall provide a minimum of four (4) distinct tones for emergency alerts that are to be initiated through web interface. Each tone shall be programmable for volume, pitch, and duration. Emergency alerts should be distributed to all speakers unless directed otherwise by the Owner or Technology Designer.

G. Provide local volume control in the locations indicated by the drawings and specifications.

H. System shall be addressable to allow each speaker to be assigned to one or multiple zones.

I. System shall contain adequate number of zone cards to meet zone requirements at each building.

J. Amplifiers shall be sized to accommodate all speaker locations defined in the plans and specifications. The system shall also allow for additional speakers to be added (allow for 20% growth).

K. Each input shall have individual volume controls. The unit shall have 1 master volume control.

L. Include programming software, if required.

M. Provide a preannounce tone over loudspeakers.

N. The Contractor is to use plenum rated cabling and accessories throughout the project. All cables shall be continuous and free from splices.

2.2 MANUFACTURERS

A. The following are acceptable manufacturers for general equipment within this section, unless noted otherwise for any product. Any deviations must be approved in writing by the Technology Designer before installation.

1. Base Bid: Audio Enhancement EPIC
2. Alternate: CareHawk CH1000LT
3. Approved equivalent

2.3 MICROPHONE

A. Provide desk-type low impedance microphone with push-to-talk switch.

2.4 SPEAKERS

A. All speaker cabling is to be shielded.

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B. Where possible, speakers shall be recessed-mounted in suspended ceiling tiles and protected with white grilles.

C. Ceiling PA speakers and grilles are to be rust-resistant Quam speakers or equivalent with load bearing tile support bridge.

D. Wall/open-ceiling PA speakers are to be Quam System 6VP or equivalent vandal resistant loudspeaker assemblies with durable white powder coat finish. Coordinate backboxes with the masonry and electrical contractors for a final flush-mount speaker.

E. Outdoor PA speakers are to be Quam System 36VPS or equivalent vandal resistant horn loudspeaker assemblies with durable stainless steel construction with white powder coat finish.

F. Any non-recessed speakers must match the surrounding architectural finishes. Speaker selection requires Technology Designer and Architect approval.

G. Appropriate mounting accessories (grilles, enclosures, baffles, etc.) shall be provided and installed with each speaker. Accessories shall be chosen to accommodate installation location.

H. All speakers to be equipped with appropriately sized transformers.

I. Include protective cage for speakers in the gym.

2.5 SPEAKER CABLING

A. Wiring shall be done per manufacturer's recommendation.

B. All terminal connections to be on barrier strips.

C. All cables to be labeled by room.

D. All speaker cabling is to be shielded and plenum rated.

E. Contractor to install conduit between speakers / backboxes where cabling is not concealed above accessible ceiling.

2.6 TELEPHONE ACCESS MODULE

A. Provide a telephone access module or PA to telephone system interface to enable a standard Owner’s handsets to interface with the PA system allowing announcements from authorized users to be made from any handset.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor’s responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

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B. Provide all cabling, equipment, and devices to ensure the system will properly function. Any issues with the systems, design, or installation must be brought to the attention of the Technology Designer before the bid is submitted.

C. Examine pathway elements intended for cabling to verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with manufacturer requirements.

D. Verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.

B. The Contractor shall protect equipment and components during installation, and clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer.

C. The Contractor shall be familiar with the site and the rooms to ensure a proper installation. The final installation methods are left to the discretion of the contractor in accordance with this specification, within standards of generally accepted workmanship, and in accordance with manufacturer's recommended installation practices.

D. Contractor shall review zone speaker assignments, zone numbering scheme, and tone generator designations with the Owner and Technology Designer before beginning installation. Configure according to Owner requirements.

1. Zone assignments will be consistent for similar spaces across buildings. For example, each building is to have the same assignment for all-call, emergency zones, gymnasiums, cafeterias, etc.

E. After balancing the system, Contractor shall mark all components with variable sound levels indicating the levels recommended.

F. Splice cable only in accessible junction boxes or at terminal block units. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.

G. Leave 24" excess cable at each termination at microphone, volume pad, speaker, or other system outlet. Leave 6 feet of excess cable at each termination at the system cabinet. Service loop to be arranged and secured.

3.3 IDENTIFICATION

A. Cable runs shall be machine labeled within 1" of each termination. All cabling is to be tagged in a consistent manner, approved by the Technology Designer.

B. Zone paging modules, tone generators, etc. shall be labeled to designate their configuration.

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3.4 FIELD QUALITY CONTROL

A. Measure and record sound power levels (dB SPL) in all areas (rooms, center of each corridor, near outdoor speakers).

B. Document call and talkback functionality performs properly in all rooms.

1. Verify correct speakers assigned to each paging zones
2. Talk back
3. Emergency tones

3.5 DEMONSTRATION

A. Contractor must test system to make sure all call, zoning, talkback, and lock down drills work properly prior to demonstration. District personnel must be present for an all call and lock down drill test.

B. Demonstrate all system functions (timed events, emergency tones, telephone and clock interfaces, etc.) to Technology Designer.

C. System training to be scheduled at Owner's convenience. Contractor to provide site-specific documentation on the basic operation, programming, bell schedules (standard and holidays), and troubleshooting of the system. Contractor to record training sessions.

3.6 SYSTEM ADJUSTMENTS

A. After initial setup, contractor may be required to make additional site visits within the first year of operation (as set forth from date of substantial completion) to adjust speaker volumes for individual speakers or zones.

3.7 DOCUMENTATION

A. As-Built Documentation:

1. Include composite drawing for each building indicating paging zones, paging zone numbers, and paging instructions.
2. Provide test results log of all systems and zones with date and time of test, the db reading, and who performed the test.
3. Include scaled drawings reflecting all changes between the bid documents and the final installation including cable routing, location of all equipment, speakers, remote volume controls, etc.
4. Drawings for systems showing location and cabinet/enclosure layout. Include all components identifying component manufacturer and model, serial numbers, label, and connections.
5. Schematic drawing indicating equipment models, interconnections, naming, serial numbers, and MAC addresses for IP-based components. Include interconnections to other systems.
6. Spreadsheet indicating the sound level recorded in each area and the test date.
7. Spreadsheet indicating call and talkback functionality has been tested in each room.

END OF SECTION 27 5100

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SECTION 27 5300 – POE CLOCK SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements
3. 27 1500 – Data Horizontal Cabling
4. 27 5100 – Public Address System

1.2 SUMMARY

A. This Section includes the following related to the wireless clock system:

1. Master Clock System
2. POE Digital Clocks
3. Wire Guards

B. The clock system shall continually synchronize clocks throughout the facility, and integrate with the public address system for time synchronization.

C. Related work provided by others:

1. Public address systems or other systems that will use the clock system for time synchronization.

D. Reference standards

1. Federal Communications Division (FCC)
   Part 15 - Code of Federal Regulations.
2. National Fire Protection Association (NFPA).
   NFPA 70E-[2012], Standard for Electrical safety in the Workplace.

1.3 DEFINITIONS

A. PA: Public Address System

B. POE: Power over Ethernet

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1.4 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Clocks
2. Wire Guards

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the equipment manufacturer, for both installation and supervision of the installation of the system.

B. Equipment and components furnished shall be of manufacturer's latest model.

C. Regulatory Requirements
1. Comply with NFPA 70
2. Solution shall not require an FCC license:
3. All components shall comply with Part 90 of FCC rules as follows:
   a. This device may not cause harmful interference, and
   b. This device must accept interference received, including interference that may cause undesired operation.
4. System shall be installed in compliance with local and state authorities having jurisdiction.

1.6 COORDINATION

A. Coordinate layout and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

1.7 WARRANTY

A. The contractor warrants the system to be free of defects of workmanship or products and will inspect and repair the system during the warranty period at no additional cost to the Owner. Contractor agrees to correct system deficiencies and replace components that fail in materials or workmanship including deficiencies arising when used according to the manufacturer or Contractor's written instructions. No warranty or terms therein shall limit or be interpreted to limit remedies as provided by law

B. The warranty period shall be five (5) years.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Clock system shall synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired. Clocks shall receive a sync signal at a maximum of every 4 hours.

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B. The system shall synchronize all clocks to each other. The system shall utilize Internet-based time sync to provide accurate time. Clocks shall automatically adjust for Daylight Savings Time.

C. System is to have web-based administration.

D. Communication between components is to be in the Power over Ethernet (POE) over the Owner's network.

E. Clocks shall be synchronized so that clock accuracy shall not exceed plus or minus 1 second.

F. The system shall include an internal clock reference so that failure of the network or master clock signal shall not cause the clocks to fail in indicating time.

G. The system shall include a "fail-safe" design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

H. System to have diagnostic feature allowing users to view when clock is not receiving the signal.

I. Provide contact closures and all labor and materials to synchronize time across the following systems: PA system, bell system.

2.2 MANUFACTURERS

A. The following are acceptable manufacturers for general equipment within this section, unless noted otherwise for any product. Other systems using wireless technology in an unlicensed frequency range will not be accepted. Any substitutions must be included in the bid as a voluntary alternate and if accepted approved in writing by the technology designer and Owner before installation.

1. Primex Wireless
2. Approved equivalent

2.3 MASTER CLOCK

A. Description: SNTP/NTP-based Master Clock.

1. Provide and configure OneView Sync PoE cloud management system to remotely manage system device settings and monitor system devices.
2. Configure identified user accounts and configure to notify the systems administrator of any devices outages.
3. Change all initial passwords to conform with the Owner's password policy.
4. Coordinate network requirements with owner's IT department.
5. Receive (S)NTP time signal via Ethernet with multiple backup addresses.
6. Automatic bi-annual Daylight Savings Time changes.
7. System shall utilize web-based programming including:
    a. Configure the master clock system
    b. Configure e-mail alerts

2.4 POE DIGITAL CLOCK

A. Description: Digital clocks shall be wall or ceiling mounted as appropriate to the location.

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1. POE IEEE 802.af power using Category 6 cabling.
2. Provide double-sided clocks where shown on the drawings.
3. Operate under DHCP or non-DHCP environments
4. If system stops transmitting valid time signals due to network failure, the clocks will continue to function as accurate clock until a valid time signal is decoded (assuming POE still works to provide power to the clock)
5. Include slope bracket with each clock
6. Provide and install wire guard for clocks in gymnasiums.
7. Typical Format: 4 digit red display
8. Gym Format: 6-digit red display with flush mount kit. Coordinate back box with the masonry and electrical contractors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Prior to installation, a site survey must be performed to determine proper transmitter placement. Any issues with the systems, design, or installation must be brought to the attention of the Technology Designer before the bid is submitted.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Clock locations shall be in the rooms indicated on the drawings. The locations identify the general location only; final location shall accommodate conditions in each room. Clocks shall not be installed until painting and other finish work in each room is complete.

B. The Contractor shall install the system according to the manufacturer's sequence and guidelines and in accordance with NFPA 70E.

C. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.

D. The Contractor shall protect equipment and components during installation until final acceptance of the project, and clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer. Remove temporary labels from clock face (labels on the backs of clocks to remain).

E. At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning. Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

F. Contractor is responsible for the initial configuration of the system including setting the initial annual schedule and events.

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3.3 FIELD QUALITY CONTROL

A. All devices must be tested at their operational location under normal operational conditions to assure reception of signal.

3.4 DELIVERY STORAGE AND HANDLING

A. Deliver all components to the site in the manufacturer's original packaging. Packaging shall contain manufacturer's name and address, product identification number, and other related information. Contractor to dispose of all packaging.

3.5 DEMONSTRATION

A. The Contractor shall demonstrate for the Technology Designer and Owner that the system operates under manufacturer guidelines under both normal operational conditions and during the loss of network connectivity.

B. The Contractor shall train the Owner on the operation of the system including user administration, clock configuration, modifications to the clock settings (brightness, etc.), clock configuration, configuring alerts, reporting, clock mounting, and removing a mounted clock.

3.6 SPARES

A. Provide the following spare equipment and/or parts

1. Five (5) 4” POE Digital clocks

3.7 DOCUMENTATION

A. Document initial user and clock settings.

B. Manufacturer's Instructions: Provide complete installation, set-up and maintenance instructions.

END OF SECTION 27 5300

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SECTION 28 1300 – ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 08 7111 – Door Hardware
2. 27 0000 – General Technology Requirements
3. 27 1000 – General Cabling Requirements

1.2 SUMMARY

A. This Section includes the following major components related to the security system:

1. Regulating access through entry doors
2. Controllers
3. Lockdown buttons and functionality
4. Bus entry

B. The intent is to expand the existing district-wide Continental Access System.

C. Card readers will be integrated into the door hardware or specified in the door hardware schedule and specifications. Refer to those documents for more information.

D. Provide an under-desk building lockdown button in the main office and principal's office including a protective cover.

E. Install new control panel/controller in the MDF Wire each door and bus entry card reader to the location of the access control door panel/controller.

F. Contractor will be required to coordinate access permissions with the owner, and apply the required individuals credential information to the new doors. The contractor will also coordinate multiple time schedules (standard school day, early release, holiday, etc.) with the owner and apply time schedules as required to each respective opening.

G. Integrate with the video intercoms located at the building and office entrances.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following are acceptable manufacturers for general equipment within this section, unless noted otherwise for any product. Any substitutions must be demonstrated to the Owner and Technology Designer for approval in writing before installation.

1. Continental Access CA4K Centennial

2.2 CONTROL PANEL

A. Provide Continental Accelaterm system sized for all doors, door contacts, etc. indicated on the drawings.

B. Integrate with Owner's existing multi-building CA4K system.

2.3 CARD READERS

A. Provided by others, wired and configured by this contractor.

2.4 PANIC/LOCKDOWN BUTTON

A. General Requirements

1. Install wireless panic buttons (hold up switches) under the receptionist and principal's desk. Coordinate location with end user.
2. Provide finger-operated RF transmitters, receivers, cabling, and integration into the access control system
3. Upon pressing the lockdown button the system will lock all electrified doors integrated with the access control system.
4. Contractor to program lockdown button to override any door schedules.
5. User credentials will become inactive in a lockdown state. Contractor to create access group with specific personnel that has the ability to override reader programming and allow entry.
6. Users will be given an emergency PIN code to use with the card reader keypads to unlock doors.
7. Alert designated building staff via text and email. Contractor to work with the owner on the list of contacts. This may include emergency responder contacts.
8. Lockdown can only be turned off/disengaged through the access control software.

B. Manufacturer:

1. Honeywell 5869 with RF receiver
2. Approved Equivalent

2.5 AUTOMATED VEHICLE CARD READERS

A. General Requirements:

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1. The system shall support the use of a uni-directional proximity card reader or vehicle tags.
2. Card readers shall utilize passive detection.
3. The card reader shall have an adjustable read range of 8 to 25 ft.
4. Configure to operate for either a timed or triggered openings

B. Control: Integrate into the door Continental Access system, and configure for use with the owner's existing credentials and configuration. Provide outdoor-rated cabling and access control electronics required for complete and functioning system.

C. Mounting: Provide antenna bracket and 3" mounting post. Coordinate with sitework and electrical contractors during installation.

D. Power: Coordinate power requirements with the electrical contractor

E. Manufacturer:

1. Doorking (basis of design)
2. American Access Systems
3. HID
4. Securakey
5. Approved Equivalent

2.6 ELECTRIC STRIKE

A. Provided by others

2.7 DOOR CONTACT

A. General Requirements:

1. Provide door contacts for all doors without door contacts integrated into the door hardware in the locations shown on the drawings.
2. Provide wiring and electronics to integrate with the Continental access control system.
3. Contractor will program contact and create events for forced entry.
4. Contractor will program and create events for held open status over three (3) minutes.

B. Manufacturer:

1. Interlogix – 1078C-G
2. Approved equivalent

2.8 MOTION REQUEST TO EXIT DEVICE

A. General Requirements:

1. Contractor shall install, configure, and program motion sensor to shunt door contact(s) on normal exit

B. Manufacturer:

1. Honeywell – IS310WH

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2. Approved equivalent

2.9 POWER SUPPLY

A. Manufacturer:

1. Altronix Power Supply (ACMCB)
   a. Provide two (2) 12V 5ah Batteries
2. Approved Equivalent

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Prior to installation, a site survey must be performed to determine equipment placement. Any issues with the systems, design, or installation must be brought to the attention of the Technology Designer and Construction Manager before the bid is submitted.

C. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

D. Notify the Construction Manager of any conditions that would adversely affect installation or subsequent use.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Review project plan with Technology Designer and Owner to clarify Owner requirements before installation. Create detailed project planning and publish documents for review and approval.

1. Complete system diagnostics and operation verification.
2. Prepare a specific plan for system testing, startup, and demonstration.
3. Develop acceptance test concept and, on approval, develop specifics of the test.

C. The Contractor shall install and configure the system according to the manufacturer's sequence and guidelines as well as generally accepted standard practices.

D. Contractor will provide floorplans/maps in the system software showing the location of doors on the access control system. Maps will include visual notifications based on created events.

E. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.

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F. The Contractor shall protect equipment and components during installation until final acceptance of the project, and clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer.

G. All security devices (proximity readers, keypads, etc.) shall be installed according to ADA requirements.

H. Contractor will integrate with ADA operators to automatically fire and open the door without any further action than presenting a credential at the respective reader. Verify with owner whether this will be configured globally or on an individual user level. Provide any relays or miscellaneous equipment and labor required to successfully implement this feature.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3.4 TRAINING

A. Perform training on any updates in software and any modifications to the software.

1. Contractor to perform two (2) 2-hour training sessions for administrators of the system.

3.5 DOCUMENTATION

A. As-Built Documentation: In addition to the requirements listed in section 27 0000 or 28 0000, include the following:

1. Composite floorplan drawing of each building indicating controlled access location, reader type and system identification, and descriptive title.

3.6 WARRANTY

A. The following warranties shall be provided by the awarded contractor at no additional cost to the Owner.

1. Include a three (3) year complete warranty, including product maintenance/software updates. The awarded contractor will be required to replace any defective product at no additional cost, including labor. The warranty shall cover defects in equipment, workmanship, materials, or system configuration.

B. Final payment shall not relieve the awarded contractor of these obligations.

END OF SECTION 28 1300

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SECTION 28 1350 – ENTRY VIDEO INTERCOM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 - General Technology Requirements
2. 27 1000 - General Cabling Requirements

1.2 SUMMARY

A. This Section includes the following major components related to the security system:

1. IP Entry Intercom
2. Master Station / Answering Device

B. Related work provided by others:

1. Phone System
2. Access Control System
3. Client Computers

C. The awarded contractor will be required to procure and install building signage at each entrance with an entry intercom.

D. The intent of this project is to install a new video entry system at each building. The general requirements include:

1. New “turnkey” entry system.
2. High quality images enabling the receptionist to clearly identify individuals.
3. Allow the receptionist to respond to the visitor, reply with instructions, and unlock the door for entry.

1.3 DEFINITIONS

A. FBO: Furnished By Owner
B. FCC: Federal Communication Commission
C. FF: Fixed Focus
D. IR: Infrared
E. LAN: Local Area Network
F. PoE: Power over Ethernet, IEEE 802.3af standard
G. PoE+: Power over Ethernet, IEEE 802.3at standard
H. TR: Telecommunication Room
I. UPS: Uninterruptible Power Supply
J. UTP: Unshielded Twisted Pair
K. VLAN: Virtual Local Area Network

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L. VMS: Video Management System

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Entry Intercom
2. Master Station

1.5 QUALITY ASSURANCE

A. Contractor must provide evidence that all installation staff have attended manufacturer training.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NECA 1.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: For outdoor locations or locations in a hazardous environment the intercom must meet the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.
2. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

1.7 COORDINATION

A. A separate low-voltage cabling contractor will install new Category 6 cabling to the accessible ceiling near new entry intercom locations. This contractor will coordinate with the cabling contractor regarding the installation and final terminations of the new data cabling. This contractor is responsible for coordinating the intercom cabling locations with the data cabling contractor; for making any penetrations between the accessible ceiling and final intercom location, and for the patch cable to connect from the accessible ceiling to the intercom location.

B. Coordinate layout and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

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C. Coordinate layout and installation of equipment with existing conditions, door operators, ADA operators, access control system, etc.

D. Coordinate requirements and installation with the Owner's technical staff regarding firewall, proxy server, network address translation (NAT), Quality of Service (QoS), IP addressing, etc.

E. Coordinate with the Owner for configuration to integrate with the existing ShoreTel phone system.

F. The awarded contractor will work with the Owner to evaluate and devise a proper VLAN quality of service (QoS) strategy. These strategies will be deployed during this Project. Deployment of the applicable VLANs and QoS settings will configured/deployed by an Owner's representative.

PART 2 - PRODUCTS

2.1 DOOR STATION CAMERA INTERCOMS

A. IP Intercom Specifications

1. General Requirements:

a.	IP Telephone:	Hands free IP SIP 2.0 speakerphone with echo cancellation
b.	Power Source:	PoE (802.3af or 802.3at)
c.	Integrated Camera:	1280x960 minimum Onvif camera
d.	Call Buttons:	One Call button must have integrated braille or the Contractor must install a braille label under/adjacent to the call button. Provide sample for Owner's approval.
e.	Visual Notifications:	Light/pictogram to indicate when receptionist is speaking to visitor Light/pictogram when door is unlocked
f.	Receptionist Interface:	Support web-based, physical answering unit, and IP telephone.
g.	Management Interface:	Web-based
h.	VMS Integration:	Yes
i.	Access Control Integration:	2 independent outputs to support remote door control using DTMF codes
j.	Access Control Reader:	No
k.	Warranty:	3 years

2. Accessories:

   a. Provide appropriate mount back box for each location to mount intercom for best visibility by receptionist for where typical user would stand, or for the existing conditions (e.g. surface mount box, angled bracket, etc.).

3. Cabling:

   a. Existing intercoms have a network cable installed or it will be installed by others. This contractor to extend as needed to new intercom location using a longer patch cable if no service loop is available.
   b. Install an 18/2 communication cable between each new intercom location and the associated door controller. Contractor to survey buildings with project team and Owner to review door controller locations.

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c. Provide conduit for any exposed cabling.

4. Installation:

a. Configure software on receptionist computer to view entry camera image and allow for door release.
b. Configure intercom to call the receptionist's master station / answering unit.
c. Configure intercom as SIP phone to call the receptionist, other phones, or a hunt group and integrate with existing access door controller to release door with key sequence from existing IP phones.
d. Include all mounting hardware, installation, and configuration.
e. Installation must meet ADA requirements.
f. Integrate with handicap door controllers.
g. Provide angled bracket where necessary for the camera to aim at the visitor while the visitor is standing in front of the entry door.
h. Install the answering unit at the receptionist desk.

5. Manufacturer

a. 2N Helios IP Force [Exterior basis of design]
b. 2N IP Verso [Interior basis of design]
c. Approved equivalent

2.2 VIDEO MASTER STATION / ANSWERING UNIT

A. In addition to the master station, provide software/licensing to allow the receptionist computer to view the video feed and configure as a SIP phone station and program the intercom to call the receptionist phone or hunt group.

B. General Requirements

1. IP Telephone: Hands free IP SIP 2.0 speakerphone
2. Power Source: PoE (802.3af)
3. 7" Touchscreen
4. LAN: Ethernet 10/100BaseT, RJ-45
5. WiFi: No
6. Power Adapter: Yes
7. Mount Type: Desk

C. Cabling

1. Provide patch cable to the desk Cat 6 cable. Identify patch panel and switch port and coordinate port configuration with the Owner.

D. Installation

1. Configure with entry intercom to view the live camera feed, provide 2-way audio communication with users, and unlock the entry door.

E. Manufacturer

1. 2N Indoor View
2. 2N Indoor Touch 2.0
3. Approved equivalent

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2.3 DOOR SIGNAGE

1. General Requirements:
   a. Size: 12”x12” max
   b. Material: Aluminum, rigid plastic, or other outdoor rated material.
   c. Lettering: Review size and layout options with Owner. Include braille lettering.
   d. Wording, layout, and format to be created by the Owner.

2. Installation:
   a. Coordinate the placement of signage at each building with Owner or owner’s representative. Use installation method appropriate for each locations’ conditions and materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor’s responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. The Contractor shall meet and work with the Owner’s staff and Technology Designer to coordinate the system operation, camera locations, camera focal areas, and integration.

C. Prior to installation, a site survey must be performed to determine equipment placement.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Contractor shall install and configure the system according to the manufacturer’s sequence and guidelines as well as generally accepted standard practices.

B. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.

C. The Contractor shall protect equipment and components during installation until final acceptance of the project, and clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer.

D. Pre-Installation

   1. Contractor to coordinate rough in requirements with the architectural and electrical contractors.
   2. Contractor to review intercom naming conventions with Owner.

E. Contractor to provide turn-key installation. See installation information in each Product section above.

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3.3 DEMONSTRATION

A. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.

B. Develop site specific training modules and materials for the following:

1. Configuration of the intercom
2. Answering an intercom call
3. Initiating intercom discussion with visitor
4. Releasing the door

C. The Contractor's trainer will supply system documentation and training aids customized to this installation. Documentation shall be tailored for system administrators and typical users.

1. Include training for the IT staff on the administration of the system.
2. Include training for the office staff after installation and testing. Training will need to be coordinated with the office staff and may not occur at the time of installation.

3.4 SYSTEM ADJUSTMENTS

A. After initial setup and use, contractor is to include one trip to each building to review usage with building administrators and to adjust intercom's viewing angle, etc.

3.5 DOCUMENTATION

A. Document configuration settings for the entry intercom and master station.

B. Provide a spreadsheet for all equipment to include:

1. Manufacturer, model number, and serial number
2. Device name and IP address
3. IDF and patch panel port connected to

C. Letter or tabloid sized composite floorplan drawing of each building indicating intercom locations, door controller locations, telecommunication closet location, and cable pathways.

D. Warranty information including contact information and expiration dates.

E. All documentation is to be delivered in electronic format.

3.6 WARRANTY

A. Include a three (3) year complete warranty, including product maintenance/software updates. The awarded contractor will be required to replace any defective product at no additional cost, including labor. The warranty shall cover defects in equipment, workmanship, materials, or system configuration.

END OF SECTION 28 1350

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SECTION 28 1600 – INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements
3. 28 1300 – Access Control
4. 28 2300 – Video Surveillance

1.2 SUMMARY

A. This Section includes the following major components related to the security system:

1. Main Control Panels
2. Infrared/Motion Sensors
3. Dial-out Requirements
4. Monitoring

B. This Section includes the following:

1. Intrusion detection with hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
2. Responsibility for integrating electronic and electrical systems and equipment.

C. Related work provided by others:

1. Electrical system
2. Public address system
3. Phone system

D. Configure system to disarm upon first authorized entry each morning of the access control system or via the receiving door keypad. System to arm at preset times each day, with varying schedules for weekdays, weekends, holidays, and school breaks. Review schedule and requirements with Owner and Technology Designer.

1.3 DEFINITIONS

A. LCD: Liquid-crystal display.

B. LED: Light-emitting diode.

C. PIR: Passive infrared.

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D. RFI: Radio-frequency interference.

E. UPS: Uninterruptible power supply.

F. Partition: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

G. Zone: A specific sensor (door contact, motion sensor, etc.) within a Partition.

H. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of an intruder in a protected zone.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats including dimensions and data on features, performance, electrical characteristics, ratings, and finishes. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Main Control Panels
2. Infrared/Motion Sensors

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

B. The Contractor will coordinate network communication requirements with the owner.

C. The Contractor will coordinate testing with the Owner and monitoring company. The district’s current monitoring company is EPS Security 800.966.9199.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following are acceptable manufacturers for general equipment within this section, unless noted otherwise for any product. Any substitutions must me demonstrated to the Owner and Technology Designer for approval in writing before installation.

1. NAPCO
2. Bosch
3. Approved equivalent

2.2 SYSTEM REQUIREMENTS

A. Integrate with the Continental Access control system.

B. Provide the most current release of software and patches at the time of implementation.

2.3 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.

B. System Control: Central-station control unit shall directly monitor intrusion detection devices**,** temperature sensors and boiler sensors with connecting wiring in a multiplexed distributed control system or as part of a network.

C. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

D. Operator Commands:

1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
5. Protected Zone Test: Initiate operational test of a specific protected zone.
6. System Test: Initiate system-wide operational test.
7. Print Reports.

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E. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

F. Response Time: Two seconds between actuation of any alarm and its indication at central-station control unit.

G. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

H. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

I. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.4 SYSTEM COMPONENT REQUIREMENTS

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads according to manufacturer and regulatory requirements. Include surge protection for external wiring of each conductor entry connection to components.

B. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.

2.5 SECURE AND ACCESS DEVICES

A. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.

2.6 PIR SENSORS

A. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.

1. Wall-Mounting Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet (15 m). Provide adjustable coverage pattern as indicated on the drawings.
2. Ceiling-Mounting Unit Spot-Detection Pattern: Full 360-degree conical not less than 70ft diameter.
   a. Coverage Information
      1) Coverage is 360° x 21 m (70 ft) diameter when the detector is mounted between 3.7 m and 7.6 m (12 ft to 25 ft) high.
      2) Coverage is 15 m (50 ft) diameter when the detector is mounted at 3 m (10 ft) high.

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3) Coverage is 12 m (40 ft) when the detector is mounted at 2.4 m (8 ft) high.
4) The pattern consists of 69 zones in 21 barriers. Each barrier is 11 m (35 ft) long and 1.5 m (5 ft) wide at 11 m (35 ft). The barriers are grouped into three groups of seven barriers each. Each group has vertical adjustment for customized coverage.

b. Mounting Considerations
1) A height range of 3 m to 7.6 m (8 ft to 25 ft) is recommended. The detectors can be mounted directly to the ceiling or to a standard 10.2 cm (4 in.) octagonal electrical box. Coverage is adjustable by ±10° horizontally and +2° to -18° vertically

B. Device Performance:

1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across 2 adjacent segments of detector's field of view.
2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.
3. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

2.7 CENTRAL-STATION CONTROL UNITS

A. Construction: Modular, with separate and independent alarm and supervisory system modules. Arrangements that require removal of field wiring for module replacement are not acceptable.

B. Alarm Indication: Audible signal sounds and a plain-language identification of protected zone originating the alarm appears on LED, LCD display at central-station control unit.

1. Alarm activation must send alert notification to users and initiate an audible alert.

C. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Include the following:

1. Acknowledge alarm.
2. Silence alarm.
3. System reset.
4. LED test.

D. Resetting Controls: Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists.

A. Alphanumeric Display and System Controls: Arranged for interface between operator at central-station control unit and addressable system components, including annunciation, supervision, and test.

1. Display: LCD, 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
3. <u>Built-in proximity reader to use of a proximity card as replacement for a passcode</u>.
4. Color: white.

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B. Protected Zones:

1. Elementary schools will be configured as one protected zone.

C. Power Supply Circuits: Central-station control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 20 percent increase in load.

D. UPS shall be sized to provide continuous operation until the building generator comes online.

E. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.

2.8 CENTRAL-STATION CONTROL-UNIT SOFTWARE

A. Support:

1. Multiuser operator with multiple tasks for each user.
2. Support operation and management of all peripheral devices.
3. File management functions for disk I/O.
4. Printer spooling.
5. Monitor status of UPS.

B. Operator Commands:

1. Help.
2. Acknowledge alarm.
3. Place protected zone in Access.
4. Place protected zone in Secure.
5. Protected zone Test.
6. System Test.
7. Print Reports.
8. Change Operator.
9. Security Lighting Controls.
10. Display Graphics
11. Command Input Errors: Supervise inputs to ensure that they are correct for proper execution. Provide automatic help when a command cannot be executed due to operator input error.

C. System Access Control: Define system operator capability and functions through password-protected operations at three operator levels. Allow operator level change only by top-level operators and managers.

1. Activate tamper alarm after three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period.
2. Allow at least 32 passwords.
3. Display operator's name or initials in console's first field.
4. Report: Print operator's name or initials, action, date, and time on system printer at log-on and log-off. Do not display or print passwords.

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5. Define and assign passwords for the following:

   a. System commands.
   b. Access to system software.
   c. Access to application software.
   d. Individual protected zones to be accessed.
   e. Access to database.

D. Alarm-Monitoring Software: Monitor all sensors, central-station control units, UPS, and data transmission circuits and notify operator of an alarm condition. Print alarms in red on alarm printer and display on console's text and graphics map.

   1. Alarm Display:

      a. Display higher-priority alarms first.
      b. Oldest unacknowledged alarm has highest priority.
      c. Operator acknowledgment of one alarm is not acknowledgment of any other alarm and may not inhibit reporting of subsequent alarms.
      d. Type of alarm, location of alarm, and secondary alarm messages.
      e. Date and time (to nearest second) of occurrence and operator response.
      f. A unique message field with a width of at least 60 characters for each alarm. Allow operator to edit assignment of messages to a protected zone or sensor.
      g. 25 secondary messages shall have a field of 4 lines of 60 characters each to allow further information to be entered by operator for each alarm.
      h. Store most recent 1000 alarms and allow the data to be recalled, but not edited, by operator using the report generator.

E. Monitor Display Software: Display text and graphic maps that integrate protected zone status. Use for various components and real-time data. Use uniform color codes on all displays as follows:

   1. FLASHING RED to alert operator that a protected zone has gone into alarm or that primary power has failed.
   2. RED to alert operator that a protected zone is in alarm and that alarm has been acknowledged.
   3. YELLOW to advise operator that a protected zone is in access.
   4. GREEN to indicate that a protected zone is secure or that power is on.

F. System Test Software: Enable operator to initiate a test of entire system or a particular portion of system. Store results of each test for future display, or print them out in report form.

G. Report Generator Software: Commands to generate reports for displaying, printing, and storing on disk and tape. Store reports by type, date, and time and print each on report printer. Provide printer spooling. Generating reports shall not interrupt system operations. Allow operator to select report-generation mode, either periodic automatic or on request. Report headers shall automatically include time and date of printing and name of operator generating the report. Exact format of each report type shall be operator configurable. Allow operator to request, at any time, an immediate printout of any report.

   1. Periodic Automatic Report Modes: Allow for specifying, modifying, or inhibiting the report to be generated, time the initial report is to be generated, time interval between reports, end of period, and output peripheral.
   2. Alarm Report: Include all alarms recorded by the system over an operator-selectable time. Include such information as type of alarm (intrusion, tamper, etc.), type of sensor, location, time, and action taken.

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3. System Test Report: This report documents the operational status of all system components following a system test.
4. Access and Secure Report: This report documents all protected zones placed in access condition, time placed in access condition, and time placed in secure condition.

2.9 SYSTEM DIAL-OUT

A. System will include network based communication and include a cellular backup.

B. At each building, provide a system to dial out to up to eight (8) selected phone numbers including the Owner's central alarm monitoring company and Owner specified numbers.

C. System shall provide for power-fail alarm, low-battery alarm, and local notification of alarm condition.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. Prior to installation, a site survey must be performed to determine equipment placement. Any issues with the systems, design, or installation must be brought to the attention of the Technology Designer.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

E. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

F. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

A. The Contractor shall install and configure the system according to the manufacturer's sequence and guidelines as well as generally accepted standard practices.

B. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.

C. The Contractor shall protect equipment and components during installation until final acceptance of the project, and clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer.

D. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

3.3 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with manufacturer guidelines and requirements in the Contract Documents.

B. Perform the following field tests and inspections and prepare reports:

1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
2. Operational Tests: Schedule tests after pretesting has been successfully completed. Test all modes of system operation and intrusion detection at each detection device. Test for detection of intrusion and for false alarms in each protected zone. Test for false alarms by simulating activities outside indicated detection patterns.

C. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.4 DEMONSTRATION

A. Develop site specific training modules and materials for the following:

1. Arming and disarming entire buildings
2. Arming and disarming individual partitions
3. Keypad operation
4. Identifying fault locations
5. Central monitor procedures

B. Training Hours

1. Include (2) one-hour user training sessions for knowledge transfer for the administrators at each building.

C. The Contractor's trainer will supply system documentation and training aids customized to this installation. Documentation shall be tailored for system administrators and typical users.

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3.5 DOCUMENTATION

A. As-Built Documentation: In addition to the requirements listed in section 27 0000, include the following:

1. Provide a letter-size composite floorplan indicating partitions, sensor locations and door contacts with their designated labels. In addition to copies included in the as-built submission, provide one copy to each building office.

2. Provide a letter-size composite floorplan indicating partitions, sensor locations and door contacts with their designated labels to each building office stored in or on the outside of the control panel.

3. Provide an electronic copy composite floorplan indicating partitions, sensor locations and door contacts with their designated labels. In addition to copies included in the as-built submission, provide one copy to each building office.

4. Provide an AutoCAD or Revit drawing showing equipment types, equipment locations, cable routing, and zone designations. Provide as PDF and in native format.

END OF SECTION 28 1600

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SECTION 28 2300 – VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Sections:

1. 27 0000 – General Technology Requirements
2. 27 1000 – General Cabling Requirements
3. 27 1500 – Data and Voice Horizontal Cabling

1.2 SUMMARY

A. This Section includes the following major components related to the security system:

1. Servers and Storage
2. Video Management System (VMS)
3. Surveillance Cameras

B. Related work provided by others:

1. Electrical System
2. Network Equipment

C. Existing Network Infrastructure:

1. All buildings are connected via a leased internet connection to the district's data center located at the Hill Center. Most buildings have a 10GB connection.
2. The network is primarily based off Aruba 2920 series PoE+ switches. Contractor will need to provide power injectors for any cameras requiring more power.

D. Existing Video Surveillance System

1. The district has an existing Milestone Professional Plus video surveillance system that this contractor will expand.
   a. SLC: M01-C05-222-01-6C4D5F
   b. Current Care Expiration: 06/30/27
   c. New camera licenses are to co-term with this date
2. Each building currently has it's own local server(s) with the management server located in the data center at the Hill Center; but they will likely consolidate all servers to the Hill Center before this project finishes.

E. New Video Surveillance System Summary

1. The Contractor is responsible for providing, installing, patching, wire managing, labeling, configuration, and interconnecting video surveillance equipment as required to provide a complete turn-key video surveillance system.

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2. Coordinate with the Owner's designee to create an IP scheme, and coordinate IP addressing and camera naming on the system.
3. Configure all analytics according to the Owner's needs.
4. Provide all required end user and administrative training.

1.3 DEFINITIONS

A. B/W: Black & White
B. DAS: Direct-Attached Storage
C. DVR: Digital Video Recorder
D. FBO: Furnished By Owner
E. FCC: Federal Communication Commission
F. FF: Fixed Focus
G. IR: Infrared
H. ISM: Information Security Management
I. LAN: Local Area Network
J. MPEG: Moving Picture Experts Group
K. NAS: Network Attached Storage
L. NAT: Network Address Translation
M. NTP: Network Time Protocol
N. NTSC: National Television System Committee
O. NVR: Network Video Recorder
P. PD: Powered Device
Q. PoE: Power over Ethernet, IEEE 802.3af standard
R. PoE+: Power over Ethernet, IEEE 802.3at standard
S. PSE: Power Source Equipment
T. PTZ: Pan/Tilt/Zoom
U. PDU: Power Distribution Unit
V. QoS: Quality of Service
W. RF: Radio Frequency
X. SAN: Storage Area Network
Y. TR: Telecommunication Room
Z. UPS: Uninterruptible Power Supply
AA. UTP: Unshielded Twisted Pair
BB. VLAN: Virtual Local Area Network
CC. VMS: Video Management System
DD. WAN: Wide Area Network

1.4 GENERAL REQUIREMENTS

A. The VMS shall offer centralized management of all devices, servers and users, and offer a rule-based system driven by schedules and events.

B. The intent of this project is to expand the existing video surveillance system at the buildings and locations identified in the drawings. The general requirements include:

1. High quality images enabling the owner to clearly identify individuals.
2. Minimum of 31 days of video storage on all cameras.
3. Designated staff members will be able to view the IP surveillance system from their networked workstations. In addition, the awarded contractor will be required to setup and configure the VMS so that staff members will be able to view both individual cameras and the created "shared" views via an iOS and Android device within the District and from outside the District. The awarded contractor will be required to setup the server(s) so that "shared" views will be accessible outside the District. Furthermore, the awarded

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contractor will work in conjunction with the Owner's technical staff in setting up any firewall rules to accommodate the inbound and outbound network traffic.

4. Cameras must capture color images in normal light and black & white images in low light.
5. As applicable, the contractor will include any required separate power supplies and cabling for the heater/blower utilized by exterior cameras. Place these power supplies in telecommunication closets unless noted otherwise or agreed upon in writing during the pre-install walkthrough.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated, provide a product data sheet in both hard-copy and electronic (PDF) formats. Data sheets indicating multiple products must have the applicable product highlighted or marked.

1. Video Management Software
2. Surveillance Cameras (including applicable camera mounts and housings)

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NECA 1.

C. Comply with NFPA 70.

D. Electronic data exchange between video surveillance system with an access control system shall comply with SIA TVAC.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Products must withstand the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.
2. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
3. Interior Harsh/Humid Environments: System components located in interior areas where humidity levels may be high, unconditioned spaces, or there may be higher levels of chemicals in the air (i.e. natatoriums) shall be rated, listed, and installed to prevent damage to all system components including but not limited to cameras, mounts, cabling, etc. All items shall be warrantied against such damage.

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1.8 COORDINATION

A. Coordinate layout and installation of the work of this section with the Owner's equipment, furniture, electrical, mechanical, architectural, and other technology trades.

B. Coordinate layout and installation of surveillance or display equipment and suspension system components with other construction that penetrates ceilings or walls or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

D. Coordinate requirements and installation with the Owner’s technical staff regarding firewall, proxy server, network address translation (NAT), network time protocol (NTP), Quality of Service (QoS), IP addressing, etc.

E. The awarded contractor will work with the Owner to evaluate and devise a proper VLAN quality of service (QoS) strategy. These strategies will be deployed during this Project. Deployment of the applicable VLANs and QoS settings will configured/deployed by an Owner’s representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. After the bid opening the Owner will select the bidders whose proposals they feel best serve the district. Selection will be based on cost, functionality, installer references, etc. in determination of the most responsive bidder.

B. The following are acceptable VMS manufacturers for general equipment within this section, unless noted otherwise for any product.

1. Milestone Systems Professional Plus
2. Approved Equivalent

C. The following are acceptable camera manufacturers for general equipment within this section, unless noted otherwise for any product.

1. Avigilon (H5 series for analytic alternate pricing)
2. Axis Communications
3. Hanwha (P Series for analytic alternate pricing)
4. Approved Equivalent

D. Any substitutions must be demonstrated to the Owner and Technology Designer for approval in writing before installation.

2.2 SYSTEM REQUIREMENTS

A. Provide the most current release of software and patches at the time of implementation. Include costs of all software updates throughout the warranty period. At the end of the warranty period the Owner will be on the latest release of the software.

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B. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for the purpose.

C. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

1. Surveillance contractor will provide and install all exterior cameras with surge protection at the camera end.

2.3 VIDEO MANAGEMENT SYSTEM (VMS)

A. Alarms Support

1. The Contractor is to configure the system to send alerts to the system administrator for events such as:
   a. Camera block fully or partially (active tampering)
   b. If the surveillance camera image becomes blurred because of the camera being out of focus
   c. Loss of network connectivity
   d. Server hardware or storage issues

B. Maps

1. The Contractor will implement VMS mapping where digital maps are used to represent the physical location of cameras and other devices throughout the surveillance system.
2. Maps shall have hyperlinks to create a hierarchy of interlinked maps.

2.4 SERVER / STORAGE

1. Existing servers will be used. Contractor to provide requirements after contract award.
2. Contractor will be responsible for configuration changes and camera configuration in the existing system.

2.5 SURVEILLANCE CAMERAS

A. Basis of Design Cameras: Provide cameras meeting the specifications of the following cameras as a minimum.

1.	2MP	Axis P3265-LV/LVE
2.	5MP	Axis P3267-LV/LVE
3.	5MP Dual-Head Camera	Axis P4707-PLVE
4.	12MP Fisheye 360	Axis M3058-PLVE
5.	15MP Multisensor (4 Independent)	Axis P3719-PLE
6.	360 Multisensor	Axis P3727-PLE
7.	180 Panoramic Multisensor	Axis P3807-PVE

B. General Camera Requirements: Dome camera (unless noted otherwise), assembled and tested as a manufacturer unit, containing dome assembly, camera, zoom lens, receiver/driver.

1. Comply with UL 639.
2. Compression: H.264, H.265 or Motion JPEG

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3. Cameras shall produce usable images in low-light conditions to 1 lux (color) and .2 lux (B&W)
4. Cameras should capture color images in normal light and black & white images in low light.
5. Selectable modes for backlight compensation or normal lighting.
6. Camera bases to be cast aluminum with polycarbonate housings.
7. Provide and install adequate power supplies and cabling for camera requiring power beyond POE+
8. Unless noted otherwise, all cameras should be equipped with a varifocal lens.
9. Camera Management Application/Tool
   a. The camera manufacturer must offer a management application/tool to manage their cameras.
   b. The camera management application/tool will allow for the following features:
      1) Discovering of new devices (cameras)
      2) Providing unit status
      3) Device configuration
      4) Device management
      5) Firmware upgrades
      6) Cameras will be allowed to be tagged or grouped by physical location/building

C. General Lens Requirements: Optical-quality coated optics, designed specifically for video surveillance applications, and matched to specified camera. Provide color-corrected lenses with color cameras.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
2. Fixed Lenses: With calibrated focus ring.
3. Zoom Lenses: Motorized, remote-controlled units, rated as "quiet operating." Features include the following:

   a. Electrical Leads: Filtered to minimize video signal interference.
   b. Motor Speed: Variable.
   c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

D. Exterior Camera Requirements: Provide the appropriate mount for each installation type. Multi-lens camera.
1. Multi-lens cameras shown on the building exterior must include a corner mount, attachment accessories, and flexible outdoor conduit as necessary to complete the installation.
2. Multi-lens cameras shown mid-way on an exterior wall must include the required mount to provide horizontal installation to optimize the use of the cameras lens capabilities.
3. Single-lens cameras on the building exterior must include accessory sunshield or utilize a 90 degree mount to provide appropriate shielding from direct sunlight, weather, and UV exposure.

E. General Requirements

1. Day/Night IR capability
2. Minimum resolution is identified on the drawings.
3. Wide Dynamic Range (WDR)
4. Vandal-resistant housing
5. H.264 and H.265 compression
6. Onvif compliant
7. Remote focus and zoom for all lenses.

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8. Bandwidth reduction enabled.
9. Multi-sensor models shall require a single IP address and license unless otherwise noted.

2.6 CAMERA-SUPPORTING EQUIPMENT

A. General Requirements:

1. Alignment Provisions: Camera mounting allows for easy camera aiming and permits removal and reinstallation of camera-lens unit without disturbing camera alignment.
2. Rated for load in excess of the total weight supported times a minimum safety factor of two.
3. Outdoor Units: Rated for a wind load of 100 mph (160 km/h).
4. Camera Viewing Window: Polycarbonate lens aligned with camera lens.

B. Mounting Brackets for Fixed Cameras: Type matched to the items supported and mounting conditions. Include manual pan-and-tilt adjustment.

C. Protective Housings for Fixed and Movable Exterior Cameras:

1. Steel or vandal resistant polycarbonate dome, dustproof exterior enclosures with internal camera mounting and connection provisions that are matched to camera/lens combination and mounting and installation arrangement of camera to be housed.
2. Include built-in thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
3. Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the installed environment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the Contractor's responsibility to review the site work, architectural, structural, mechanical, and electrical drawings, specifications, and field conditions, for any details that may impact the installation or provisioning of the system.

B. The Contractor shall meet and work with the Owner's staff and Technology Designer to coordinate the system operation, camera locations, camera focal areas, and integration.

C. Prior to installation, perform a site survey to determine equipment placement. Any issues with the systems, design, or installation must be brought to the attention of the Technology Designer before the bid is submitted.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install and configure the system according to the manufacturer's sequence and guidelines as well as generally accepted standard practices.

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B. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.

C. The Contractor shall protect equipment and components during installation until final acceptance of the project, and clean all equipment before Owner acceptance using methods and materials recommended by the manufacturer.

D. Surveillance Cameras

1. The contractor shall carefully follow instructions in documentation provided by the manufacturer to insure all steps have been taken to provide a reliable, easy-to-operate system.
2. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation to provide the maximum field of view and security.
3. All firmware found in the products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the video management system. If in the event that a newer firmware revision is released by the manufacturer, during the project but prior to “final” acceptance, the awarded contractor will be required to deploy the latest firmware to the components/products (i.e. surveillance cameras).
4. All equipment requiring users to log on using a password shall be configured with user/site-specific password(s). No system/product default passwords shall be allowed.
5. The awarded contractor will be responsible for configuring each surveillance camera with a name chosen by the Owner along with its applicable configuration settings. The naming convention of the surveillance cameras will be discussed in the design meetings.
6. Review all exterior cameras with the owner and configure motion masking where the following conditions occur in the view:
   a. Tree branches and leaves
   b. Unwanted street traffic
   c. Activity on neighboring private properties
7. Review all cameras with the owner and create privacy masking on computer screens and other areas deemed necessary.
8. Contractor shall configure pre/post event triggers for 10 seconds on all cameras.

E. Interior Surveillance Cameras

1. When utilizing lay-in ceilings, the contractor is to install a security cable between each camera and the building structure or ceiling tile bridge so the camera is supported independent of the ceiling tile.
2. Install so the structured data cabling system is not visible after the surveillance camera has been securely mounted.
3. Some locations will require the surveillance camera to be mounted on a wall. In this case, the awarded contractor shall utilize Wiremold® V700® or equivalent metal raceway.
4. The Wiremold® V700® metal raceway shall consist of the raceway, appropriate fittings (i.e. mounting clips and straps, bushings, etc.) and device boxes for a complete installation.
5. Due to the width of the interior hallways and stairwells, the field of view/camera image may have to be rotated so that the optimal field of view is deployed. The awarded contractor should account for the necessary time to account for this task.

F. Exterior Surveillance Cameras

1. External mounts shall be sealed to prevent any water or environmental condition from entering the surveillance camera.
2. The structured data cabling system may not be visible at any time after the surveillance camera has been securely mounted.

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3. During the initial walkthrough, the awarded contractor will review the proposed mounting locations and determine the optimal height of each surveillance camera. The height of each surveillance camera shall provide that camera with the best quality of picture.
4. All exterior cameras are to be installed with surge protectors at the camera end.

G. Video Management System

1. Servers must be configured and fully installed before any internal or external cameras are mounted. Cameras are to be integrated and brought online as they are installed.
2. The awarded contractor shall meet with the Owner and Technology Designer, prior to installation, to discuss all aspects of the VMS and its storage component(s) (including recording, storage, archiving, retention, etc.)
3. The awarded contractor will be required to configure each of the surveillance cameras' properties (i.e. resolution, frame rate, sensitivity to motion, etc.) within the VMS.
4. Each server or storage component must be labeled with the applicable component name and IP address.
5. All firmware, including device packs, found in the VMS equipment and software shall be the latest and most-up-to-date provided by the manufacturer, or of a version as specified by the provider of the VMS.
6. All equipment requiring users to log on using a password shall be configured with user accounts from Microsoft® Active Directory. No system/product default passwords shall be allowed. In addition, the service accounts and system administrator shall utilize different passwords. As a direct result, if the system administrator password is modified, the various services will not be affected.
7. All permission levels, as directed by the Owner, will be configured by the awarded contractor. In addition, the awarded contractor will be required to link the Microsoft® Active Directory user groups within the VMS.
8. Each building will have its' own folder within the directory of buildings. The awarded contractor will be required to create all of the various folders. The names of the folders will be discussed within the initial design meetings. In addition, the awarded contractor will be required to create all default views within each building. All network cameras must be included in at least one default view. The default views must not contain a high number of cameras where the view slows down the various workstations or laptops. As a rule, eight (8) network cameras is the greatest number of cameras per view.
9. The awarded contractor will be required to implement the interactive mapping function of the VMS to enable users with the ability to preview a camera by "mousing over" a camera icon. In addition, all the exterior doors are labeled with number for life safety purposes. The contractor will include the door numbers on the mapping software. The number on each door will be provided by the Owner. Real-time updates of system components shall be displayed directly on the map. All building maps/images will be provided by an Owner's representative, except district level maps that will be created using satellite imagery by the contractor.
    a. Create a hierarchy of interlinked maps, starting from a broad view of the district, hyperlink to each site view for exterior cameras.
        1) Contractor to create an overview of the district utilizing satellite imagery with target hyperlinks at each precise building location.
    b. Create multi-layer hyperlinks at each site.
        1) Hyperlink from each site's exterior view to an interior view of each level of the building.
        2) Each level of the building will have its own hyperlinked map. Create an on-screen button to hyperlink between levels.
10. All interior and exterior cameras are labeled with a number for life safety and troubleshooting purposes. The surveillance contractor will work with the owner on a labeling scheme. Surveillance Contractor will label all cameras prior to installation. These numbers will be required to be transferred to the interactive mapping function. All labels must be rated for external conditions. Any labels that fall off during the warranty period

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are to be replaced at no cost to the Owner. The awarded contractor will be required to create a rule, within the VMS solution, that will notify the District administrators that a surveillance camera has lost its network connection. This particular rule must be applied to all surveillance cameras.

11. The “camera tampering” alert shall also be enabled within each network camera. In addition, the VMS must recognize the condition and alert the Owner if this condition is met. The contractor is to configure the alerts based on the Owner’s preference.
12. The VMS shall direct all cameras to obtain their time from a District specified NTP (Network Time Protocol) server. If the Owner doesn’t have an existing NTP server, the contractor shall configure the NTP on one of the security servers or through a third party.
13. Load balance each building’s cameras across multiple servers. If a server fails, the entire building will not suffer due to a camera outage.
14. Load balance all servers to prevent video loss due to over buffering (exceeding the processing limits of any single server).

H. Camera Management Application/Tool

1. Contractor to discover all network cameras and import them into the management application.
2. Each building will have its own folder. Within each building folder, each installed model will have its own folder.
3. Populate each camera within the appropriate folder to allow for simpler future camera management.

3.3 FIELD QUALITY CONTROL

A. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video surveillance equipment for acceptance and operational testing as follows:

1. Verify operation of auto-iris lenses.
2. Work with Owner and to set all varifocal lenses.
3. Set and name all preset positions; consult Owner's personnel.
4. Set sensitivity of motion detection.
5. Connect and verify responses to alarms.
6. Verify operation of control-station equipment.

3.4 SYSTEM ADJUSTMENTS

A. Before customer sign off takes a place, a walkthrough with the awarded contractor, building administration, IT Director and Technology Consultant will take place to approve field of views and focus of all surveillance cameras. The awarded contractor will have at least a total of three (3) personnel onsite to make changes during walkthrough for approval. One (1) staff member viewing the cameras and two (2) staff members making any necessary adjustments.

B. Six (6) months after initial setup and substantial completion, Contractor is to include one trip to each building to review VMS usage with building administrators and to adjust any individual camera’s viewing angle, etc.

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3.5 DOCUMENTATION

A. As-Built Documentation:
   1. All of the items below must be included in a three-ring binder that will be presented to the Owner during the "close out" meeting. The following items are to be a minimum:
      a. Awarded Contractor's Contact Information
      b. Contractor's Guarantee/Warranty
      c. VMS Licensing Information
      d. Operations & Maintenance Manuals/CDs
      e. Spreadsheet with the following for each server and camera
         1) Equipment manufacturer and model
         2) Serial Number
         3) MAC address
         4) IP address (if static IP addresses are used)
         5) Installed location (building and location description)
         6) Data cable number, closet location
         7) Network port information
   2. A set of drawings showing locations of all equipment locations and approximate cable paths.
   3. Documentation (including contact information) on the equipment warranties, warranty expiration, manufacturer and Contractor technical support number, and applicable software assurance(s)
   4. Manufacturer specification/cut sheets for the systems and equipment installed.
   5. Installation and programming manuals for all hardware and software components.

3.6 WARRANTY

A. Contractor is to register all equipment in the Owner's name, not the Contractor's. All manufacturer warranty and support must be available to the Owner directly and not required to channel through the Contractor, distributor, or other entity.

B. The Contractor warrants the system to be free of defects of workmanship or products and will inspect and repair the system within twenty-four (24) hours during the warranty period at no additional cost to the Owner. The Contractor shall respond on site within four (4) hours notice, and without cost to the Owner, during this warranty period. Contractor agrees to correct system deficiencies and replace components that fail in materials or workmanship including deficiencies arising when used according to the manufacturer or Contractor's written instructions. No warranty or terms therein shall limit or be interpreted to limit remedies as provided by law.

C. Warranty Duration
   1. All equipment will be provided with a five (5) year hardware and software warranty unless noted otherwise.

D. Contractor will be responsible for servicing any new servers during the warranty period. Contractor will be responsible to coordinate camera replacement and shipping, though the Owner can physically install warranty cameras.

E. Bidders are to extend the same hardware and software warranty duration for their entire proposed base bid and alternate solution(s) whether the item is to comply with the base bid or whether it is a value-added benefit of the solution not specifically requested in the specifications but provided as part of the proposed solution.

F. The warranty shall include phone support and software assurance including patches, updates and version upgrades for both major and minor releases throughout the warranty period.

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G. The Owner shall not be responsible for additional charges during the equipment warranty period. Labor, service charges, trip charges, etc. to configure and install equipment during the warranty period shall be included in the contractor's warranty.

H. Contractor is to provide documentation for all manufacturer's warranties including the operating conditions required for the warranty.

I. Contractor is also to provide terms of any additional warranties as a manufacturer's standard. Special warranty specified shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

END OF SECTION 28 2300

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Delegated Design

1. This specification is a performance-based specification, and the Contractor shall be fully responsible for engineering and providing the Fire Alarm System necessary to meet the specified requirements and as required by the codes associated with the building.
2. The Contract Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, device locations and profiles of units. The Contractor shall provide engineered shop drawings for review and submission to the authority having jurisdiction. Field verify and coordinate with other trades, the device and equipment locations, and cable/circuit routing.

B. Section Includes:

1. Fire-alarm control panel.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. Radio alarm transmitter.
11. System printer.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NAC: Notification Appliance Circuit.

C. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction **prior** to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified fire-alarm technician, Level III minimum.
   c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Delegated-Design Submittal: For notification and initiation appliances, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification and initiation appliance, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

E. Qualification Data: For qualified Installer.

F. Field quality-control reports.

G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control panel.
7. Copy of NFPA 25.
8. Software and Firmware Operational Documentation:
    a. Software operating and upgrade manuals.
    b. Program Software Backup: Transmitted electronically, complete with data files.
    c. Device address list.
    d. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project, with a minimum NICET certification of Fire Alarm Level II.

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 WARRANTY

A. Special Warranty for Fire Alarm System: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period. Manufacturer may exclude lightning damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period: Two years from date of Substantial Completion.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Strobe Units: Quantity equal to 10 percent of amount installed, no more than 10, but no fewer than 1 unit.
2. Smoke Detectors and Heat Detectors: Quantity equal to 10 percent of amount of each type installed, no more than 10, but no fewer than 1 unit of each type.
3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Keys and Tools: One extra set for access to locked and tamper-proofed components.
5. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. National Time & Signal Corporation
   2. Siemens Building Technologies, Inc.; Fire Safety Division.
   3. Faraday; Siemens Building Technologies, Inc.
   4. Federal Signal Corporation.
   5. Gamewell; a Honeywell Fire Systems Company.
   6. NOTIFIER; a Honeywell Fire Sysytems Company.
   7. Edwards System Technologies.
   8. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

   1. Manual stations.
   2. Heat detectors.
   3. Smoke detectors.
      a. Spot type
      b. Air aspirated type
   4. Automatic sprinkler system water flow.
   5. Fire-extinguishing system operation.

B. Fire-alarm signal shall initiate the following actions:

   1. Continuously operate alarm notification appliances.

      a. Visible notification appliances shall operate until FACP is reset.
      b. Audible notification appliances shall be capable of being manually reset.

   2. Identify alarm at fire-alarm control panel and remote annunciators.

3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

    a. Where return air duct or plenum capacity is 2000 CFM (0.9 cubic m/s) or more, de-energize heating, ventilating, and air-conditioning equipment serving zone where alarm was initiated.
    b. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
    c. Transmit alarm signal per air-handling zone to building energy management system.
    d. For Kitchen Hood Fire Extinguishing System Activation, open shunt-trip circuit breakers and close natural gas valves.

8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Activate emergency lighting control.
12. Activate emergency shutoffs for gas and fuel supplies.
13. Record events in the system memory.
14. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control panel.
4. Ground or a single break in fire-alarm control panel internal circuits.
5. Abnormal ac voltage at fire-alarm control panel.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control panel or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.
11. Emergency generator:
    a. Generator trouble
    b. Generator running

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control panel and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL PANEL

A. General Requirements for Fire-Alarm Control Panel:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

   a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control panel.
   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
   c. Manual pull stations.
   d. Interface modules.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control panel and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 lines of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

2. Serial Interfaces: Two RS-232 ports for printers.

D. Door Controls: Door hold-open devices: Install no more devices on the circuit than recommended by the manufacturer, while leaving 25% spare capacity on the circuit.

Devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

E. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control panel.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

   a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
   b. Programmable tone and message sequence selection.
   c. Standard digitally recorded messages for "Evacuation" and "All Clear."
   d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control panel.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

H. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.
2. Battery and Charger Capacity: Comply with NFPA 72, but not less than 24 hours normal operation and 30 minutes alarm operation.
3. Housing: Size FACP housing to accommodate batteries without use of separate enclosures.

K. Surge Protection:

1. Install surge protection on normal ac power for FACP and its accessories.
2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to building housing FACP.

L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control panel.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control panel.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control panel for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control panel.

    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control panel for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control panel to operate at 135 or 155 deg F.
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control panel and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control panel, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control panel and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control panel, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
7. Ambient temperature rating -4˚F to +152˚F.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 degree F or a rate of rise that exceeds 15 degree F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control panel.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 degree F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control panel.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

a. 15 cd, unless otherwise indicated on the Drawings.
b. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place. Wire guards shall be provided on devices installed in gym and locker room areas.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, **white**.

D. Weatherproof Bells: Electric-vibrating, 24-V dc, under-dome type; with provision for housing operating mechanism behind bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet (3 m) from bell. 10-inch (254-mm) size, unless otherwise indicated.

E. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Flush.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated. Units shall have a 3.625” minimum depth from the wall.
3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control panel for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control panel, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control panel. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

C. Interactive Graphic Display annunciation panel -

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal **to** circuit-breaker shunt trip for power shutdown, to heating, ventilating, and air conditioning equipment controllers for power shutdown, to close smoke dampers, to release magnetic door holders, electric locks, and coiling doors and grilles, to transmit signal to building management systems, to circuit-breaker shunt trip for power shutdown to the elevator.

2.11 NAC PANELS

A. General Description: Power-limited design, UL 864 listed.

B. Notification-Appliance Circuits: NFPA 72, Class and Style to match FACP.

C. Alarm Silencing: On-until-silenced for horns, on-until-reset for visible notification appliances. Reset and silence switches located at FACP and remote annunciators.

D. Synchronize visual notification appliances.

E. System Layout: Load notification-appliance circuits no more than 70 percent of rated capacity.

F. Total Rated NAC Current: 8 amps.

G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Notification appliances shall be powered by the 24-V dc source.

H. Alarm current draw of entire NAC panel shall not exceed 80 percent of power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

J. Batteries: Sealed lead calcium.

K. Battery and Charger Capacity: Comply with NFPA 72, but not less than 24 hours normal operation and 30 minutes alarm operation.

L. Power supply/charger shall be supervised for power loss, brownout, batteries, and ground faults.

M. Surge Protection:

1. Install surge protection on normal ac power for NAC panel.
2. Install surge protectors recommended by NAC panel manufacturer. Install on all system wiring external to building housing NAC panel.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control panel and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control panel.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address or Zone of the supervisory signal.
3. Address or Zone of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity shall comply with NFPA 72 requirements, but not less than 24 hours.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

2.14 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG.

C. Power-Limited and Non-Power-Limited Circuits other than Signaling Line Circuits: Solid-copper conductors with 600-V rated, 75 degree C, color-coded insulation.
1. Low-Voltage Circuits: No. 14 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, galvanized steel armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install wall-mounted fire-alarm control panel with tops of cabinets not more than 72 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
5. HVAC: Locate detectors not closer than 5 feet from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. For Boiler Rooms and Kitchens, provide 190 degree F (88 degree C) fixed heat detectors.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

1. Furnish and install duct smoke detectors associated with air handling equipment and life safety dampers, fire alarm communication modules, power, and all necessary wiring. Refer to mechanical floor plans and temperature control drawings for life safety damper locations and duct detectors associated with air handling units. Provide the quantity of duct detectors recommended by the manufacturer for the installed duct configuration.

F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

1. Install in ceiling below duct smoke detectors.
2. Locate in public space near the device that they monitor. Do not install in normally unoccupied spaces.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Fire-Alarm Control Panel: Mount with tops of cabinets not more than 72 inches above the finished floor.

M. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

N. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist [**100-mph**] wind load with a gust factor of 1.3 without damage.

O. NAC Panels: Provide quantity of NAC panels requires for notification appliances indicated.

1. Provide a smoke detector in ceiling above each NAC panel.
2. Provide 120V, 20amp AC circuit to each NAC panel.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wall mounted conduit below 10’ shall be concealed

C. Wiring Method: Install wiring in conduit or provide NFPA 70, Type MC cable. Do not use open cable wiring methods.

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with fire alarm system, may not contain any other wire or cable.
2. Signaling Line Circuits: Power-limited fire alarm cables may be installed in same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (Metric designator 27) conduit between the FACP and transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated air-conditioning duct systems.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches (including automatic sprinkler system water flow, valve tampers, and positive indicator valve tampers).
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at kitchen hood fire extinguishing system.
10. Supervisory connections at elevator shunt trip breaker.
11. Supervisory connections at fire-pump engine control panel.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control panel.

3.5 PROGRAMMING

A. Program the fire alarm system to function as indicated and per code.

B. Program the fire alarm system to recognize the location of the unit in alarm. The alarmed unit or zone shall be displayed in the alphanumeric display per the Owners direction, using the Owner’s final room numbering, room naming convention or area of the building which will allow easy identification of the unit in alarm.

C. Program the fire alarm system to recognize the location of each addressable unit using per the Owners direction, using the Owner's final room numbering, room naming convention or area of the building which will allow easy identification of addressable unit.

3.6 GROUNDING

A. Ground fire-alarm control panel, NAC panels, and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control panel and NAC panels.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of

Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Protecting existing trees to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities, and abandoning site utilities in place.
7. Maintaining existing and providing Temporary erosion and sedimentation control.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing and imported topsoil; the zone where plant roots grow.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings and as indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Project site that should include a representative from the Lansing School District.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or video recordings.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide signed detours around closed or obstructed roadway as approved by authorities having jurisdiction.

B. Utility Locator Service: Notify Miss Dig 811 for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

D. Tree and Plant Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection" and as shown on the plans.

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged facility to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Maintain existing and provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair existing and proposed erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection" and as shown on the plans.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Do not stockpile topsoil within protection zones.
   2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning of any waste material or vegetation is prohibited.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks, pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities for buried utility structures.

B. Related Requirements:
1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
3. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owners representative.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owners representative. Unauthorized excavation, as well as remedial work directed by Owners representative, will be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at the Project site.
   1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
      a. Personnel and equipment needed to make progress and avoid delays.
      b. Coordination of Work with utility locator service.
      c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
      d. Extent of potential existing non-hazardous material.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D2487.
   2. Laboratory compaction curve according to ASTM D698 or ASTM D1557.

1.5 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Miss Dig" 811 for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

E. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification [Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487], or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification [Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability:
      a. Class 2; AASHTO M 288.
      b. As follows:
         1) Grab Tensile Strength: 157 lbf; ASTM D4632.
         2) Sewn Seam Strength: 142 lbf; ASTM D4632.
         3) Tear Strength: 56 lbf; ASTM D4533.
         4) Puncture Strength: 56 lbf; ASTM D4833.
      c. Apparent Opening Size: No. 40 sieve, maximum; ASTM D4751.
      d. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
   1. Portland Cement: ASTM C150/C150M, Type I.
   2. Fly Ash: ASTM C618, Class C or F.
   3. Normal-Weight Aggregate: ASTM C33/C33M, 3/8-inch nominal maximum aggregate size.
   4. Water: ASTM C94/C94M.
   5. Air-Entraining Admixture: ASTM C260/C260M.
   6. Compressive Strength: 80 psi, when tested according to ASTM C495/C495M.

2.4 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. 24 inches outside of concrete forms other than at footings.
      b. 12 inches outside of concrete forms at footings.
      c. 6 inches outside of min. required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. 6 inches beneath bottom of concrete slabs-on-grade.
      f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Excavation for Underground Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
   1. Clearance: See Trench Detail in the contacts plans.

C. Trench Bottoms:
   1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
      a. See trench details on plans.

3.7 SUBGRADE INSPECTION

A. Notify Owners representative when excavations have reached required subgrade.

B. If owner’s representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the owner’s representative, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owners representative, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Owners representative.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owners representative.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring, bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Trenches under Roadways: See trench detail on plans.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:
   1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
      a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
   2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use 4 inches of satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698 or ASTM D1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
   3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
   4. For utility trenches (not under roadways), compact each layer of initial and final backfill soil material at 85 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
   1. Turf or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 0.5 inches.
   3. Pavements: Plus or minus 0.5 inches

C. Grading inside Building Lines: Finish subgrade to a tolerance of 0.5 inches when tested with a 10-foot straightedge.

3.16 SUBSURFACE DRAINAGE

A. Subsurface Drain: See plans for additional information.

B. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
   1. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
   2. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698 or ASTM D1557.

3.18 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified inspector to perform the following inspections:
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material classification and maximum lift thickness comply with requirements.
   3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owners representative.

E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Owners representative; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hot mix asphalt (HMA) paving.

B. Related Requirements:
   1. Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
   2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
   3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
   4. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer.

B. Material Certificates
   1. Aggregates.
   2. Asphalt binder.
   3. Asphalt cement.
   4. Cutback prime coat.
   5. Emulsified asphalt prime coat.
   6. Tack coat.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Michigan Department of Transportation pre-qualified.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Prime Coat: Minimum surface temperature of 60°F.

2. Tack Coat: Minimum surface temperature of 60°F.
3. Asphalt Base Course and Binder Course: Minimum surface temperature of 45°F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60°F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692, sound; angular crushed stone, crushed gravel, or cured.

C. Fine Aggregate: ASTM D1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: See plans for additional information.

B. Asphalt Cement: See plans for additional information.

C. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: See Geotechnical Report.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

A. Hot-Mix Asphalt: See Geotechnical Report

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner Representative, and replace with compacted backfill or fill as directed.

3.3 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated on the plans.
   2. Spread mix at a minimum temperature of 250°F.
   3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
   2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185°F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Average Density: See Geotechnical Report for additional information.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
   1. Base Course and Binder Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course and Binder Course: 1/4 inch.
   2. Surface Course: 1/8 inch.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979 or AASHTO T 168.
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041, and compacted in accordance with job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726.
      a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950 and coordinated with ASTM D1188 or ASTM D2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete paving including the following:
   1. Driveways.
   2. Roadways.
   3. Dumpster/Service Area.
   4. Curbs and gutters.
   5. Walks.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
   2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
   3. Section 321723 "Pavement Markings."
   4. Section 321726 "Tactile Warning Surfacing" for detectable warning surface.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
   1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.4 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884, Class A, plain steel.

D. Reinforcing Bars: ASTM A615, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A767, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A775 or ASTM A934; with ASTM A615, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A184; with ASTM A615, Grade 60 deformed bars; assembled with clips.

H. Deformed-Steel Wire: ASTM A1064.

I. Joint Dowel Bars: ASTM A615, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

J. Epoxy-Coated, Joint Dowel Bars: ASTM A775; with ASTM A615, Grade 60 plain-steel bars.

K. Tie Bars: ASTM A615/A615M, Grade 60; deformed.

L. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

M. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
   2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

N. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

O. Zinc Repair Material: ASTM A780.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
   1. Portland Cement: ASTM C150. See Geotech Report for additional information.
   2. Fly Ash: ASTM C618, Class C or Class F.
   3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33, Class 4S uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

C. Air-Entraining Admixture: ASTM C260.

D. Water: Potable and complying with ASTM C94.

2.5 CURING MATERIALS

A. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

2.7 CONCRETE MIXTURES

A. Prepare design mixtures in accordance with the Geotechnical Report.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
   1. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
   1. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows**,** to match jointing of existing adjacent concrete paving:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

E. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

F. Screed paving surface with a straightedge and strike off.

G. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

H. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

I. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.7 INSTALLATION OF DETECTABLE WARNINGS

A. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by curing compound as follows:
   1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
   4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
   5. Lateral Alignment and Spacing of Dowels: 1 inch.
   6. Vertical Alignment of Dowels: 1/4 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

C. Test results to be reported in writing to Owners representive, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner representative but will not be used as sole basis for approval or rejection of concrete.

E. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner representative.

F. Concrete paving will be considered defective if it does not pass tests and inspections.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Owner representative.

B. Drill test cores, where directed by Owner representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Cold-applied, fuel-resistant joint sealants.
4. Hot-applied, fuel-resistant joint sealants.
5. Joint-sealant backer materials.
6. Primers.

B. Related Requirements:
1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.2 QUALITY ASSURANCE

A. Qualifications:
1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.3 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40°.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893, Type SL.

C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
1.

E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.

2.4 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant, Type IV: ASTM D6690.

B. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

C. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

D. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

E. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of joint-sealant backer materials.
   2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
   3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
   1. Place joint sealants so they fully contact joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   1. Remove excess joint sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joints within concrete paving:
   1. Joint Location:
      a. Expansion and isolation joints in concrete paving.
      b. Contraction joints in concrete paving.
      c. Other joints as indicated.
   2. Joint Sealant: Single-component, self-leveling, silicone joint sealant.

END OF SECTION 321373

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Painted markings applied to asphalt paving.
   2. Painted markings applied to concrete surfaces.

B. Related Requirements:
   1. Section 099114 "Exterior Painting (MPI Standards)" for painting exterior concrete surfaces other than pavement markings.
   2. Section 099124 "Interior Painting (MPI Standards)" for painting interior concrete surfaces other than pavement markings.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of MDOT for pavement-marking work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55° for water-based materials, and not exceeding 95°.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint, Solvent-Borne: MPI #32, solvent-borne traffic-marking paint.
   1. Color: Yellow and Blue.

B. Pavement-Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than three minutes.
   1. Color: Yellow and Blue.

C. Pavement-Marking Paint, Latex: MPI #97, latex traffic-marking paint.
   1. Color: Yellow and Blue.

D. Glass Beads: AASHTO M 247, Type 1 or FS TT-B-1325D, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow asphalt paving or concrete surfaces to age for a minimum of 14 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
   1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
   2. Broadcast glass beads uniformly into wet markings at a rate of 6 lbs/gal.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 321726 - TACTILE WARNING SURFACE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cast-in-place detectable warning ductile iron tiles.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.
   1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

2.2 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
   1. Material:
      a. Cast Iron: Gray iron, ASTM A 48/A 48M, CL 35.
   2. Shapes and Sizes:
      a. Rectangular panel, 24 by 60 inches.
   3. Dome Spacing and Configuration: Manufacturer's standard compliant spacing, in manufacturer's standard pattern.
      a. Permanently embedded detectable warning tile wet-set into freshly placed concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Chain-link fences.
   2. Horizontal-slide, motor-operated gates.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, equipment bases/pads for gate operators and controls and post footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Fence and gate posts, rails, and fittings.
      b. Chain-link fabric, reinforcements, and attachments.
      c. Accessories: Cards and Card reader for security gate.
      d. Gates and hardware.
      e. Gate operators, including operating instructions and motor characteristics.

B. Shop Drawings: For each type of fence and gate assembly.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include accessories, hardware, gate operation, and operational clearances.
   3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
   4. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Installer shall repair or replace components of chain-link fences and motorized gates and related components that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to comply with performance requirements.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Faulty operation of gate operators and controls.
   2. Warranty Period: 1 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
   1. Design Wind Load: to meet local building codes.
      a. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

B. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
   1. Fabric Height: As indicated on Drawings.

2. Steel Wire for Fabric: As indicated on Drawings.
   a. Mesh Size: As indicated on Drawings.
   b. Polymer-Coated Fabric: As indicated on Drawings.
   c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.

2.3 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:
   1. Fence Height: As indicated on Drawings.
      a. Line Post: 2.875 inches in diameter
      b. End, Corner, and Pull Posts: 2.875 inches.
   2. Horizontal Framework Members: Intermediate, top and bottom rails according to ASTM F1043.
      a. Top Rail: 1.66 inches in diameter.
      b. Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A123/A123M or 4.0-oz./sq. ft. zinc coating according to ASTM A653/A653M.
   3. Polymer coating over metallic coating.
      a. Color: Black, according to ASTM F934.

2.4 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire according to ASTM A817 or ASTM A824, with the following metallic coating:
   1. Type I: Aluminum coated (aluminized).

B. Aluminum Wire: 0.192-inch-diameter tension wire, mill finished, according to ASTM B211, Alloy 6061-T94 with 50,000-psi minimum tensile strength.

2.5 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.
   1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Tension and Brace Bands: Pressed steel or Aluminum Alloy 6063.

E. Truss Rod Assemblies: Mill-finished aluminum rod and turnbuckle or other means of adjustment.

F. Tie Wires, Clips, and Fasteners: According to ASTM F626.

G. Finish:
   1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
      a. Polymer coating over metallic coating.
   2. Aluminum: Mill finish.

2.6 GATE OPERATORS

A. Operators: Factory-assembled, automatic, gate-operating system designed for gate size, type, weight, and frequency of use. Control system shall have characteristics suitable for Project conditions, with control stations, safety devices, and weatherproof enclosures.
   1. Operator design shall allow for removal of cover or motor without disturbing limit-switch adjustment and without affecting auxiliary emergency operation.
   2. Electronic components shall have built-in troubleshooting diagnostic feature.
   3. Unit shall be designed and wired for both right-hand/left-hand opening, permitting universal installation.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Standard: Manufacture and label gate operators according to UL 325.

D. Motors: Comply with NEMA MG 1.
   1. Duty: Continuous duty at ambient temperature of 0° F and at altitude of 1000 feet above sea level.
   2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
   3. Service Factor: 1.15.
   4. Electrical Characteristics:
      a. Horsepower: 2
      b. Voltage: 115 V ac, single phase, 60 hertz.

E. Control Devices:
   1. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide 10 programmable transmitter(s) with multiple-code capability, permitting validating or voiding of not less than 1000 codes per channel configured for the following functions:
      a. Transmitters: 10 Single-button operated, with open function.
   2. Telephone Entry System: Hands-free voice-communication system for connection to building telephone system, with digital-entry code activation of gate operator and auxiliary keypad entry.

3. Vehicle Loop Detector: System that includes automatic closing timer with adjustable time delay before closing**,** and loop detector designed to open and close gate, hold gate open until traffic clears. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, and as recommended in writing by detection system manufacturer for function indicated.
   a. Loop: Factory-preformed wire, in size indicated, for saw-cut and epoxy-grouted installation.
4. Vehicle Presence Detector: System that includes automatic closing timer with adjustable time delay before closing, and presence detector designed to hold gate open until traffic clears.

F. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
   1. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully open and fully closed positions.

H. Operating Features:
   1. Open Override Circuit: Designed to override closing commands.
   2. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
   3. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.

I. Accessories:
   1. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
      a. Fail Safe: Gate opens and remains open until power is restored.
      b. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.
   2. External electric-powered lock with delay timer allowing time for lock to release before gate operates.
   3. Intercom System: Ability to connect with Front Office.
   4. Instructional, Safety, and Warning Labels and Signs: According to UL 325 and Manufacturer's standard for components and features specified.
   5. Equipment Bases/Pads: Cast-in-place concrete, dimensioned according to gate-operator component manufacturer's written instructions and as indicated on Drawings.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.8 GROUNDING MATERIALS

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
   1. Connectors for Below-Grade Use: Exothermic welded type.
   2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for earthwork, pavement work, and other conditions affecting performance of the Work.
   1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
   1. Install fencing as shown on the plans.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
      a. Concealed Concrete: Place top of concrete 4 inches below to allow covering with maintenance strip.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15°. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 10 feet o.c.

F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
   1. Locate horizontal braces at mid-height of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
   1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

H. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

I. Intermediate and Bottom Rails: Secure to posts with fittings.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
   1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GATE-OPERATOR INSTALLATION

A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.

C. Vehicle Loop Detector System: Cut grooves in pavement, bury, and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

D. Ground electric-powered motors, controls, and other devices according to NFPA 70 and manufacturer's written instructions.

3.6 GROUNDING AND BONDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fence and Gate Grounding:
   1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
   2. Install ground rods and connections at maximum intervals of 1500 feet.
   3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
   4. Ground fence on each side of gates and other fence openings.
      a. Bond metal gates to gate posts.
      b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

D. Connections:
   1. Make connections with clean, bare metal at points of contact.
   2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   4. Make above-grade ground connections with mechanical fasteners.
   5. Make below-grade ground connections with exothermic welds.
   6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

E. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
   1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
   2. Test and adjust operators, controls, alarms, and safety devices. Replace damaged and malfunctioning controls and equipment.
   3. Lubricate operator and related components.

C. Lubricate hardware and other moving parts.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 323300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bicycle racks.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish, not less than 6-inch-long linear components and 4-inch-square sheet components.
   1. Include full-size Samples of bicycle rack Approved samples may be incorporated into the Work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 BICYCLE RACKS Refer to Landscape Plan Sheet L-100 in the Drawings.

A. Ensure bike rack(s) are one of the following or an approved equal:

Products Name	Supplier	Telephone No.
Rack 83-00/S-1	Dumor Site Furnishings	800-598-4018
Rack BRCS-101	Victor Stanley	800-368-2573
Rack AP2-02-SM	Sitescapes	888-331-9464

B. Bicycle Rack Construction:
   1. Frame: Steel [single loop
      a. Pipe Tubing OD: Not less than 2-3/8 inches
   2. Style: Double-side parking
      a. Capacity: Designed to accommodate no fewer than two bicycles.
   3. Security: Designed to lock wheel
   4. Color: Black.

C. Steel Finish: Color coated.
   1. Color: Black

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 323300

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes planting soilsspecified by composition of the mixes.

B. Related Requirements:
1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include recommendations for application and use.
   2. Include test data substantiating that products comply with requirements.
   3. Include sieve analyses for aggregate materials.
   4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
      a. Manufacturer's qualified testing agency's certified analysis of standard products.
      b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
      c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
   1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.
   1. Notify Landscape Architect or Architect ten days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
   1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Owner’s Representative under the direction of the testing agency.
   1. Number and Location of Samples: Minimum of eight representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.

2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils." Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
3. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:
1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.
2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:
1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:
1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm

14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type for perennial and shrub beds: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
1. Soil Moist or approved equal, according to manufacturer specification.

2.2 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
   1. Feedstock: Limited to leaves
   2. Reaction: pH of 5.5 to 8
   3. Soluble-Salt Concentration: Less than 4 dS/m.
   4. Moisture Content: 35 to 55 percent by weight.
   5. Organic-Matter Content: 50 to 60 percent of dry weight.
   6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth indicated on Drawings but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
   1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
      a. Mix fertilizer, if required, with planting soil no more than seven days before planting.
   2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in-place.

3.4 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 FIELD QUALITY CONTROL

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Vehicle traffic.
   4. Foot traffic.
   5. Erection of sheds or structures.
   6. Impoundment of water.
   7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Owner’s Representative and replace contaminated planting soil with new planting soil.

3.6 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
   1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hydroseeding.
   2. Turf renovation.
   3. Erosion-control materials.

B. Related Requirements:
   1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
   1. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   3. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion
   1. Spring Planting: April 1 – July 1.
   2. Fall Planting: September 1 – November 1.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:
   1. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, and not less than 95 percent pure seed:
   2. Full Sun, Cool-Season Grass: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
   3. Sun and Partial Shade, Cool-Season Grass: Proportioned by weight as follows:
      a. 50 percent Kentucky bluegrass (Poa pratensis).
      b. 30 percent chewings red fescue (Festuca rubra variety).
      c. 10 percent perennial ryegrass (Lolium perenne).
      d. 10 percent redtop (Agrostis alba).
   4. Shade, Cool-Season Grass: Proportioned by weight as follows:
      a. 50 percent chewings red fescue (Festuca rubra variety).
      b. 35 percent rough bluegrass (Poa trivialis).
      c. 15 percent redtop (Agrostis alba).

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the composition indicated by soil testing agency.

2.3 MULCHES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation." Coordinate "Placing Planting Soil" Paragraph below with Section 329113 "Soil Preparation".

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
   1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre] dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.7 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
   1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
   2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and] initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
   1. Soil Amendment(s): Amend soil according to requirements of Section 329113 "Soil Preparation."
   2. Initial Fertilizer: Slow-release fertilizer] applied according to manufacturer's recommendations.

J. Apply seed and protect with straw mulch] as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. Mow bentgrass to a height of 1/2 inch or less.
   2. Mow perennial ryegrass to a height of 1 to 2 inches.
   3. Mow Kentucky bluegrass and chewings red fescue to a height of 1-1/2 to 2 inches.
   4. Mow turf-type tall fescue to a height of 2 to 3 inches.

D. Turf Post-fertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.
   1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.9 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:
   1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.12 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
   1. Seeded Turf: 60 days from date of planting completion.
      a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.
6. Tree-watering devices.

B. Related Requirements:
1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn), hydroseeding, and erosion-control materials.

1.2 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:
1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.
6. Tree-watering devices.

B. Product Data Submittals: For each product.
1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.

C. Samples for Verification: Actual sample of finished products for each of the following:
   1. Organic Mulch: 1-pint volume of each organic mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Provide an accurate representation of color, texture, and organic makeup.
   2. Weed-Control Barrier: 12 by 12 inches.
   3. Slow-Release, Tree-Watering Device: One unit of each size required.
   4. Root Barrier: Width of panel by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: Percolation tests for tree pits. Include the following:
   1. Tree identification number matching the plans.
   2. Date of test.
   3. Time when water was added to tree pit to start percolation test.
   4. Time with photo documentation showing increments of testing with water level in tree pit.
   5. Identification of tester.

B. Qualification Statements: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.

D. Pesticides and Herbicides: Product label and manufacturer's written application instructions specific to Project.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
   2. Installer's Field Supervision: Maintain an experienced full-time supervisor on Project site when work is in progress.
   3. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
   1. Selection of plants purchased under allowances is made by Architect or Landscape Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure in accordance with ANSI Z60.1. Do not prune to obtain required sizes.
   1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
   2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect or Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect or Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
   1. Notify Architect or Landscape Architect of sources of planting materials ten days in advance of delivery to site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, or walkways and pavements; or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 36 hours] of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
   1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
   2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   3. Do not remove container-grown stock from containers before time of planting.
   4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
   1. Spring Planting: April 1 – July 1
   2. Fall Planting: September 1 – November 1

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
      b. Structural failures, including plantings falling or blowing over.
      c. Faulty performance of tree stabilization], deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Periods: From date of planting completion]
      a. Trees, Shrubs, and Ornamental Grasses: 12months.
      b. Ground Covers, Biennials, Perennials, and Other Plants: 12months.
   3. Include the following remedial actions as a minimum:
      a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
      b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
      c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
      d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
   1. Trees with damaged, crooked, or multiple leaders; with tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; with cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
   2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect or Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare in accordance with ANSI Z60.1.

D. Labeling: Label at least one] plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to ensure symmetry in planting.

2.2 FERTILIZERS

A. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and maximum of 5.5 percent inert material

B. Soil Moist polymer granular or approved equal.

2.3 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers inert to biological degradation and naturally resistant to chemicals, alkalis, and acids, formed into a stable network so that fibers retain their relative position.

2.4 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
   1. Type: Double Shredded hardwood
   2. Size Range: 3 inches maximum, 1/2-inch minimum
   3. Color: Dark Brown.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.5 HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

C. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.6 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over two to three weeks manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BIO-PLEX.
      b. Engineered Watering Solutions; PQ Partners, LLC.
      c. Spectrum Products, Inc.

2.7 MISCELLANEOUS PRODUCTS

A. Root Barrier: Black, molded, modular panels 24 inches high (deep), 85 mils thick, and with vertical root deflecting ribs protruding 3/4 inch out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
      a. DeepRoot Green Infrastructure, LLC.
      b. NDS Inc.
      c. Villa Root Barrier; Villa Landscape Products.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix in accordance with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
   3. Suspend planting operations during periods of excessive soil moisture until moisture content reaches acceptable levels to attain required results.
   4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove soil and contamination as directed by Landscape Architect or Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect or Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Landscape Architect or Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil in accordance with Section 329113 "Soil Preparation." Coordinate "Placing Planting Soil" Paragraph below with Section 329113 "Soil Preparation".

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain Landscape Architect or Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.
   1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
   3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   4. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.

5. If area under the plant was initially dug too deep, add soil to raise it to correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected overnight].
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations maybe used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Landscape Architect or Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Landscape Architect or Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Plant trees with approved mechanized tree spade at designated locations. Do not use tree spade to move trees larger than maximum size allowed for similar field-grown, balled-and-burlapped, root-ball diameter in accordance with ANSI Z60.1, or trees larger than manufacturer's maximum size recommendation for tree spade being used, whichever is smaller.

B. Use same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting tree, center the trunk within the tree spade and move tree with solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect or Architect.

C. Prune, thin, and shape trees, shrubs, and vines in accordance with standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect or Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 INSTALLATION OF ROOT BARRIER

A. Install root barrier where trees are planted within 48 inches of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier with bottom edge angled at 20 degrees away from the paving or other hardscape element, and run it linearly along and adjacent to paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for distance of 60 inches in each direction from tree trunk, for total distance of 10 ft. per tree. If trees are spaced closer, use single continuous piece of root barrier.
   1. Position top of root barrier flush with finish grade.
   2. Overlap root barrier minimum of 12 inches at joints.
   3. Do not distort or bend root barrier during construction activities.
   4. Do not install root barrier surrounding the root ball of tree.

3.9 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil composed of native topsoil and Soil Moist for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 INSTALLATION OF MULCHES

A. Install weed-control barriers before mulching in accordance with manufacturer's written instructions. Completely cover area to be mulched, overlapping edges minimum of 6 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.
   1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 4-inch average thickness, with 36-inch radius around trunks or stems. Do not create a mulch cone or place mulch within 3 inches of trunks or stems.
   2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 INSTALLATION OF TREE-WATERING DEVICES

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water in accordance with manufacturer's written instructions.

C. Remove device at the end of the growing season.

3.12 APPLICATION OF HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.13 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Perform tree pit percolation tests.
   2. Tree pit construction will be considered defective if it does not pass percolation tests and inspections.
   3. Do not proceed with planting in tree pits until satisfactory percolation is demonstrated.

C. Prepare test and inspection reports.

3.15 REPAIR AND REPLACEMENT

A. Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect or Architect.
   1. Submit details of proposed pruning and repairs.
   2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
   3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect or Architect.

B. Remove and replace trees that are more than 25 percent dead or in unhealthy condition before end of corrections period or are damaged during construction operations that Landscape Architect or Architect determines are incapable of restoring to normal growth pattern.
   1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
   2. Provide two new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
   3. Species of Replacement Trees: Species selected by Landscape Architect or Architect

3.16 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

END OF SECTION 329300

SECTION 330500 – COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Piping joining materials.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Sleeves.
   5. Identification devices.
   6. Grout.
   7. Flowable fill.
   8. Piped utility demolition.
   9. Piping system common requirements.
   10. Equipment installation common requirements.
   11. Painting.
   12. Concrete bases.
   13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.5 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D2235.
   2. CPVC Piping: ASTM F493.
   3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
   4. PVC to ABS Piping Transition: ASTM D3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:
   1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
   2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:
   1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:
   1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:
   1. Description: MSS SP-107, **PVC** four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
   1. Description: ASTM C1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
   1. Description: Factory fabricated, union, NPS 2 and smaller.
      a. Pressure Rating: 150 psig minimum at 180° F.
      b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:
   1. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.
      a. Pressure Rating: 150 psig minimum.
      b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:
   1. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.
      a. Pressure Rating: 150 psig minimum.
      b. Gasket: Neoprene or phenolic.
      c. Bolt Sleeves: Phenolic or polyethylene.
      d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:
   1. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.
      a. Pressure Rating: 300 psig at 225°F.
      b. End Connections: Threaded.

F. Dielectric Nipples:
   1. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
      a. Pressure Rating: 300 psig at 225° F.
      b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

F. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
   2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.
   1. Material: Fiberboard.
   2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360° around pipe at each location.

F. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

G. Lettering: Manufacturer's standard preprinted captions as selected by Architect.

H. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
   1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

I. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.
   1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
   2. Color: Comply with ASME A13.1, unless otherwise indicated.

J. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

K. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

L. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
   2. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
   3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

M. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
   1. Green: Cooling equipment and components.
   2. Yellow: Heating equipment and components.
   3. Brown: Energy reclamation equipment and components.
   4. Blue: Equipment and components that do not meet criteria above.
   5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
   6. Terminology: Match schedules as closely as possible. Include the following:
      a. Name and plan number.
      b. Equipment service.
      c. Design capacity.
      d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
   7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

N. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
   1. Size: 3-1/4 by 5-5/8 inches.
   2. Fasteners: Brass grommets and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

O. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
   1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.
   1. Cement: ASTM C150, Type I, portland.
   2. Density: 125-lb/cu. ft.
   3. Aggregates: ASTM C33, natural sand, fine and crushed gravel or stone, coarse.
   4. Aggregates: ASTM C33, natural sand, fine.
   5. Admixture: ASTM C618, fly-ash mineral.
   6. Water: Comply with ASTM C94/C94M.
   7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:
   1. NPS 2 and Smaller: Dielectric unions.
   2. NPS 2-1/2 to NPS 12: Dielectric flanges.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:
   1. NPS 2 and Smaller: Dielectric couplings.
   2. NPS 2-1/2 to NPS 4: Dielectric nipples.
   3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
   4. NPS 10 and NPS 12: Dielectric flange kits.

3.2 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
      a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 appendixes.
3. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
5. PVC Nonpressure Piping: Join according to ASTM D2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.
1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.5 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Section 099114 "Exterior Painting (MPI Standards)," Section 099124 "Interior Painting (MPI Standards)," and Section 099600 "High-Performance Coatings."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
   1. Stenciled Markers: According to ASME A13.1.
   2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
   3. Locate pipe markers on exposed piping according to the following:
      a. Near each valve and control device.
      b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
      c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
      d. At manholes and similar access points that permit view of concealed piping.
      e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
   1. Lettering Size: Minimum 1/4-inch-high for name of unit if viewing distance is less than 24 inches, 1/2-inch-high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
   2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.8 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.10 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 331415 – SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Water-distribution piping and related components outside the building for domestic water service fire-suppression water service, combined domestic water service and fire-suppression water service and service entrance piping to a point 1 ft. above finished floor and service entrance piping to a point 1 ft. inside finished wall.

B. Related Requirements:
   1. Section 031000 "Concrete Forming and Accessories."
   2. Section 032000 "Concrete Reinforcing."
   3. Section 211119 "Fire Department Connections."

1.2 DEFINITIONS

A. CDA: Copper Development Association.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
   1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
   2. Protect threaded ends and flange faces against damage.
   3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.

B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.5 COORDINATION

A. Coordinate connection to water main with the Lansing Board of Water and Light mailto: Bryce.Hengesbach@LBWL.COM.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of Lansing Board of Water and Light for supplying water. Include tapping of water mains and backflow prevention.

B. Comply with standards of authorities having jurisdiction for domestic water-service piping, including materials, installation, testing, and disinfection.

C. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

D. Piping materials to bear label, stamp, or other markings of specified testing agency.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

F. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.

G. Comply with FM Approvals' "Approval Guide" and/or UL's "Fire Protection Equipment Directory" for fire-suppression water-service products.

H. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

I. All piping and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.

B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type K and ASTM B88, Type L.

B. Annealed-Temper Copper Tube: ASTM B88, Type K and ASTM B88, Type L.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

F. Cast-Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock-body, ball-and-socket, metal-to-metal seating surfaces; and solder-joint or threaded ends.

G. Wrought-Copper Unions: ASME B16.22.

2.4 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. AWWA C104/A21.4 cement mortar-lined.

B. Mechanical-Joint, Ductile-Iron Fittings:
   1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
   3. AWWA C104/A21.4 cement mortar-lined.

C. Push-on-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. AWWA C104/A21.4 cement mortar-lined.

D. Push-on-Joint, Ductile-Iron Fittings:
   1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
   2. Gaskets: AWWA C111/A21.11, rubber.
   3. AWWA C104/A21.4 cement mortar-lined.

E. Grooved-End, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with cut, rounded-grooved ends.
   2. AWWA C104/A21.4 cement mortar-lined.

F. Grooved-End, Ductile-Iron Pipe Appurtenances:
   1. Source Limitations: Obtain grooved-end, ductile-iron pipe appurtenances from single manufacturer.
   2. Grooved-End, Ductile-Iron Fittings:
      a. ASTM A536, ductile-iron castings with dimensions matching pipe.
      b. AWWA C104/A21.4 cement mortar-lined.
   3. Grooved-End, Ductile-Iron-Piping Mechanical Couplings:
      a. AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

G. Flanges: ASME 16.1, Class 125, cast iron.

2.5 PE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 200 psig.
   1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
   2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psig.
   1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig.

2.6 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D1785.
   1. PVC, Schedule 40 Socket Fittings: ASTM D2466.

B. PVC, Schedule 80 Pipe: ASTM D1785.
   1. PVC, Schedule 80 Socket Fittings: ASTM D2467.

2. PVC, Schedule 80 Threaded Fittings: ASTM D2464.

2.7 SPECIAL PIPE FITTINGS

A. Ductile-Iron Rigid Expansion Joints: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, end sections.
   1.
   2. Source Limitations: Obtain ductile-iron rigid expansion joints from single manufacturer.
   3. Standards: AWWA C110 or AWWA C153/A21.53; AWWA C111/A21.11.
   4. Pressure Rating: 250 psig minimum.

B. Ductile-Iron Flexible Expansion Joints: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends. Include two gasketed ball-joint sections and one or more gasketed sleeve sections.
   1. Source Limitations: Obtain ductile-iron flexible expansion joints from single manufacturer.
   2. Standards: AWWA C110 or AWWA C153/A21.53; AWWA C111/A21.11.
   3. Pressure Rating: 250 psig minimum.

C. Ductile-Iron Deflection Fittings: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends.
   1. Source Limitations: Obtain ductile-iron deflection fittings from single manufacturer.
   2. Standards: AWWA C110 or AWWA C153/A21.53; AWWA C111/A21.11.
   3. Pressure Rating: 250 psig minimum.

2.8 PIPING JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

C. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.9 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
   1. Source Limitations: Obtain tubular-sleeve pipe couplings from single manufacturer.
   2. Standard: AWWA C219.
   3. Center-Sleeve Material: Ductile iron.
   4. Gasket Material: Natural or synthetic rubber.
   5. Pressure Rating: 200 psig minimum.
   6. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
   1. Source Limitations: Obtain split-sleeve pipe couplings from single manufacturer.
   2. Standard: AWWA C227.
   3. Sleeve Material: Stainless steel.
   4. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
   5. Gasket Material: O-rings made of EPDM rubber unless otherwise indicated.
   6. Pressure Rating: 200 psig minimum.
   7. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:
   1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
   2. Ferrous-Metal Piping: Stainless steel hose covered with stainless steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
   1. Dielectric Unions:
      a. Standard: ASSE 1079.
      b. End Connections: Solder-joint copper alloy and threaded ferrous.
   2. Dielectric Flanges:
      a. Standard: ASSE 1079.
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
   3. Dielectric-Flange Insulating Kits: Nonconducting materials for field assembly of companion flanges.
      a. Pressure Rating: 150 psig.
      b. Gasket: Neoprene or phenolic.
      c. Bolt Sleeves: Phenolic or PE.
      d. Washers: Phenolic with steel backing washers.
   4. Dielectric Nipples:
      a. Standard: IAPMO PS 66.
      b. Electroplated steel nipple complying with ASTM F1545.

c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, PP.

2.10 GATE VALVES

A. Gate Valves - AWWA, Cast Iron: As required by the Lansing Board of water and Light

2.11 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies: As required by the Lansing Board of water and Light.

B. Valve Boxes: As required by the Lansing Board of water and Light

C. Indicator Posts: UL 789, FM Global approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.12 CHECK VALVES

A. Check Valves - AWWA: Swing-check type with resilient seat with ends to match piping.
1. Source Limitations: Obtain check valves, AWWA, from single manufacturer.
2. Standards:
   a. AWWA C508.
   b. Interior coating in accordance with AWWA C550.
3. Pressure Rating: 175 psig.

2.13 DETECTOR CHECK VALVES

A. Detector Check Valves: As required by the Lansing Board of water and Light

B. Source Limitations: Obtain detector check valves from single manufacturer.

C. Description: Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
1. Standards: UL listed and FM Global approved.
2. Pressure Rating: 175 psig.

D. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.14 BUTTERFLY VALVES

A. Butterfly Valves - AWWA:
1. Source Limitations: Obtain butterfly valves - AWWA, from single manufacturer.
2. Standard: AWWA C504.
3. Body: Cast or ductile iron.
4. Body Type: Wafer or flanged.

5. Seat: Rubber.
6. Pressure Rating: 150 psig.

2.15 WATER METERS

A. Water Meter - Lansing Board of Water and Light Furnished

2.16 WATER METER BOXES

A. Water Meter Boxes:
1. Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

2.17 FIRE HYDRANTS

A. Fire Hydrants - Dry Barrel:
1. Source Limitations: Obtain fire hydrants - dry barrel, from single manufacturer.
2. Pressure Rating: 250 psig.
3. Standard: AWWA C502.
4. Freestanding configuration, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating in accordance with AWWA C550. Hydrant to have cast-iron body, compression-type valve opening against pressure and closing with pressure.
5. Standards: UL 246, and FM Global approved.
6. Freestanding configuration, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Hydrant to have cast-iron body, compression-type valve opening against pressure and closing with pressure.
   a. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
   b. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
   c. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
   d. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.

2.18 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:
1. Coordinate with City of Lansing Fire Department for specific connection requirements
2. Source Limitations: Obtain fire department connections from single manufacturer.
3. Standard: UL 405.
4. Configuration: Freestanding, with cast-bronze body, thread inlets in accordance with NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch-high, brass sleeve; and round escutcheon plate.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING APPLICATIONS

A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.

B. Do not use flanges or unions for underground piping.

C. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

D. Underground water-service piping shall meet the Lansing Board of Water and Light requirements.

E. Water Meter Box Water-Service Piping: to meet the Lansing Board of Water and Light requirements

F. Underground fire-service-main piping shall meet the Lansing Board of Water and Light requirements.

G. Underground Combined Water-Service and Fire-Service-Main Piping shall meet the Lansing Board of Water and Light requirements.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM Global, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Comply with Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

B. Provide a continuous bare copper or aluminum tracer wire not less than 0.10 inch in diameter in sufficient length over each separate run of nonmetallic pipe.

3.5 INSTALLATION OF PIPING

A. Water-Main Connection:
   1. Arrange with Lansing Board of Water and Light for tap of size and in location indicated in water main.
   2. Tap water main in accordance with requirements of water Lansing Board of Water and Light and of size and in location indicated.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

C. Install ductile-iron, water-service piping in accordance with AWWA C600 and AWWA M41.

D. Bury piping with depth of cover over top at least 60 inches.

E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

F. Comply with Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

G. Comply with Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

A. Comply with Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:
   1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
   2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
   3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
   4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts in accordance with coupling manufacturer's written instructions.
   5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners in accordance with fitting manufacturer's written instructions.
   6. PVC Piping Gasketed Joints: Use joining materials in accordance with AWWA C900. Construct joints with elastomeric seals and lubricant in accordance with ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.
   7. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
   8. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.7 INSTALLATION OF VALVES

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.

H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

I. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete" for support of valves and piping not direct buried.

3.8 INSTALLATION OF WATER METERS

A. Install water meters, piping, and specialties in accordance with Lansing Board of Water and Light's instructions.

3.9 INSTALLATION OF FIRE HYDRANTS

A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA Fire Hydrants: Comply with AWWA M17.

D. UL/FM Global Fire Hydrants: Comply with NFPA 24.

3.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
   1. Increase pressure in 50 psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.12 CLEANING

A. Clean and disinfect water-distribution piping as follows shall meet the Lansing Board of Water and Light requirements.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331415

SECTION 334200 – STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Corrugated-steel pipe and fittings.
2. Corrugated-aluminum pipe and fittings.
3. ABS pipe and fittings.
4. PE pipe and fittings.
5. PVC pipe and fittings.
6. Concrete pipe and fittings.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes in accordance with manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets in accordance with manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Source Limitations: Obtain hub-and-spigot, cast-iron soil pipe and fittings from single manufacturer.

B. Pipe and Fittings:
1. Marked with CISPI collective trademark and NSF certification mark.
2. Class: ASTM A74, Service class.

C. Gaskets: ASTM C564, rubber.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Source Limitations: Obtain hubless cast-iron soil pipe and fittings from single manufacturer.

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Standard: ASTM A888 or CISPI 301.

2.3 CORRUGATED-STEEL PIPE AND FITTINGS

A. Source Limitations: Obtain corrugated-steel pipe and fittings from single manufacturer.

B. Corrugated-Steel Pipe and Fittings: ASTM A760/A760M, Type I with fittings of similar form and construction as pipe.
   1. Special-Joint Bands: Corrugated steel with O-ring seals.
   2. Standard-Joint Bands: Corrugated steel.
   3. Coating: Zinc.

2.4 CORRUGATED-ALUMINUM PIPE AND FITTINGS

A. Source Limitations: Obtain corrugated-aluminum pipe and fittings from single manufacturer.

B. Corrugated-Aluminum Pipe and Fittings: ASTM B745/B745M, Type I with fittings of similar form and construction as pipe.
   1. Special-Joint Bands: Corrugated aluminum with O-ring seals.
   2. Standard-Joint Bands: Corrugated aluminum.

2.5 ABS PIPE AND FITTINGS

A. Source Limitations: Obtain ABS pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. Solid-Wall ABS Pipe: ASTM D2661, Schedule 40.

D. BS Socket Fittings: ASTM D2661, made to ASTM D3311, drain, waste, and vent patterns.

E. Gaskets: ASTM F477, elastomeric seals.

F. Solvent Cement: ASTM D2235.

2.6 CORRUGATED-PE PIPE AND FITTINGS

A. Source Limitations: Obtain corrugated-PE pipe and fittings from single manufacturer.

B. Corrugated-PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252, Type S, with smooth waterway for coupling joints.

C. Corrugated-PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294, Type S, with smooth waterway for coupling joints.

D. Corrugated-PE Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

E. Corrugated-PE Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings.

2.7 PVC PIPE AND FITTINGS

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. PVC Cellular-Core Piping:
   1. PVC Cellular-Core Pipe and Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
   2. Fittings: ASTM D3034, SDR 35**,** PVC socket-type fittings.

D. PVC Corrugated Sewer Piping:
   1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
   3. Gaskets: ASTM F477, elastomeric seals.

E. PVC Profile Sewer Piping:
   1. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM D3034, PVC with bell ends.
   3. Gaskets: ASTM F477, elastomeric seals.

F. PVC Type PSM Sewer Piping:
   1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM D3034, PVC with bell ends.
   3. Gaskets: ASTM F477, elastomeric seals.

G. PVC Gravity Sewer Piping:
   1. Pipe and Fittings: ASTM F679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F477, elastomeric seals for gasketed joints.

2.8 CONCRETE PIPE AND FITTINGS

A. Source Limitations: Obtain concrete pipe and fittings from single manufacturer.

B. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C14, with bell-and-spigot ends and gasketed joints with ASTM C443, rubber gaskets.

2.9 PRESSURE PIPE COUPLINGS

A. Source Limitations: Obtain pressure pipe couplings from single manufacturer.

B. Description: AWWA C219, tubular-sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.

C. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150- psig minimum pressure rating and ends sized to fit adjoining pipes.

D. Gasket Material: Natural or synthetic rubber.

E. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping in accordance with the following:

1. Install piping pitched down in direction of flow.
2. Install nonreinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
   1. Join nonreinforced-concrete sewer piping in accordance with ASTM C14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1 inches above finished surface elsewhere unless otherwise indicated.

3.5 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping in accordance with ASTM F1417.
6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig (kPa).
   a. Ductile-Iron Piping: Test in accordance with AWWA C600, "Hydraulic Testing" Section.
   b. PVC Piping: Test in accordance with AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.8 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334200

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Perforated-wall pipe and fittings.
   2. Drainage conduits.
   3. Drainage panels.
   4. Geotextile filter fabrics.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Drainage conduits, including rated capacities.
   2. Drainage panels, including rated capacities.
   3. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:
   1. NPS 6 and Smaller: ASTM F405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
   2. NPS 8 and Larger: ASTM F667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
   3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D2729, bell-and-spigot ends, for loose joints.

2.2 DRAINAGE CONDUITS

A. Mesh Fabric Drainage Conduits: Prefabricated geocomposite with plastic-filament drainage core wrapped in geotextile filter fabric. Include fittings for bends and connection to drainage piping.
   1. Nominal Size: 6 inches high by approximately 0.9 inch thick.
      a. Minimum In-Plane Flow: 2.4 gpm at hydraulic gradient of 1.0 when tested in accordance with ASTM D4716.
   2. Filter Fabric: Nonwoven geotextile made of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft. when tested in accordance with ASTM D4491.

2.3 SOIL MATERIALS

A. Soil materials are specified in Section 312000 "Earth Moving."

2.4 WATERPROOFING FELTS

A. Material: Comply with ASTM D226, Type I, asphalt saturated organic felt.

2.5 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested in accordance with ASTM D4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.
   1. Survivability: AASHTO M 288 Class 2.
   2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

J. Install drainage panels on foundation walls as follows:
   1. Coordinate placement with other drainage materials.
   2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.
   3. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end of remaining core.
   4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 UNDERSLAB DRAINAGE INSTALLATION

A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.

F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

H. Install horizontal drainage panels as follows:
   1. Coordinate placement with other drainage materials.

2. Lay perforated drainage pipe at inside edge of footing.
3. Place drainage panel over drainage pipe with core side up. Peel back fabric and wrap fabric around pipe. Locate top of core at bottom elevation of floor slab.
4. Butt additional panels against other installed panels. If panels have plastic flanges, overlap installed panel with flange.

3.5 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions and other requirements indicated.
   1. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches unless otherwise indicated.
   2. Lay perforated pipe with perforations down.
   3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install thermoplastic piping in accordance with ASTM D2321.

3.6 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings in accordance with ASTM D3212 with loose banded, coupled, or push-on joints.

B. Join perforated PVC sewer pipe and fittings in accordance with ASTM D3212 with loose bell-and-spigot, push-on joints.

C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
   2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

DRIESENGA & ASSOCIATES, INC.
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September 16, 2022 *via electronic mail*

Mr. Barry Roney
LANSING SCHOOL DISTRICT
519 WEST KALAMAZOO
LANSING, MI 48933

Re: Geotechnical Report
Lansing School District 2022 Bond - Mt. Hope Elementary
1215 East Mt. Hope Avenue, Lansing, Michigan
Driesenga & Associates, Inc. Project No. 2240647.3A

Dear Mr. Roney:

Driesenga & Associates, Inc. is pleased to submit the attached report of subsurface exploration performed for the above-referenced project. The report presents the exploration procedures, subsurface conditions encountered, and our recommendations for development of the site with respect to proposed earthwork, foundation construction, and pavement design. As the project nears construction you can contact Beni Traore at 517-505-0220 in our local office to provide a quote for construction materials testing and survey needs.

Proper execution of our recommendations will affect the design, construction and performance of the structure and related facilities, and the potential associated risks involved. Therefore, the issues and recommendations presented in this report should be discussed with the project team, including Driesenga & Associates, Inc. This will increase the likelihood that the issues are understood and our recommendations are applied in a manner consistent with the project budget, tolerance of risk, and expectations for performance and maintenance.

We appreciate the opportunity to be of service to you. If you have any questions concerning this report, or if we can be of further service as design and construction progresses, please contact our office.

Sincerely,
DRIESENGA & ASSOCIATES, INC.

Michael Stork
Senior Project Geologist

Musana Nabil
Senior Project Engineer

Randy Pail, P.E
Director of Geotechnical Engineering

Cc: Steve Jurczuk – C2AE

GEOTECHNICAL REPORT

SITE:

LANSING SCHOOL DISTRICT 2022 BOND
MT. HOPE ELEMENTARY
1215 EAST MT. HOPE AVENUE, LANSING, MICHIGAN

September 16, 2022
PROJECT NO. 2240647.3A

PREPARED FOR:

LANSING SCHOOL DISTRICT
519 WEST KALAMAZOO
LANSING, MI 48933

Prepared by:

DRIESENGA & ASSOCIATES, INC.

Engineering · Surveying · Testing

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APPENDIX A	Figure 1 – Site Location
	Figure 2 – Boring Locations
APPENDIX B	Soil Boring Logs
APPENDIX C	Field and Laboratory Procedures

1.0 INTRODUCTION

1.1 LOCATION

This report presents the results of the geotechnical investigation completed for the proposed improvement to the Mt. Hope School. The site is located at 1215 East Mt. Hope Avenue, Lansing, Michigan as shown on Figure 1 – Site Location (Appendix A).

1.2 PURPOSE

The purpose of this investigation was to determine the subsurface profile, the engineering characteristics of the subsurface soils, and to provide recommendations in regard to the proposed design and construction based on our interpretation of the test results. This report was prepared in general accordance with our revised proposal dated May 26, 2022, as authorized by Mr. Barry Roney of the Lansing School District on August 1, 2022.

1.3 SCOPE

The field exploration to estimate engineering characteristics of the site soils included performing a site reconnaissance, advancing the soil borings, performing standard penetration tests, and recovering split-spoon samples. Soil boring locations were determined in the field by measuring from existing site features. Existing ground surface elevations were not provided and obtaining them was beyond the scope of this investigation

Ten (10) soil borings, designated SB-1 to SB-10, were advanced in the vicinity of the proposed building and parking areas on August 31, 2022, at the approximate locations shown on Figure 2 - Boring Locations (Appendix A). The soil borings were advanced with hollow-stem augers to depths ranging between ten (10) to twenty-five (25) feet below the ground surface. During drilling, soil samples were collected from split-spoon sampling via standard penetration testing (ASTM

method D 1586) at intervals of 2.5 feet to a depth of 10 feet, and intervals of 5 feet from a depth of 10 feet to the end of each boring. The soil boring logs are contained in Appendix B. The field and laboratory procedures are described in Appendix C.

1.4 DESIGN INFORMATION

It is understood the proposed building is to be a one-story steel framed structure with poured concrete footings and masonry block foundation walls and will be located in the center of the site. The new construction will also include a new parking area to the east, a bus drop-off area to northeast, driveway, a rain garden and a playground to the north.

Structural load information was not available as of the time of this report, but should be provided to Driesenga & Associates, Inc. for review in light of the recommendations contained herein as soon as available. For calculation purposes, maximum loads of 4,000 pounds per lineal foot of wall and 80 kips per column were assumed. Assuming that the new construction will not include any basement areas, exterior footing depths are assumed to be a minimum of 3.5 feet below the final ground surface elevation.

We have assumed maximum tolerable settlements of 1 inch total and ½ inch differential. We anticipate cuts and fills on the order of 1.0 feet will be required to establish site grades. Any significant deviation from these assumptions should be brought to the attention of Driesenga & Associates, Inc. as soon as possible.

2.0 SITE CONDITIONS

2.1 GENERAL

The stratification of the soils, as shown on the soil boring logs in Appendix B, represents the soil conditions at the actual soil boring locations. Variations may occur away from or between the soil borings. Stratigraphic lines shown on the soil boring logs represent the approximate boundary between the soil types, but the transition may be gradual. They are not intended to show exact depths of change from one soil type to another. In addition, changes in soil type may occur between the sample intervals that are consequently not observed by the driller.

The soil boring logs in Appendix B include the drilling method, materials encountered, penetration resistances, and pertinent field observations made during the drilling operations along with the results of the laboratory testing.

2.2 SURFACE CONDITIONS

The subject property is currently occupied by an existing school building, playground, maintained lawn and asphalt parking areas and drives. This area is relatively flat. The site is bordered to the south by East Mt. Hope Avenue, to the east by Harding Avenue, to the west by Shubel Avenue.

2.3 DESCRIPTION OF SUBSURFACE SOILS

Soils encountered at the site generally consist of 3 inches to 7 inches of topsoil underlain by very loose to dense, brown, fine to coarse clayey sand/sand/silty sand with gravel and silt to explored depth of the soil borings. Stiff to very stiff, brown and gray, silty and sandy clay was generally encountered beneath the sand at depths ranging from 8 to 16 feet below grade, however, at soil boring SB-4 clay was encountered at a depth of 2 feet below grade.

Moisture content tests were performed on representative portions of clayey samples from the soil borings. As indicated on the soil boring logs, moisture content test results ranged from 9% to 17%. Hand Penetrometer tests were performed on representative portions of cohesive soil samples to obtain an indication of the unconfined compressive of the material. As indicated on the soil boring logs, the estimated unconfined compressive strength ranged from 1.75 to 4.0 tons per square foot (tsf).

The estimated group symbol, according to the USCS, is shown in the USCS column just before the textural description of the various strata on the soil boring logs in Appendix B.

2.4 GROUNDWATER OBSERVATIONS

Groundwater was initially encountered at a depth of 9 feet below the existing ground surface at soil boring locations SB-2 and SB-4. Upon completion of the borings, groundwater was measured at a depth of 9 feet below the existing ground surface at soil boring locations SB-2 and SB-4. Hydrostatic groundwater levels and the elevations and volumes of groundwater should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater levels (or lack thereof) indicated by the soil borings and presented in this section represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.

Groundwater measurements were collected during drilling and attempted shortly after completion of the drilling operations. After drilling and collection of groundwater readings, the boreholes were backfilled with auger cuttings and the surface was repaired approximating previous conditions. Since the boreholes were backfilled shortly after drilling, long-term groundwater level information is not available from the soil borings. To obtain long-term groundwater levels, groundwater observation wells would be required.

2.5 SEISMIC SITE CLASS

The proposed building's seismic class was determined for use in the structural design of the proposed project. Soils information was obtained from the soil borings completed on-site, as well as information obtained from the "Soil Survey of Ingham County" by the United States Department of Agriculture, the "Quaternary Geology of Michigan" completed by W.R. Farrand, the USGS Topographic Quadrangle and the Hydrogeologic Atlas of Michigan. It is assumed that the proposed structure falls under Building Class II according to the 2015 Michigan Building Code (MBC) Table 1604.5. Based on this information it is our determination that seismic site class D be used according to the ASCE 7 – Table 20.3-1 for structural calculations.

2.6 LIMITATIONS

Soil and groundwater conditions have been observed and interpreted at the soil boring locations only. This information has been used as the basis for our analyses and the recommendations that follow. Although we have allowed for minor variations in subsurface conditions in the development of our recommendations, conditions can vary away from and between soil boring locations. Should this become evident during construction, we should be contacted to review our recommendations. This geotechnical evaluation and report were prepared for geotechnical purposes only. We did not perform environmental related borings or analytical tests.

3.0 RECOMMENDATIONS

3.1 SITE PREPARATION

To increase the likelihood that the recommended allowable soil bearing capacities are achieved and tolerable settlements are not exceeded, the recommendations contained herein should be followed. Within the building footprint and any areas to receive fill, all existing building material, topsoil, old fill if encountered, organic-containing material, frozen soil and other unsuitable material should be removed. The clearing should extend a minimum of 5 feet beyond the limits of proposed building and pavement areas and areas to receive structural fill.

It is strongly recommended that the building pad and pavement subgrade areas be evaluated by Driesenga & Associates, Inc. after the area has been cleared and stripped. This evaluation may be performed by proofrolling with a loaded tandem axle dump truck or another method selected by the geotechnical engineer. To identify any areas of soft subgrade soil. Where soft subgrade soils are encountered, remedial actions as recommended by the geotechnical engineer will be required.

We understand the existing building will be demolished as part of the project. Any existing foundations, floor slabs, utilities, and other below-grade structures from previous construction should be completely removed from the footprint of the proposed building. In proposed pavement areas, existing utilities and other below-grade structures should be removed to at least 2.5 feet below the final subgrade level. Alternatively, utilities can be left in place below pavement areas if the void space of the utility is completely grouted. Depressions or excavations from the demolition and removal operations should be backfilled with granular structural fill meeting the requirements of MDOT Class II sand compacted in accordance with the recommendations below.

Trees were located within the project area when this investigation was conducted. Large trees may have relatively widespread root structures and related organic veins. The earthwork activities

within the building and pavement areas should include complete removal of the tree roots and organic veins.

In all general fill areas, the exposed soil surface should be scarified to a depth of 12 inches and recompacted to a minimum of 95% of Modified Proctor maximum dry density (MDD) per ASTM D 1557 method, or 98% of MDD as determined by the Michigan Cone Method. Sand soils were encountered at or near the final subgrade level in some of the soil borings in the proposed building area. Within the proposed building area the native sand should be proof-compacted by at least six (6) passes of a 10-ton vibratory roller.

The contractor should remove standing water from the subgrade and prevent surface water from reaching the footing excavations and the prepared subgrade. In addition, construction traffic should use haul roads and should not haphazardly traffic the site. Subgrade soils that become disturbed should be removed and replaced with structural fill or crushed aggregate. Under wet weather conditions, the subgrade may be protected by placing crushed aggregate on the exposed subgrade.

Where clay soils may be exposed, such as soil boring SB-4, significant disturbance of the subgrade may result from repeated construction traffic. The exposed subgrade may need to be stabilized after removal of topsoil to support construction traffic or to reduce subgrade disturbance. Also, the clays may become disturbed due to ponded water and/or repeated construction traffic. Therefore, the contractor should remove standing water from the subgrade and prevent surface water from reaching the footing excavations and the subgrade. In addition, construction traffic should use haul roads and should not haphazardly traffic the site. The client should understand that construction costs may be higher during wet, snowy and/or colder months and that site preparation may be more extensive due to the effects of moisture on the soils. The contractor should limit the number and size of construction equipment on the site, should grade the site during stripping operations to allow surface water to drain from areas of proposed development, and should remove water from areas where it collects. In addition, site utilities should be installed early in the project to channel

groundwater into the sand-filled trenches. Even with the above precautions, a significant amount of subgrade disturbance may result. Subgrade soils that become disturbed should be removed and replaced with structural fill or crushed aggregate. We recommend including a contingency in the construction budget to provide for subgrade improvements.

Aeration by methods such as disking may be required to reduce subgrade moisture content to the optimum moisture content range for compaction. In cold and/or wet weather conditions such as during the winter and spring months, it may not be possible to reduce the subgrade moisture content and granular fill or crushed aggregate may need to be imported to the site.

It is recommended that any fill materials be placed in or near horizontal maximum 8-inch-thick loose lifts and compacted to a minimum of 95% of Modified Proctor MDD, or 98% of Michigan Cone MDD. If a vibratory roller is used for compaction, the loose lift thickness may be increased to 12 inches. Soils used for structural fill should consist of clean sand meeting SW or SP classification in accordance with USCS criteria. Care should be taken not to disturb or undermine the existing foundations.

3.2 FOUNDATIONS

Considering the subsurface conditions on this site and the assumed proposed construction, it is acceptable for the proposed school building to be supported on conventional spread footings. Footings bearing on newly placed structural fill placed over suitable native soils or directly on the native soils may be designed for a maximum net allowable soil bearing pressure of 2,000 psf.

At some locations, the native sand soils may be in relatively loose condition and not suitable for support of foundations at the recommended design soil bearing pressure. In addition, these soils may become loosened below the bottom of footing level from the excavation activities or from construction traffic, especially if allowed to dry out. Therefore, the excavated footing bearing surfaces should be compacted to a minimum of 95% of Modified Proctor MDD, or 98% of MDD

as determined by the Michigan Cone Method, just prior to concrete placement. A hand-operated plate compactor may be used for loose or disturbed soil that is less than 6 inches in thickness. For deeper compaction, we recommend using a hoe-pac mounted on a backhoe. Water may need to be added to achieve the desired compaction for the allowable bearing capacity.

If it is not possible to improve the sands by densification, the unsuitable soils may need to be removed and the foundations placed on suitable native soils encountered at lower levels. Alternatively, the undercut may be backfilled with crushed aggregate to the bottom of footing level. In addition, wet or easily disturbed foundation bearing soils could be encountered at some locations. If wet soils are encountered, we recommend a layer of crushed aggregate be placed on the subgrade. The thickness of this layer will depend on the conditions encountered at the time of construction. In areas where undercutting is required, the undercut should extend laterally on a two vertical to one horizontal slope from the edge of the footing.

To attain the recommended bearing pressure where foundations bear on clay soils, improvement of the foundation subgrade may be required in some areas. The soil conditions may vary from those disclosed by the soil borings and undercuts may be required. The amount of improvement will depend on the finished floor elevation, the amount of disturbance during earthwork operations, and the soil and groundwater conditions at the foundation bearing level(s). We do not anticipate compaction of the clay soils will be effective and improvements may include mixing a layer of coarse crushed aggregate into the subgrade. If the subgrade conditions cannot be improved either by compaction or mixing in crushed aggregate, the unsuitable soil should be removed and replaced with structural fill. In areas where undercutting is required, the undercut should extend laterally on a two vertical to one horizontal slope from the edge of the footing.

All perimeter footings and footings in unheated areas should bear at least 42 inches below finished grade for protection from frost action. To reduce the likelihood of frost heave, trench footings should be formed vertically and should not be allowed to widen near the top. If interior footings are to bear on compacted fill, the fill should be placed in accordance with the recommendations of

Section 3.1. Interior foundations can be constructed on suitable natural soils or on structural fill overlying suitable natural subgrade just below the floor slab. However, the footings and proposed bearing soils should be protected from freezing during construction if work is conducted in the cold winter months. Due to the sands encountered at the site, construction of trench footings is probably not feasible. Therefore, we anticipate footing excavations will need to be sloped back and the foundations formed. The placement of footing concrete should be done as soon as footing excavations have been completed and approved to reduce the potential for disturbance or freezing of the footing subgrade.

Prior to concrete placement, the bearing surface should be free of loose soil and standing water. The contractor should avoid stockpiling excavated materials immediately adjacent to the excavation walls. It is recommended that stockpiled materials be kept back from the excavation a minimum distance equal to half the excavation depth to prevent surcharging the excavation walls.

Total and differential settlement of foundations properly designed and constructed based on our recommendations are not expected to exceed 1 inch and ½ inch, respectively.

3.3 FLOORS

The soil below the floor slab should be prepared in accordance with the recommendations in Section 3.1. A noncohesive soils mat such as MDOT Class II sand should be provided directly below the floor slabs. The mat should be a minimum of 8 inches in thickness and compacted to a minimum of 95% of Modified Proctor MDD.

We recommend providing vapor barriers below floor slabs that will receive an impermeable floor finish/seal. Even if these floor coverings are not planned, the vapor barrier can reduce the transmission of moisture vapor from the ground into the building. However, the placement of a vapor barrier affects construction of the floor slab, concrete curing, and the rate of moisture loss as

the concrete dries. These factors could affect the performance of the slab. The manufacturer of the vapor barrier should be consulted in regard to the depth of the barrier below the slab.

The floor slab should be suitably reinforced and proper joints should be provided at the junctions of the slab and foundation system so that a small amount of independent movement can occur without causing damage. A minimum of 6 inches of structural fill should be provided between the bottom of the slab and the top of the shallow spread footing below. Otherwise, other arrangements should be made to allow for potential relative settlements, such as grade beams, thickened slabs with appropriate reinforcing steel or other appropriate details. A modulus of subgrade reaction of 150 pci should be used in the design of slabs-on-grade.

3.4 PAVEMENTS

Specific traffic information was not available in developing these pavement recommendations. For design purposes, we have assumed that passenger vehicles and light trucks will traffic all light/medium duty pavement areas. Heavy duty pavement areas will include entrances, service drives and bus parking areas, and will be trafficked by light to moderately loaded service vehicles, buses, refuse trucks, and fire engines.

The pavement subgrade should be prepared as described in Section 3.1. Above the subgrade, the sand subbase should be constructed using a minimum of 12 inches of Michigan Department of Transportation (MDOT) Class II Fine Aggregate fill (MDOT Division 3, Section 301 "2012 Standard Specifications for Construction", April 1, 2011) compacted to a minimum of 95% of the material's MDD as determined by Modified Proctor.

Due to the clayey soils encountered at the site, site grading and stormwater controls will be important to protect paved drives and parking areas. To further protect new paved areas, perimeter underdrains should be placed beneath pavement edges within the bottom portion of the pavement

sand subbase. Four (4) inch-diameter sock-tube backfilled with at least 6 inches of peastone cover should be used. The drains should flow via gravity to a common low point and into the off-site storm sewer system.

The aggregate base for pavement areas should follow MDOT Dense-Graded Aggregate Base Course Materials – Division 3, Section 302 and Division 9, Section 902, using a 21AA (Grading Requirements per MDOT Table 902-1) Limestone Dense-Graded Aggregate material with a minimum compacted thickness of 8 inches. This gravel base may be placed in one (1) lift and should be compacted to a minimum of 95% of the material's MDD as determined by Modified Proctor.

Light/medium duty bituminous pavement should consist of a 1.5 inch base course and a 1.5 inch surface course for a total thickness of 3.0 inches. Heavy duty bituminous pavement should consist of a 2.5 inch base course and a 1.5 inch surface course for a total thickness of 4.0 inches. The HMA material and binder should be selected in accordance with the Local Agency Programs Hot Mix Asphalt Selection Guidelines Revised November 1, 2017 and FHWA Approved December 26, 2017. Compaction of asphalt courses should range between 92% and 96% of the Theoretical Maximum Density (TMD).

Construction traffic should be minimized on the new pavement. If excessive construction traffic is anticipated on the pavement structure, the initial asphalt lift thickness could be increased and placement of the final lift could be delayed until the majority of the construction activities have been completed. This action will allow repair of localized failure, if any does occur, as well as reduce load damage on the pavement system.

A bond coat of emulsion should be used between the base course and wearing course when more than 48 hours have elapsed between placement of the courses, or the surface of the base course has been contaminated by soil or dust. Performance grade asphalt cement should be used in the

production of all bituminous mixtures. Reclaimed Asphalt Pavement (RAP) should not be used in the surface course.

After the pavement is complete, we recommend instituting a regular maintenance program that includes sealing of cracks and patching of distressed areas. This should reduce the effect of water infiltration and associated frost action.

In areas where the durability of Portland cement concrete (PCC) is desired over bituminous pavement (i.e., loading areas, dumpster pads) a rigid pavement is recommended. Concrete pavement should be constructed on a base layer of at least 6 inches of Michigan Department of Transportation (MDOT) Class II sand subbase (Division 9, Section 902, Grading Requirements per Table 902-3). The concrete slab should consist of a minimum of 6 inches of 4,000 psi, air entrained concrete (MDOT Division 6, Section 601 – PCC Pavement and Division 9, Section 901 – Cement and Lime); however, actual design of the slab including reinforcement type and spacing should be performed by the Project Structural Engineer.

These recommendations assume typical conditions during the June through September construction season. Any substitution of materials or deviation from these stated assumptions should be reviewed to assess potential impact on the recommended design.

3.5 GROUNDWATER CONTROL

Groundwater problems are not anticipated to be a significant issue during construction. However, because the native clay/clayey sand foundation materials generally tend to soften or loosen when exposed to free water, every effort should be made to keep the excavations dry if perched water is encountered or if rainfall occurs while the footing excavations are open. Ideally, the footings should be excavated, formed, and poured on the same day to reduce the potential for rainwater to affect footing subsoils. Any water which enters the footing excavation can likely be controlled by a gravity drain system, sump pump, or other minor dewatering procedure. Concrete should not be

placed in footing excavations containing water. Upon removal of any trapped water, the soils should be reviewed by a soils engineer and any soft areas replaced with structural fill per Section 3.1, as necessary.

As stated in Section 3.4, perimeter underdrains should be placed beneath all pavement edges within the lower portion of the 12 inches sand subbase. Four (4) inch-diameter sock-tube backfilled with at least 6 inches of peastone cover should be used. The drains should flow via gravity to a common low point and into the on-site storm sewer system. In addition, finger drains should extend radially out from the catch basins and gutter inlets.

Perimeter foundation drains should be installed along foundations where interior finished floor elevations are lower than perimeter grades, or where exterior grades slope toward the building. In addition, all roof drains should be diverted to downspouts which carry water away from foundations and supporting walls.

3.6 TEMPORARY EXCAVATION STABILITY

If excavations are anticipated for the proposed structure and/or utilities, shoring and bracing or flattening (laying back) of the slopes may be required to obtain a safe working environment. Excavations should be sloped or shored in accordance with local, state and federal regulations, including OSHA (CFR Part 1926) excavation trench safety standards. We recommend that all excavated soils be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. In addition, surface runoff water should be diverted away from the crest of the excavated slopes to prevent erosion and sloughing.

Localized areas of soft or unsuitable soils not detected by our borings or in unexplored areas may be encountered once construction begins. Vertical cuts in these soils may be unstable and may present a significant hazard because they can fail without warning. Therefore, temporary construction slopes greater than 5 feet high should not be steeper than one horizontal to one vertical

(1H: 1V) and excavated material should not be placed within 10 feet of the crest of any excavated slope.

Unbraced excavations may experience some minor localized instability (i.e., sloughing). To reduce potential sloughing, excavated slopes should be covered with plastic for protection from rainfall and moisture changes. It should be emphasized that continuous observations by personnel from our office are important during trenching or excavation operations at the site.

4.0 GENERAL COMMENTS

If significant changes are made in the plans and specifications or location of the proposed school building, a consultation should be arranged to review such changes with respect to the prevailing soil conditions. It may then be necessary to submit supplementary recommendations. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of Driesenga & Associates, Inc.

Driesenga & Associates, Inc. should be afforded the opportunity to review the project design drawings and specifications to verify the factors affecting subgrade and foundation performance comply with our recommendations.

It is recommended that the services of Driesenga & Associates, Inc. be engaged to observe excavation for the footings and to test and evaluate the soils in the footing excavations prior to placement of foundations in order to determine that the soils have the required bearing capacities. Monitoring and testing should also be performed to verify that suitable materials are used for controlled fills and that they are properly placed and compacted.

This report and any future reports or addenda performed for this site should be supplied to potential bidders prior to them submitting their proposals. We also recommend the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction.

This report was for geotechnical purposes only. We did not sample for environmental purposes or perform any analytical testing. However, the contractor should be prepared to handle environmental conditions encountered at this site that may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this property should be made available for review by bidders and the successful contractor.

This report has been prepared solely for the use of the client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in this project, unless written permission is granted by Driesenga & Associates, Inc. If this report or any of its contents are utilized by parties other than our original client and the project team members, Driesenga & Associates, Inc. can not be held responsible for the suitability of the field exploration, scope of services, or recommendations made for the new project. Driesenga & Associates, Inc. also is not responsible for the interpretation of our soil boring logs and the recommendations provided herein by other parties.

Driesenga & Associates, Inc. will evaluate this report for other parties and developments at this site, provided our original Client agrees to release this information in writing. However, before this report can be relied upon by other parties. Driesenga & Associates, Inc. must review the proposed development since the new project will likely require additional field exploration, laboratory tests, analysis, and modifications to our recommendations to adequately address the needs of the new project.

APPENDIX A

·FIGURE NUMBER 1 – SITE LOCATION·

·FIGURE NUMBER 2 – BORING LOCATIONS·

Figure Number: 1
Site Location

Project Name
Mt. Hope Elementary School

Project Number
2240647.3A

Project Location
1215 East Mt. Hope Avenue
Lansing, Michigan

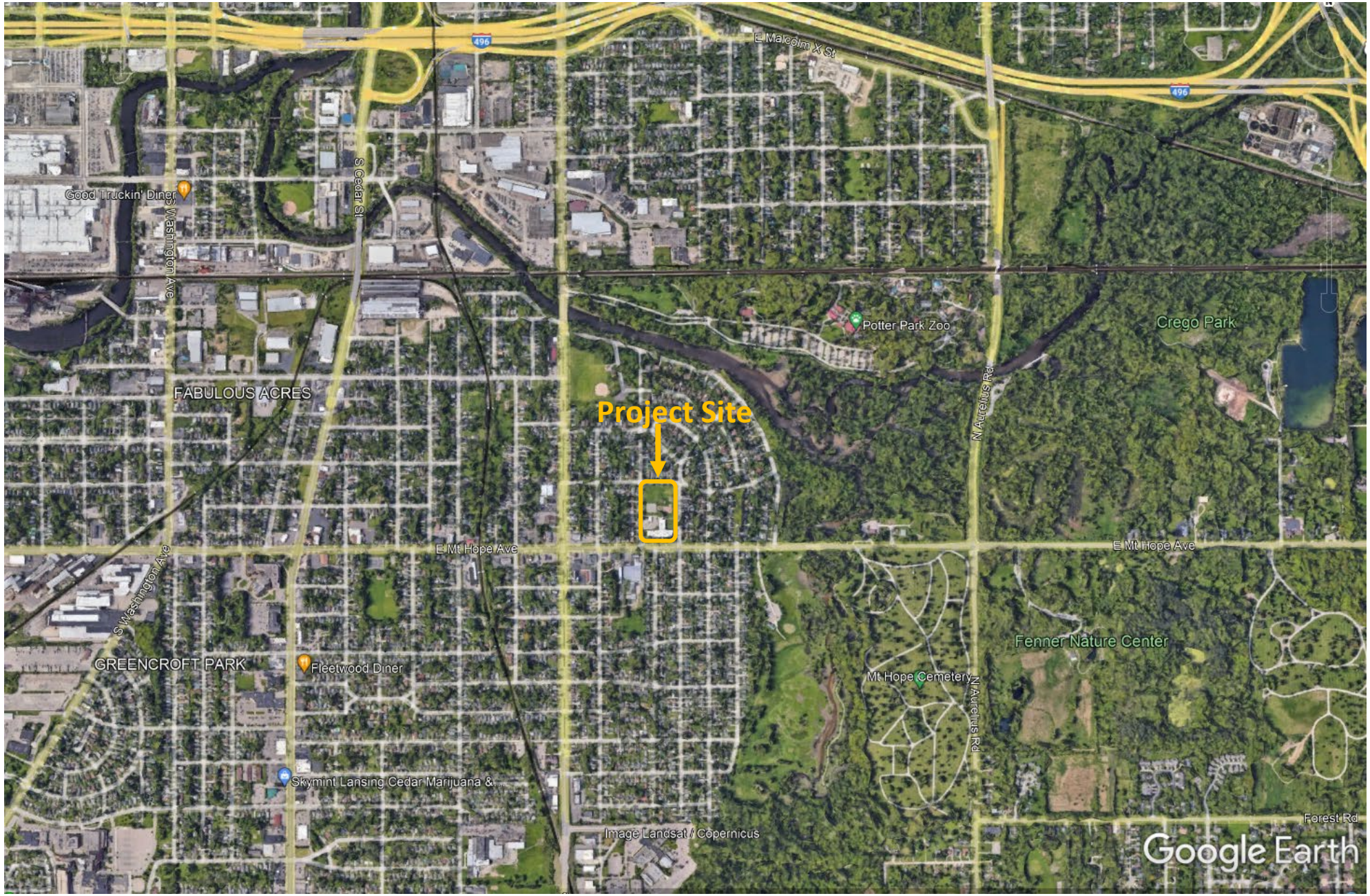

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Figure Number: 2
Boring Locations

Project Name
Mt. Hope Elementary School

Project Number
2240647.3A

Project Location
1215 East Mt. Hope Avenue
Lansing, Michigan

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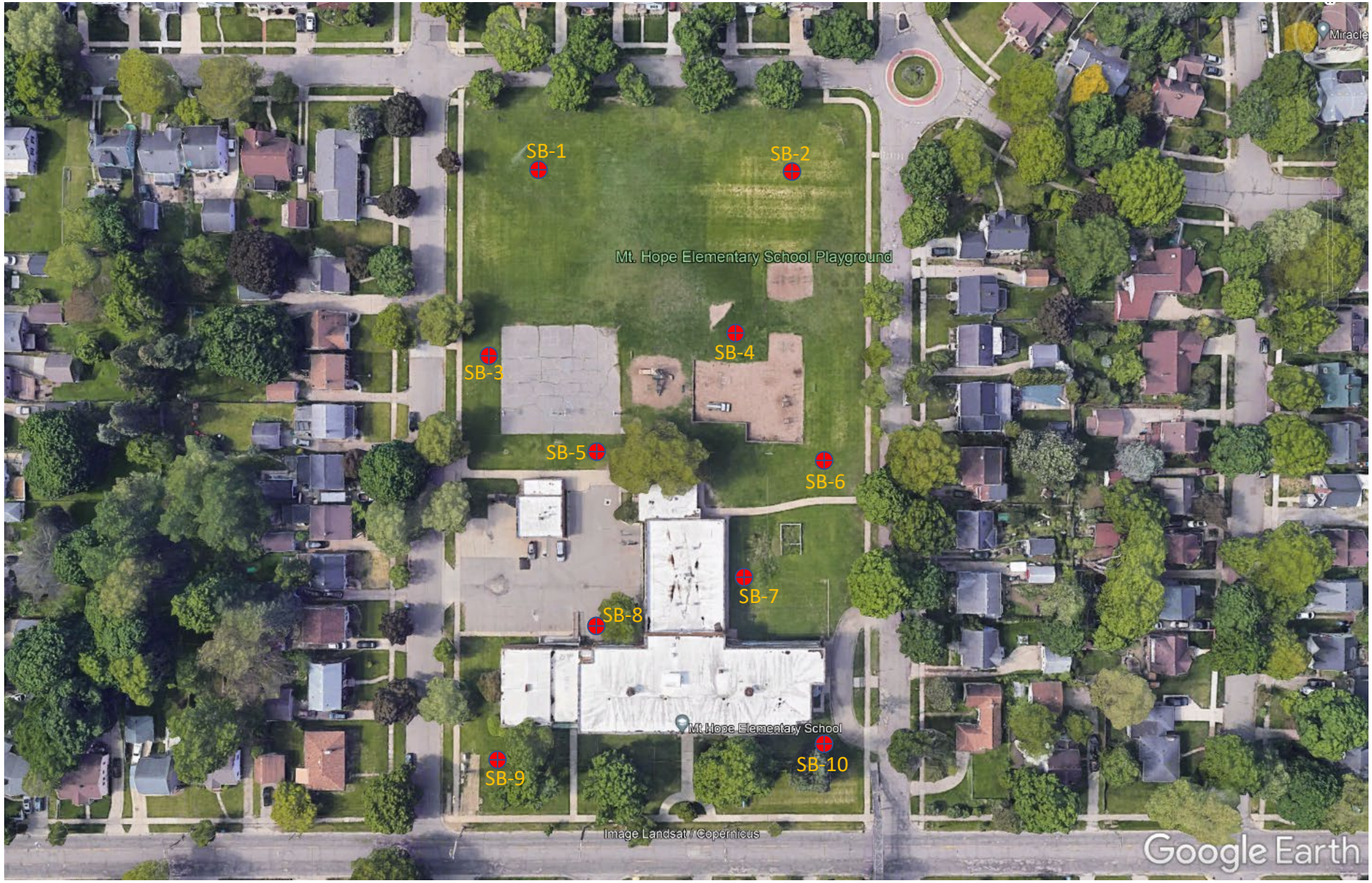

APPENDIX B

·SOIL BORING LOGS·

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SB-1

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 4 inches						
		SC		Clayey SAND, medium dense to dense, brown, fine to medium grained, trace gravel, moist.	1	5 9 11	20			
					2	6 7 9	16			
5					3	6 7 15	22			
					4	12 15 21	36			
10										
		SC		Clayey SAND, dense, gray, fine grained, trace gravel, moist.	5	9 18 15	33			
15				E.O.B. @ 15'						
20										
25										
30										

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SB-2

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : 9'
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : 9'

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 6 inches						
		SM		Silty SAND, loose, brown to gray, fine grained, trace gravel, moist.	1	3 3 4	7			
		SC		Clayey SAND, loose, brown to gray, fine to medium grained, trace gravel, moist.	2	3 2 3	5			
5		SM		Silty SAND, loose to medium dense, brown, fine to medium grained, trace gravel, moist to wet.	3	2 3 2	5			
					4	2 4 7	11		▼	
10										
					5	8 8 5	13			
15				E.O.B. @ 15'						
20										
25										
30										

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SB-3

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 4 inches						
		SC		Clayey SAND, medium dense, light brown, fine grained, trace gravel, moist.	1	5 6 8	14			
5					2	5 6 8	14			
					3	6 6 7	13			
10		CL		Sandy CLAY, very stiff, gray, trace gravel, moist.	4	5 7 7	14	3.0		
15					5	7 10 11	21	3.75		
20					6	6 8 11	19	2.25		
				E.O.B. @ 20'						
25										
30										

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DRIESENGA & ASSOCIATES, INC.
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SB-4

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : 9'
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : 9'

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 3 inches						
				TOPSOIL & SAND, medium dense, black, fine grained, trace gravel, moist.	1	4 5 4	9			
		CL		Sandy CLAY, stiff to very stiff, light brown, trace gravel, moist.	2	5 4 2	6	1.75		15
5					3	2 7 8	15	2.25		17
		SW		SAND, medium dense, brown, fine to coarse grained, some gravel, a little clay, moist to wet.	4	5 7 6	13		▼	
10				E.O.B. @ 10'						
15										
20										
25										
30										

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DRIESENGA & ASSOCIATES, INC.
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SB-5

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 5 inches						
				TOPSOIL & SAND, medium dense, black, fine grained, moist.	1	7 4 5	9			
		SW		SAND, medium dense, brown, fine to coarse grained, trace gravel, moist.	2	5 4 5	9			
5										
		SC		Clayey SAND, very loose to medium dense, light brown, fine to medium grained, moist.	3	2 2 4	6			
					4	2 1 2	3			
10										
					5	7 8 8	16			
15										
		CL		Sandy CLAY, very stiff, gray, trace gravel, moist.	6	6 7 13	20	3.5		9
20										
					7	4 7 9	16	2.75		9
25				E.O.B. @ 25'						
30										

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SB-6

Project: Mt. Hope Elementary School
1215 East Mt. Hope Avenue
Lansing, Michigan

Project No. 2240647.3A

Client: Lansing School District

Date Started	: Aug 31, 2022	Drilling Company	: Midwest Envirotech
Date Completed	: Aug 31, 2022	Field Sampling	: J. Spaans
Hole Diameter	: 6-inches	Reviewed By	: M. Pilot
Drilling Method	: Hollow-Stem Auger	GW Encountered	: Dry
Sampling Method	: Split-Spoon Sampler	GW Completed	: Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 7 inches						
		SP		SAND, loose to medium dense, brown, fine grained, trace gravel, moist.	1	3 4 4	8			
					2	5 6 5	11			
5										
		SM		Silty SAND, loose to medium dense, brown, trace gravel, trace clay, moist.	3	3 6 8	14			
					4	4 4 4	8			
10				E.O.B. @ 10'						
15										
20										
25										
30										

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SB-7

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 6 inches						
		SP		SAND, loose to medium dense, brown, fine grained, trace gravel, moist.	1	5 4 4	8			
					2	3 4 4	8			
5					3	3 3 4	7			
					4	3 5 5	10			
10		SW		SAND, medium dense, brown, fine to coarse grained, trace gravel, moist.						
		CL		Sandy CLAY, stiff to very stiff, brown to gray, trace gravel, moist.	5	4 7 8	15	2.5		10
15										
					6	3 5 4	9	1.5		13
20				E.O.B. @ 20'						
25										
30										

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SB-8

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				ASPHALT - 3 inches						
		SC		Clayey SAND, loose to medium dense, brown, fine to medium grained, trace gravel, moist.	1	6 7 7	14			
					2	5 5 5	10			
5					3	2 3 3	6			
					4	1 3 6	9			
10										
		CL		Sandy CLAY, stiff to very stiff, gray, trace gravel, trace silt, moist.	5	4 5 6	11	2.25		9
15										
					6	3 4 6	10	2.25		9
20										
					7	2 2 2	4	1.0		10
25				E.O.B. @ 25'						
30										

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SB-9

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 5 inches						
		SW		SAND, medium dense, brown, fine to medium grained, trace gravel, moist.	1	5 6 6	12			
		SM		Silty SAND, medium dense, light brown, fine grained, trace gravel, trace clay, moist.	2	6 5 10	15			
5					3	6 7 7	14			
					4	2 3 7	10			
10										
		CL		Sandy CLAY, very stiff, gray, trace gravel, moist.	5	5 7 10	17	3.25		10
15										
					6	5 6 7	13	4.0		13
20				E.O.B. @ 20'						
25										
30										

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DRIESENGA & ASSOCIATES, INC.
Engineering · Surveying · Testing

SB-10

Project: Mt. Hope Elementary School 1215 East Mt. Hope Avenue Lansing, Michigan	Date Started	: Aug 31, 2022	Drilling Company : Midwest Envirotech
	Date Completed	: Aug 31, 2022	Field Sampling : J. Spaans
	Hole Diameter	: 6-inches	Reviewed By : M. Pilot
Project No. 2240647.3A	Drilling Method	: Hollow-Stem Auger	GW Encountered : Dry
Client: Lansing School District	Sampling Method	: Split-Spoon Sampler	GW Completed : Dry

Water Levels
▼ During Drilling
▽ After Completion

Standard Hammer Used for SPT

Depth in Feet	Elev.	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	N Value	Pocket Pen (tsf)	Water Level	Moisture Content %
0				TOPSOIL - 3 inches						
		SW		SAND, medium dense to dense, brown, fine to coarse grained, trace gravel, moist.	1	15 18 14	32			
					2	3 4 7	11			
5					3	4 7 10	17			
					4	8 8 7	15			
10				E.O.B. @ 10'						
15										
20										
25										
30										

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APPENDIX C

·FIELD AND LABORATORY PROCEDURES·

FIELD PROCEDURES

The soil borings were performed using a truck-mounted drill rig equipped with a standard hammer. Split-barrel samples were obtained in the soil below the bottom of the augers in general accordance with the Standard Method for Penetration and Split-Barrel Sampling of Soils. Samples were collected at 2.5 feet intervals to 10 feet below grade, and every 5 feet thereafter. After recovery, the samples were removed from the split-spoon sampler, visually reviewed and classified, placed in glass jars and transported to our laboratory for additional review.

Soil samples stored for extended periods are susceptible to moisture loss and are no longer indicative of the conditions originally encountered in the soil borings. Therefore, soil samples are usually stored in our laboratory for a period of 60 days, unless instructed otherwise.

Soil boring logs were prepared based on field notes and visual classification of the samples in the laboratory. Indicated on each soil boring log is the description of each stratum observed, the approximate depth and/or elevation of each stratum change observed, Standard Penetration Test resistance values, and the observed groundwater levels. The soil boring logs are presented in Appendix B.

LABORATORY PROCEDURES

The laboratory testing program included supplementary visual classification of the samples in general accordance with the Unified Soil Classification System. The following two pages describe the soils classification procedure.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

Per ASTM D 2487—00
(Based on Unified Soil Classification System)

Soil Description: Secondary Soil Type BASIC SOIL TYPE, Consistency/Relative Density, Color, Supplemental Soil Type, Moisture, Miscellaneous comments.

Ex. Silty SAND, loose, brown, fine to medium, trace gravel, moist.

Secondary Soil Type – adjective for the BASIC SOIL TYPE describing material making up greater than 12% but less than 50% of the primary soil type by weight. For sands this also includes a description of grain size (fine, medium or coarse).

BASIC SOIL TYPE – primary constituent of sample; material making up greater than 50% of the sample by weight. Material is classified by grain size and material properties.

Consistency/Relative Density – a measurement of in-situ consistency or density of cohesive or cohesionless soils, respectively, based upon Standard Penetration Testing blow counts (N) per ASTM D 1586.

Color – visual inspection of soil appearance.

Supplementary Soil Type – a description of any other material that may be mixed with the BASIC SOIL TYPE. Qualifying terms are based on the percentage of the supplementary soil type in the sample by weight.

Moisture – description of the in-situ moisture content of the sample (dry, moist or wet).

Miscellaneous Comments – anything observed in the sample or in the field that does not fit into the above categories but should be noted (odor, etc.).

CALIBRATED AUTO HAMMER CONSISTENCY/RELATIVE DENSITY				
COHESIONLESS SOILS		COHESIVE SOILS		
SPT N-VALUES	IN-SITU RELATIVE DENSITY	SPT N-VALUES	SHEAR STRENGTH (PSF)	IN-SITU CONSISTENCY
0-3	VERY LOOSE	0-1	BELOW 250	VERY SOFT
4-8	LOOSE	2-3	250 - 500	SOFT
9-23	MEDIUM DENSE	4-6	500 - 1,000	MEDIUM STIFF
24-38	DENSE	7-12	1,000 - 2,000	STIFF
>38	VERY DENSE	13-25	2,000 - 4,000	VERY STIFF
		>26	OVER 4,000	HARD

STANDARD HAMMER CONSISTENCY/RELATIVE DENSITY				
COHESIONLESS SOILS		COHESIVE SOILS		
SPT N-VALUES	IN-SITU RELATIVE DENSITY	SPT N-VALUES	SHEAR STRENGTH (PSF)	IN-SITU CONSISTENCY
0-4	VERY LOOSE	0-2	BELOW 250	VERY SOFT
5-10	LOOSE	3-4	250 - 500	SOFT
11-30	MEDIUM DENSE	5-8	500 - 1,000	MEDIUM STIFF
31-50	DENSE	9-16	1,000 - 2,000	STIFF
>50	VERY DENSE	17-32	2,000 - 4,000	VERY STIFF
		>32	OVER 4,000	HARD

SUPPLEMENTAL TEXTURE QUALIFYING TERMS	
DESCRIPTOR	PERCENTAGE BY WEIGHT
TRACE	1-10%
LITTLE	10-20%
SOME	20-35%
AND	35-50%

SOIL CLASSIFICATION CHART (Per ASTM D2487)

Criteria for Assigning Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name
COHESIONLESS SOILS More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines[C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3[E]	GW	Well-graded gravel[F]
			Cu < 4 and/or 1 > Cc > 3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands More than 50% of coarse fraction retained on No. 4 Sieve	Clean Sands Less than 5% fines[D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3[E]	SW	Well-graded sand[F]
			Cu < 6 and/or 1 > Cc > 3[E]	SP	Poorly graded sand[F]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
COHESIVE SOILS 50% or more passes the No. 200 Sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI ≥ 7 and plots on or above 'A' line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below 'A' line[J]	ML	Silt[K,L,M]
		Organic	Liquid limit - oven dried < 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried < 0.75		Organic silt[K,L,M,0]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above 'A' line	CH	Fat clay[K,L,M]
			PI plots below 'A' line	MH	Elastic Silt[K,L,M]
		Organic	Liquid limit - oven dried < 0.75	OH	Organic Clay[K,L,M,P]
			Liquid limit - not dried < 0.75		Organic silt[K,L,M,0]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			PT	Peat

A Based on the material passing the 3-in. sieve

B If field sample contained cobbles or builders, or both, add "with cobbles or boulders or both" to group name

C Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

D Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

E $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10}*D_{60})$

F If soil contains ≥ 15% sand, add "with sand" to group name.

G If fines classify as CL-ML, use dual symbol GC-GM or SC-SM

H If fines are organic, add "with organic fines" to group name.

I If soil contains ≥ 15% gravel, add "with gravel" to group name.

J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant

L If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.

M If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name

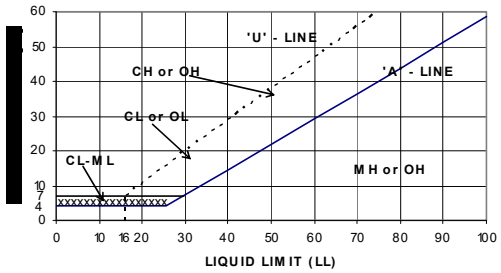
N PI ≥ 4 and plots on or above 'A' line.

O PI < 4 or plots below 'A' line.

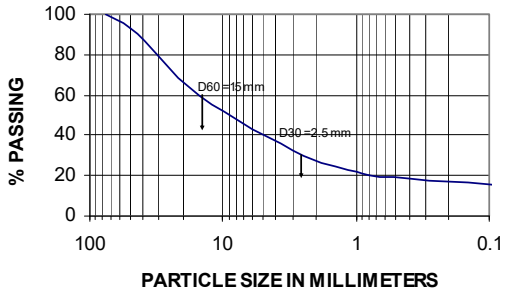
P PI plots on or above 'A' line.

Q PI plots below 'A' line.

For classification of fine-grained soils and fine-grained fraction of coarse-grained soils



SIEVE ANALYSIS



Local Agency Programs
Hot Mix Asphalt (HMA) Selection Guidelines
Revised: 11/01/2017
FHWA Approved: 12/26/2017

The following guidelines have been developed at the request of Local Agency Engineers for use on Local Agency projects. These guidelines have been reviewed and approved by the County Road Association of Michigan Engineering Committee. Previous experience and performance shall permit variations from these guidelines as per Sect D: Alternative Mixes**.**

A. HMA Mixture Type and Binder Selection

Selection is based on present day two-way commercial ADT. The commercial ADT ranges for each of the mixture types have taken into account an assumed future traffic growth rate.

Com. ADT.	Com. ADT 0-300	Com. ADT 301-700	Com. ADT 701-1000	Com. ADT 1001-3400	Com. ADT 3401- 9999
Mixture Type					
Top	LVSP or 13A, 36A	4C 5E1/4E1	5E3, or 4E3	5E10, or 4E10	5E30, or 5E10
Leveling	LVSP or 13A	3C 4E1	4E3	4E10	4E30
Base	13A / 3C	2C / 3C	3E3	3E10	3E30
Binder Grades by Region					
Superior	PG 58-34	PG 58-34	PG 58-34	PG 58-34	
Metro	PG 58-22	PG 64-22	PG 64-22	PG 64-22	PG 70-22P
All Other	PG 58-28	PG64-28	PG-64-28	PG64-28	PG70-28P

Note 1: If the designer wishes to reduce the target air voids on projects to 3.5%, a note needs to be added to the plans on the HMA Application Table stating that the air voids have been changed to 3.5% for that particular project for top and leveling courses. For mixtures meeting the definition of base course, field regress air void content to 3.0 percent with liquid asphalt cement unless specified otherwise on HMA application estimate.

Note 2: The mixture type in each traffic category listed in the above table is specifically designed to perform under their respective Commercial ADT. Selecting a mixture type that is specifically designed for a higher Comm. ADT than the project being designed may adversely affect performance.

Note 3: One course overlays on composite pavements where the prevention of cold temperature related thermal cracking is not as much of a concern, the cold temperature number of the PG binder may be decreased by one grade to help reduce costs.

Example: For a one course overlay in the Superior Region on a composite project, the recommended PG binder would be a PG58-28 instead of a PG58-34.

Note 4: To address traffic areas that are more susceptible to rutting early in pavements life such as signalized intersections and other areas of stop/start traffic use the pay item entitled **High Stress Hot Mix Asphalt Mixture**. The difference between the High Stress HMA Mixture and the typical HMA pay item is the Performance Graded binder. For High Stress Mixtures, increase the high temperature binder by one grade and add the polymer. The increase in the high temperature number results in an asphalt binder with improved high temperature stiffness or rutting resistance for both the leveling and top course.

Example: For a high stress application for a mixture type 5E3 placed in an intersection the recommended binder grade would be a PG70-28P instead of a PG64-28. Following are the recommend guides for the proper application of the Special Provision for High Stress Hot Mix Asphalt Mixture:

a. Use this pay item 1000 feet on either side of the center of signalized intersections and other areas where stop/start traffic occurs on the mainline (for quantity calculations use 1100 feet).

b. There are cases where the signalized intersections are spaced 1 mile or less over the entire length of the project. When this occurs, specify the High Stress HMA Mixture pay item for the entire length.

c. All HMA approaches that are adjacent to the High Stress HMA Mixture areas should be specified using this pay item.

d. Use of the Pay Item High Stress HMA (mix), should not be used unless it is to be distinguished from the same mix with a different PG grade.

B. Application Rates

HMA application rates shown in the table below are the required minimum and maximum rates for each of the specific mixtures. Pavement designs requiring a HMA greater than the recommended maximum will require multiple lifts of the leveling and/or base mixes.

Mixture Type	Marshall Mixture					**Superpave Mixture**				
	36A	13A	2C	3C	4C	LVSP	3E_	4E1	4E3+	5E_
Min. #/syd	110	165	350	220	165	165 Top or Leveling	330	165	220	165
Max. #/syd	165	275	500	330	275	220 Top 250 Leveling	410	330	275	220

Note 1: Application rate of 110 #/syd. per 1-inch thickness.

Note 2: When shoulders of 8 ft. or greater are being paved as a separate operation on a project, the following note should be added to the plans near the HMA Application Table; "For shoulders only, the mix design and/or JMF target value for Air Voids are to be adjusted to 2.5 percent." If it is not known whether the shoulders will be placed as a separate paving operation, the note should be added.

C: Aggregate Wear Index (All Projects)

Aggregate Wear Index (AWI) is required for all aggregates used in HMA top course mixtures. The following table identifies the required minimum AWI, based on the present average daily traffic (vehicular and commercial) per lane (ADT/Lane):

ADT/Lane	Minimum AWI
<100	None
100 - 2000	220
>2000	260

D: Alternative Mixes

These guidelines provide for the selection of Hot Mixed Asphalt (HMA) and application rates utilizing the Superpave mix design system along with the Marshall Mix design system. The substitution of another HMA mixture type other than the recommended mixture is acceptable if it has demonstrated to perform under similar traffic conditions. If a local agency desires to use an HMA mixture or grade of binder other than what is contained within this guide, they must submit the change in writing. The letter or email must include the alternate mix design, the justification/reason for the change, and a statement that they accept responsibility for the outcome of the performance of the mix design that is used in lieu of the recommended mixture.

E. Non-Motorized Path Mixes

When designing a Non-Motorized Path, recommended HMA Mixes that have historically worked well include:

Superpave mixes:

HMA, LVSP

HMA, 5E_

Shared Use Path, HMA Snowmobile Wearing Cse – Special (See: 12DS806(F355))

Marshall mixes:

HMA, 13A

HMA, 36A

No AWI is required on the top course, however, if the designer wishes, he or she can use the Aggregate Wear Index (AWI) of 220 minimum.

Use PG 58-28 for all mixes, except for HMA, 5E_, which should be PG 64/28.

Application rates should match the chart on the previous page (page 3 of 4).

F. Non-Motorized Path Alternative Mixes

If a local agency desires to use an HMA mixture or grade of binder other than what is contained within this guide, or if they propose another pavement treatment or type, they must submit the change request to the LAP Staff Engineer in writing. The letter or email must include the alternate mix design, or pavement treatment, the justification and/or reason for the change, and a statement that they accept responsibility for the outcome of the performance of the mix design that is used in lieu of the recommended mixture.

WE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK WHITE

NEW SCHOOL FOR:
LANSING SCHOOL DISTRICT

Mt. Hope

1215 E Mt Hope Ave, Lansing, MI 48910

PROJECT NUMBER: 220116

LANSING SCHOOL DISTRICT BOND: SB-1785

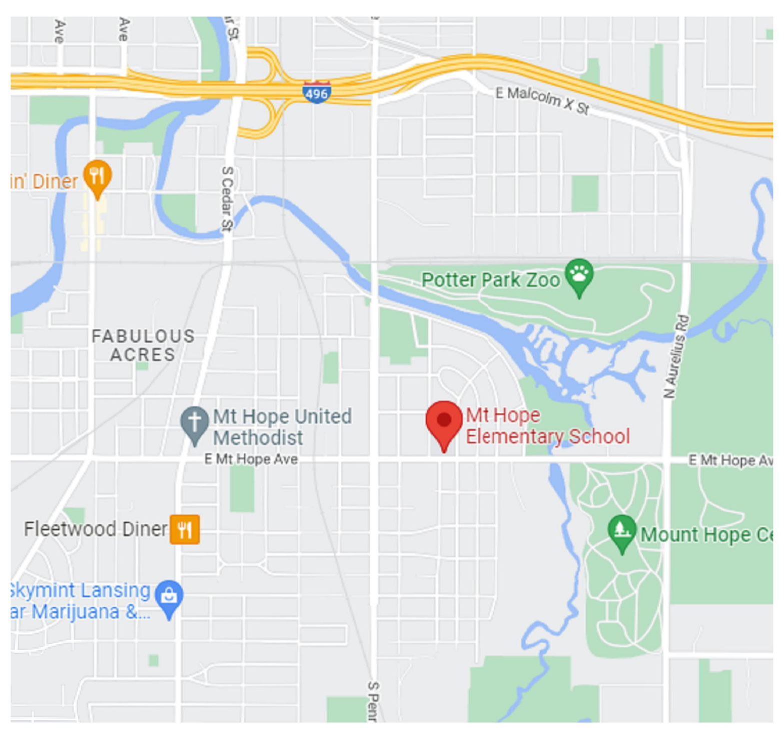
ISSUE DATE: 23-JUN-2023

100% CONSTRUCTION DOCUMENTS

N W E S

LOCATION MAP

NO SCALE



N W E S

VICINITY MAP

NO SCALE

811 Know what's below. Call before you dig.

IT IS UNDERSTOOD THAT THE CONTRACTOR SHALL PERFORM ALL WORK UNDER THIS CONTRACT IN ACCORDANCE WITH ALL APPLICABLE PROVISIONS, POLICIES, RULES AND STANDARDS OF THE MICHIGAN OCCUPATIONAL SAFETY AND HEALTH ACT (MDSHA), BEING ACT 154 OF THE PUBLIC ACTS OF 2013 AND AS AMENDED.

EXCEPT WHERE OTHERWISE INDICATED ON THE PLANS OR IN THE PROPOSAL SUPPLEMENTAL SPECIFICATIONS CONTAINED THEREIN, ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE APPLICABLE SECTIONS OF THE MICHIGAN DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION, 2012 EDITION, AND THE CURRENT SUPPLEMENTAL SPECIFICATIONS. (AVAILABLE AT WWW.MDOTJBOSS.STATE.MI.US/SPECPROV/SPECBOOKHOME.HTM#1468271)

THROUGHOUT THE DRAWING SET, THE GRAYSCALE LEGEND ON THE EDGE OF TITLE BLOCKS SHOULD TRANSITION FROM WHITE THROUGH EIGHT SHADES OF GRAY TO SOLID BLACK. IF THE GRAYSCALE SHADES ARE NOT DISTINCT, THE DRAWING(S) HAVE NOT PRINTED CORRECTLY.

6/26/2023 6:46:30 AM
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DESIGNED BY: Designer

CHECKED BY: Checker APPROVED BY: Approver

ALTERNATES:

ALT1: PUBLIC ADDRESS SYSTEM

REVISE PUBLIC ADDRESS SYSTEM.

ALT 2: FIVE VS. THREE YEAR WARRANTY

PROVIDE FIVE YEAR EQUIPMENT WARRANTY IN LIEU OF THREE YEAR BASE BID WARRANTY.

ALT 3: SURVEILLANCE CAMERA TYPE

REVISE SURVEILLANCE CAMERA TYPE

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TECHNOLOGY CONSULTANT
BARTON MALOW
26500 American Drive
Southfield, MI 48034

SHEET LIST

SHEET NO.	SHEET NAME
GENERAL	
G-001	COVER SHEET
G-101	LIFE SAFETY PLAN - OVERALL
CIVIL	
C-100	TOPOGRAPHICAL SURVEY
C-101	SESC
C-102	SITE DEMOLITION PLAN
C-103	SITE IMPROVEMENTS PLAN
C-104	SITE GRADING
C-105	SITE UTILITY PLAN
C-500	ADA RAMP DETAILS
C-501	CIVIL NOTES AND DETAILS
C-502	CIVIL DETAILS
C-503	CIVIL DETAILS
C-504	TYPICAL CROSS SECTIONS
C-505	SESC NOTES AND DETAILS
C-506	CIVIL NOTES AND DETAILS
L-100	LANDSCAPE PLAN
L-500	LANDSCAPE NOTES AND DETAILS
STRUCTURAL	
S-001	GENERAL NOTES AND LEGENDS
S-100	FOUNDATION PLAN - OVERALL
S-100A	FOUNDATION PLAN - AREA A
S-100B	FOUNDATION PLAN - AREA B
S-101	FRAMING PLAN - OVERALL LOW ROOF
S-101A	FRAMING PLAN - AREA A LOW ROOF
S-101B	FRAMING PLAN - AREA B LOW ROOF
S-102	FRAMING PLAN - OVERALL HIGH ROOF
S-102A	FRAMING PLAN - AREA A HIGH ROOF
S-102B	FRAMING PLAN - AREA B HIGH ROOF
S-103A	MASONRY FRAMING PLAN - AREA A
S-103B	MASONRY FRAMING PLAN - AREA B

SHEET LIST

SHEET NO.	SHEET NAME
S-201	FRAMING ELEVATIONS
S-202	FRAMING ELEVATIONS
S-203	FRAMING ELEVATIONS
S-301	READING NOOK DETAILS
S-302	SECTIONS
S-401	ENLARGED PLANS
S-501	FOUNDATION DETAILS
S-502	FRAMING DETAILS
S-503	FRAMING DETAILS
ARCHITECTURAL	
A-001	ARCHITECTURAL LEGENDS, SYMBOLS, AND ABBREVIATIONS
A-101	FLOOR PLAN - OVERALL
A-101A	FLOOR PLAN - AREA A
A-101B	FLOOR PLAN - AREA B
A-102	ROOF PLAN
A-102A	ROOF PLAN - AREA A
A-102B	ROOF PLAN - AREA B
A-111	REFLECTED CEILING PLAN - OVERALL
A-111A	REFLECTED CEILING PLAN - AREA A
A-111B	REFLECTED CEILING PLAN - AREA B
A-121A	EQUIPMENT PLAN - AREA A
A-121B	EQUIPMENT PLAN - AREA B
A-122	INTERIOR SIGNAGE
A-123	EXTERIOR SIGNAGE
A-131	ENLARGED FLOOR PLANS
A-201	EXTERIOR ELEVATIONS
A-202	EXTERIOR ELEVATIONS
A-211	CANOPY ELEVATION DETAILS
A-301	BUILDING SECTIONS
A-302	BUILDING SECTIONS
A-303	BUILDING SECTIONS
A-311	WALL SECTIONS
A-312	WALL SECTIONS

SHEET LIST

SHEET NO.	SHEET NAME
A-313	WALL SECTIONS
A-314	WALL SECTIONS
A-315	WALL SECTIONS
A-316	READING NOOK SECTIONS AND ELEVATIONS
A-401	INTERIOR ELEVATIONS - CLASSROOMS GENERAL
A-402	INTERIOR ELEVATIONS - CLASSROOMS SPECIFIC
A-403	INTERIOR ELEVATIONS - CAFETERIA
A-404	INTERIOR ELEVATIONS - CAFETERIA
A-405	INTERIOR ELEVATIONS - GYMNASIUM
A-406	INTERIOR ELEVATIONS - GYMNASIUM
A-407	INTERIOR ELEVATIONS - ANCILLARY SPACES
A-408	INTERIOR ELEVATIONS - CORRIDORS
A-409	INTERIOR ELEVATIONS - CLASSROOMS SPECIFIC
A-501	PLAN DETAILS
A-502	PLAN DETAILS
A-503	SECTION DETAILS
A-504	SECTION DETAILS
A-505	SECTION DETAILS
A-506	DOOR & WINDOW DETAILS
A-521	TYPICAL EXTERIOR ASSEMBLIES, DETAILS
A-522	READING NOOK DETAILS
A-523	CASEWORK DETAILS
A-531	ROOF DETAILS
A-601	SCHEDULES & DIAGRAMS
A-602	CURTAIN WALL & STOREFRONT ELEVATIONS
INTERIORS	
I-001	INTERIORS LEGENDS, SYMBOLS, AND ABBREVIATIONS
I-002	INTERIORS LEGENDS, SYMBOLS, AND ABBREVIATIONS
I-101	FINISH PLAN - OVERALL
I-101A	FINISH PLAN - AREA A
I-101B	FINISH PLAN - AREA B
I-131	ENLARGED PLANS
I-132	ENLARGED PLAN - GYMNASIUM

SHEET LIST

SHEET NO.	SHEET NAME
FIRE PROTECTION	
FP-001	FIRE PROTECTION SYMBOLS, SCHEDULES AND ABBREVATIONS
FP-111	FIRE PROTECTION PLANS
FP-501	FIRE PROTECTION DETAILS
PLUMBING	
P-001	PLUMBING LEGEND, SYMBOLS AND ABBREVIATIONS
P-110A	UNDERGROUND PLUMBING PLAN - AREA A
P-110B	UNDERGROUND PLUMBING PLAN - AREA B
P-111A	PLUMBING PLAN - AREA A
P-111B	PLUMBING PLAN - AREA B
P-301	ENLARGED PLUMBING PLANS
P-401	PLUMBING DIAGRAMS
P-501	PLUMBING DETAILS
P-502	PLUMBING DIAGRAMS
P-601	PLUMBING SCHEDULES
MECHANICAL	
M-001	MECHANICAL LEGEND, SYMBOLS, AND ABBREVIATIONS
M-111A	SHEET METAL PLAN - AREA A
M-111B	SHEET METAL PLAN - AREA B
M-112A	MECHANICAL AND PLUMBING LOWER ROOF AND UPPER CAFE PLAN - AREA A
M-112B	MECHANICAL AND PLUMBING LOWER ROOF AND UPPER GYM PLAN - AREA B
M-113	MECHANICAL AND PLUMBING UPPER ROOF PLAN
M-211A	HVAC PIPING PLAN - AREA A
M-211B	HVAC PIPING PLAN - AREA B
M-301	ENLARGED MECHANICAL PLANS AND SECTIONS
M-302	ENLARGED MECHANICAL PLANS AND SECTIONS
M-401	MECHANICAL DIAGRAMS
M-501	MECHANICAL DETAILS
M-502	MECHANICAL DETAILS
M-503	MECHANICAL DETAILS

SHEET LIST

SHEET NO.	SHEET NAME
M-601	MECHANICAL SCHEDULES
M-602	MECHANICAL SCHEDULES
M-603	MECHANICAL SCHEDULES
M-701	TEMPERATURE CONTROLS LEGEND
M-702	TEMPERATURE CONTROL DIAGRAMS
M-703	TEMPERATURE CONTROL DIAGRAMS
M-704	TEMPERATURE CONTROL DIAGRAMS
M-705	TEMPERATURE CONTROL DIAGRAMS
M-706	TEMPERATURE CONTROL DIAGRAMS
M-707	TEMPERATURE CONTROL DIAGRAMS
M-708	TEMPERATURE CONTROL DIAGRAMS
ELECTRICAL	
E001	ELECTRICAL SYMBOLS AND ABBREVIATIONS
E002	ELECTRICAL SYMBOLS AND ABBREVIATIONS
ES01	ELECTRICAL SITE PLAN
E111A	LIGHTING PLAN - AREA A
E111B	LIGHTING PLAN - AREA B
E112A	SECOND LEVEL LIGHTING PLAN - AREA A
E112B	SECOND LEVEL LIGHTING PLAN - AREA B
E211A	POWER & AUXILIARY PLAN - AREA A
E211B	POWER & AUXILIARY PLAN - AREA B
E212A	ROOF POWER & AUXILIARY PLAN - AREA A
E212B	ROOF POWER & AUXILIARY PLAN - AREA B
E301	ENLARGED ELECTRICAL PLANS
E302	ENLARGED ELECTRICAL PLANS
E401	ELECTRICAL SINGLE LINE DIAGRAM
E411	ELECTRICAL PANEL SCHEDULES
E412	ELECTRICAL PANEL SCHEDULES
E501	ELECTRICAL DETAILS
E502	ELECTRICAL DETAILS
E503	ELECTRICAL DETAILS
E601	LIGHTING FIXTURE SCHEDULE
E602	LIGHTING CONTROL DETAILS

SHEET LIST

SHEET NO.	SHEET NAME
E611	FIRE ALARM RISERS AND DIAGRAM
FOOD SERVICE	
FSE-1	FOOD SERVICE EQUIPMENT FLOOR PLAN
FSE-2	FOOD SERVICE EQUIPMENT SCHEDULE
FSE-3	FOOD SERVICE ELECTRICAL FLOOR PLAN
FSE-4	FOOD SERVICE PLUMBING FLOOR PLAN
FSE-5	FOOD SERVICE REFRIGERATION FLOOR PLAN
FSE-6	FOOD SERVICE VENTILATION FLOOR PLAN
TECHNOLOGY	
T0	TECHNOLOGY SYSTEMS
T1.1	1ST FLOOR COMPOSITE TECHNOLOGY PLAN
T3.1A	1ST FLOOR UNIT A DATA INFRASTRUCTURE
T3.1B	1ST FLOOR UNIT B DATA INFRASTRUCTURE
T4.1A	1ST FLOOR UNIT A CLOCK SYSTEM PUBLIC ADDRESS SYSTEM
T4.1B	1ST FLOOR UNIT B CLOCK SYSTEM PUBLIC ADDRESS SYSTEM
T5.1A	1ST FLOOR UNIT A AUDIOVISUAL SYSTEMS
T5.1B	1ST FLOOR UNIT B AUDIOVISUAL SYSTEMS
T6.1A	1ST FLOOR UNIT A ACCESS CONTROL SYSTEM
T6.1B	1ST FLOOR UNIT B ACCESS CONTROL SYSTEM
T7.1	1ST FLOOR COMPOSITE VIDEO SURVELLIANCE SYSTEM
T9.1	TYPICAL CLASSROOM SCHEMATIC, ELEVATIONS, DETAILS
T9.2	CAFETERIA AUDIOVISUAL SCHEMATIC NORTH WALL ELEVATION
T9.3	DETAILS
T9.4	DETAILS

CIVIL	STRUCTURAL	ARCHITECTURAL	MECHANICAL	ELECTRICAL

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PROJECT NUMBER : 214100605

LANSING SCHOOL DISTRICT
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COVER SHEET

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116

DATE: 23-JUN-2023

SHEET

G-001

100% CONSTRUCTION DOCUMENTS

APPLICABLE CODES AND STANDARDS

APPLICABLE CODES	EDITION:
BUILDING CODES:	
NFPA 101 LIFE SAFETY CODE	2012
MICHIGAN BUILDING CODE	2015
INTERNATIONAL FIRE CODE	2015
2015 MICHIGAN ENERGY CODE	2015
ASHRAE 90.1 2013	
PLUMBING CODE:	
MICHIGAN PLUMBING CODE	2015
HVAC CODE:	
ASME BOILER AND PRESSURE VESSEL CODE	
ASME CODE FOR PRESSURE PIPING	
ASHREA STANDARD 62.1 - VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY	2004
ASHREA STANDARD 15 - SAFETY STANDARD FOR REFRIGERATION SYSTEMS	2007
MICHIGAN MECHANICAL CODE	2015
ELECTRICAL CODE:	
NATIONAL ELECTRICAL CODE	2017

CODE SUMMARY

CODE SUMMARY IS BASED ON THE FOLLOWING CRITERIA:
NEW BUILDING IS TO BE SPRINKLERED THROUGHOUT.
MEETS THE REQUIREMENTS OF NFPA 101, 2012.
CHAPTER 14 - NEW EDUCATIONAL

OCCUPANCY CLASSIFICATION:
- E EDUCATION

BUILDING AREA:
- NEW BUILDING AREA: 57,290 SF

TYPES OF CONSTRUCTION:
- III (200) AND 3B

AUTOMATIC SPRINKLER SYSTEM:
- YES, TO BE SPRINKLED

FIRE ALARM SYSTEM AND SMOKE DETECTION:
- YES

EGRESS REQUIREMENTS:
- AS SHOWN BELOW

OCCUPANCY LOAD:
- CLASSROOM 1/20 SF NET
- LAB 1/50 SF NET
- LOCKERS 1/15 SF GROSS
- EXERCISE 1/50 SF GROSS
- LAB W/ GAS = 1 HOUR
- LABS WITH 3 OR MORE GAS : REMOTE SHUT OFF
- MEANS OF EGRESS (DOORS) = 0.2"/OCCUPANCY
- DEAD ENDED CORRIDOR CORRIDOR = 20' MAX
- TRAVEL DISTANCE BETWEEN EXISTING= 200' MAX

FIRE CODE RATINGS

- SMOKE TIGHT PARTITION
- 1-HR. FIRE RATED WALL
- 2-HR. FIRE RATED WALL

SYMBOL LEGEND

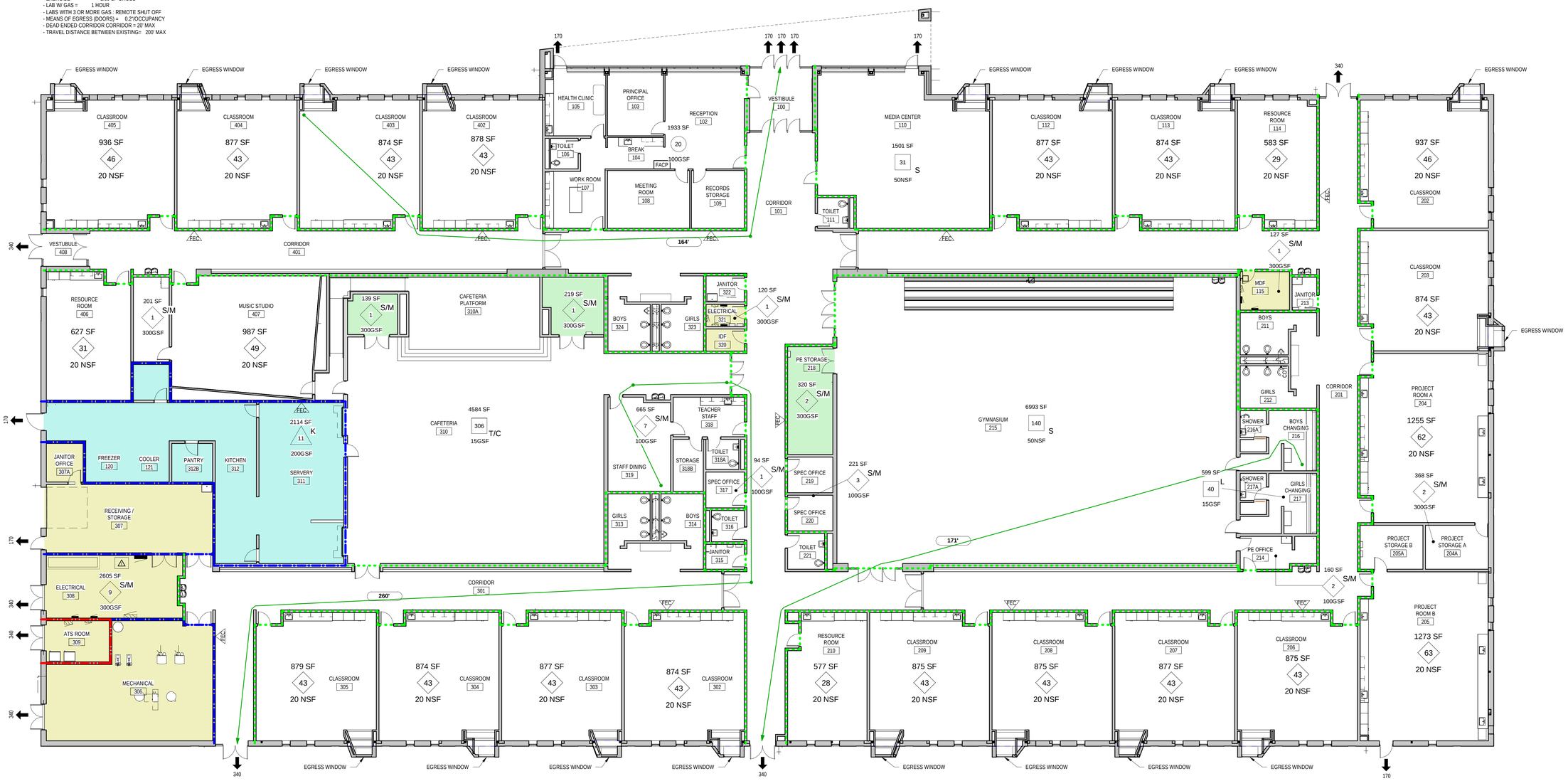
- EXIT
- FEC — FIRE EXTINGUISHER CABINET
- DIST. TO EXIT / PERSONS TO EXIT — EGRESS PATH COMPUTATION
- ### — EGRESS PATH DISTANCE IN FT

- EDUCATION
- KITCHEN
- MECHANICAL
- STORAGE

MBC TABLE

MAX. FLOOR AREA ALLOWANCES PER OCCUPANT FUNCTION OF SPACES SYMBOL LEGEND

000 SF / S/M / 00 / 00 GSF — ACCESSORY STORAGE AND MECHANICAL EQUIPMENT ROOMS 300 SF GROSS / OCC	000 SF / C / 00 / 00 NSF — EDUCATIONAL: CLASSROOM 20 SF NET / OCC
000 SF / 00 / FS / 00 NSF — ASSEMBLY: FIXED SEATING REFER TO PLANS PER SECTION 1004.4	000 SF / S/V / 00 / 00 NSF — EDUCATIONAL: SHOPS AND VOCATIONAL 50 SF NET / OCC
000 SF / 00 / C / 00 NSF — ASSEMBLY: CONCENTRATED (CHAIRS ONLY) 7 SF NET / OCC	000 SF / K / 00 / 00 GSF — KITCHENS, COMMERCIAL 200 SF GROSS / OCC
000 SF / 00 / S / 00 NSF — ASSEMBLY: STANDING SPACE 5 SF NET / OCC	000 SF / 00 / 00 GSF — BUSINESS AREAS 100 SF GROSS / OCC
000 SF / 00 / T/C / 00 NSF — ASSEMBLY: UNCONSECRATED (TABLES AND CHAIRS) 15 SF NET / OCC	000 SF / 00 / R / 00 NSF — ASSEMBLY: READING ROOM 50 SF NET / OCC
000 SF / 00 / L / 00 NSF — EDUCATION: LOCKER ROOM 15 SF NET / OCC	



LIFE SAFETY PLAN
3/32" = 1'-0"

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LIFE SAFETY PLAN - OVERALL

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
G-101

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
6/26/2023 8:49:39 AM
Acadatek Docs:\220116_LSD - Mt HOPE\220116_A.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

SURVEY LEGEND

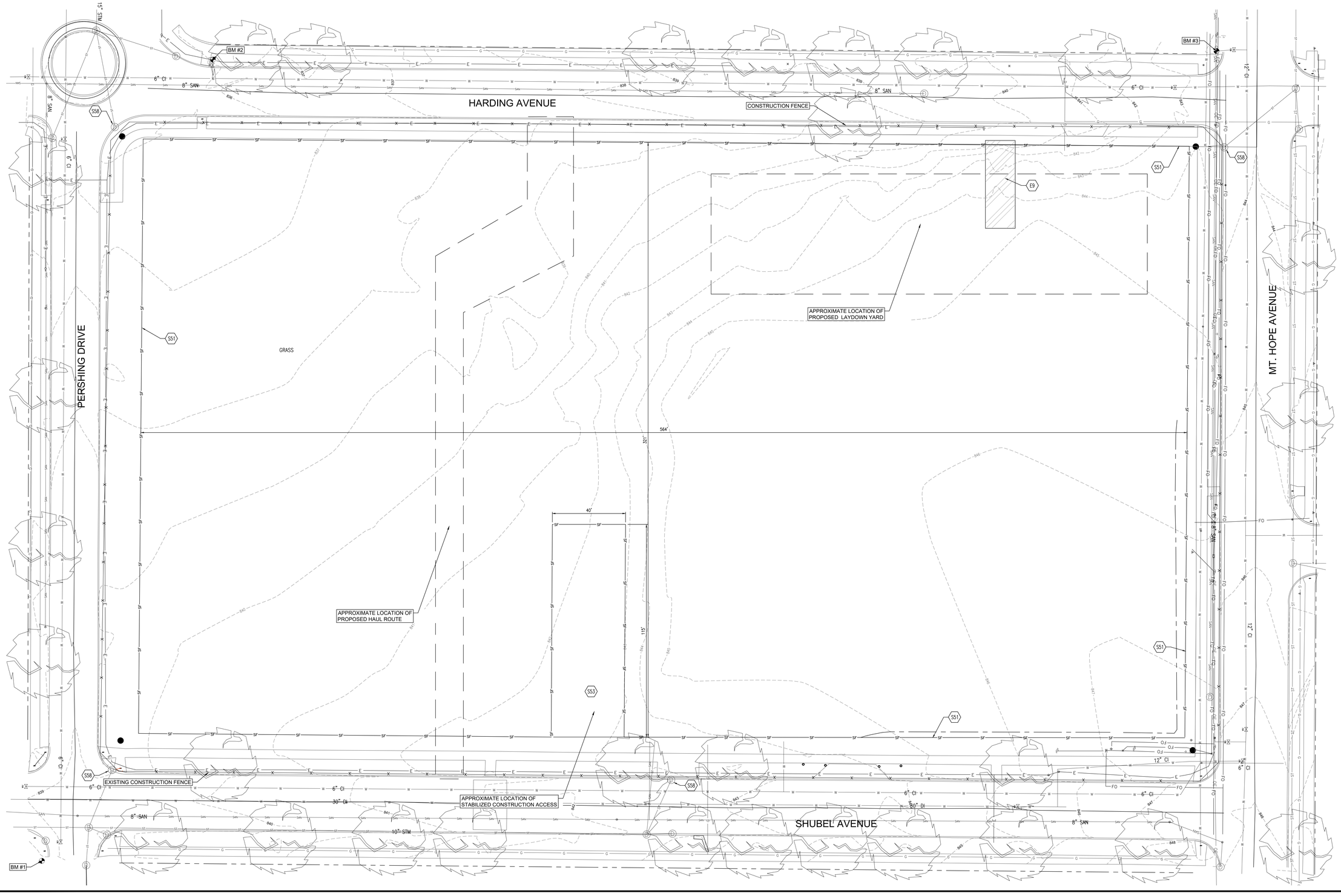
- = RIGHT-OF-WAY
- = PROPERTY LINE
- OE = EXISTING OVERHEAD ELECTRIC
- E = EXISTING UNDERGROUND ELECTRIC
- G = EXISTING GAS LINE
- SAN = EXISTING SANITARY SEWER
- ST = EXISTING STORM SEWER
- T = EXISTING UNDERGROUND TELEPHONE
- W = EXISTING WATER MAIN
- SF = EXISTING SILT FENCE
- X = EXISTING CONSTRUCTION FENCE
- E9 = EX. MULCH BLANKET
- S51 = EX. SILT FENCE
- S53 = EX. STABILIZED CONSTRUCTION ACCESS
- S58 = EX. INLET FABRIC DROP

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE

0 10 20 40 Feet
5 15 30



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MT. HOPE
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TOPOGRAPHIC SURVEY

REVISIONS

REV	DESCRIPTION	DATE
-	-	-

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-100

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK

THE RECYCLE

PLOTTED BY: MEAVE, GABRIEL 6/23/2023 4:45 PM
DWG: C:\Users\gabriel.meave@stantec.com\DESKTOP\LANSING SCH DIST MT HOPE\SHEETSET\01 LSD MT HOPE_BASE_SURVEY\E\E2.DWG - TOPOGRAPHIC SURVEY
CAD STANDARDS: B-TB

DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

SESC LEGEND

- SF — SILT FENCE
- CONSTRUCTION LIMITS
- 843 — EXISTING CONTOUR
- 843 — PROPOSED CONTOUR
- HYDROMULCH AREA
- MULCH BLANKET

SESC NOTES

1. CONTRACTOR SHALL HYDRO SEED MULCH IN ACCORDANCE WITH SHEET C-505
2. ALL AREAS DISTURBED SHALL BE HYDROMULCH SEEDED AT THE FOLLOWING RATE AND MIXTURE;
   RATE=8 LBS/1000 SFT
   25% PARK KENTUCKY BLUEGRASS
   15% PENNLAWN CREEPING RED FESCUE
   15% PENNFINE PERENNIAL RYE GRASS
   20% RUGBY KENTUCKY BLUEGRASS
   25% BANFF OR BRONCO KENTUCKY BLUEGRASS
   WEED SEED SHALL NOT EXCEED 0.35% BY WEIGHT IN THE TOTAL AMOUNT SUPPLIED.
3. CONTRACTOR SHALL PLACE/MAINTAIN PROPOSED SESC MEASURES FOR THE DURATION OF THE PROJECT, UNLESS OTHERWISE NOTED.
4. THE CONTRACTOR SHALL REMOVE, SALVAGE, AND TEMPORARILY STORE EXISTING TOPSOIL ON SITE FOR FUTURE USE. STORAGE AREA TO BE APPROVED BY CONSTRUCTION MANAGER.
5. THE CONTRACTOR SHALL RENEW THE EXISTING SESC PERMIT AND SHALL ASSUME RESPONSIBLE OF ALL REQUIRED ACTIVITIES AND APPURTENANCES.

SOIL EROSION CONTROL MEASURES KEY

KEY	DETAIL	NOTES
E5	DUST CONTROL	USE OF AN APPROVED TACKIFIER WITH DUST CONTROL IS REQUIRED.
E7	MAINTAIN TEMPORARY SEEDING	SEE RESTORATION REQUIREMENTS
E9	MULCH BLANKETS	SEE RESTORATION REQUIREMENTS
S51	SILT FENCE	CONTRACTOR SHALL MAINTAIN UNTIL TURF IS ESTABLISHED
S53	STABILIZED CONSTRUCTION ACCESS	USE MDOT GEOTEXTILE SEPARATOR, WOVEN SEE TABLE 910-1
S58	INLET PROTECTION-FABRIC DROP	CATCH BASIN SILT GUARD SHALL BE "SILT SACK" AS MANUFACTURED BY ACF OR "BASIN BAG" AS SUPPLIED BY CONSTRUCTION SUPPLY INC., OR APPROVED EQUAL

SESC DETAILS UTILIZE STATE OF MICHIGAN, DEPARTMENT OF TECHNOLOGY MANAGEMENT AND BUDGET, INFRASTRUCTURE SERVICES, DESIGN AND CONSTRUCTION DIVISION "SOIL EROSION AND SEDIMENTATION CONTROL GUIDEBOOK".

RESTORATION REQUIREMENTS:

TURF SEED SHALL BE MDOT TUF SEED MIXTURE APPLIED AT 220# PER ACRE (APPLIED BY HYDROMULTCHING)

FERTILIZER SHALL BE MDOT CLASS A APPLIED AT 228 POUNDS OF CHEMICAL FERTILIZER NUTRIENT PER ACRE.

MULCH BLANKETS IN DITCH LINES OR ON SIDE SLOPES SHALL BE S150BN – 10 OUNCES PER SQUARE YARD.

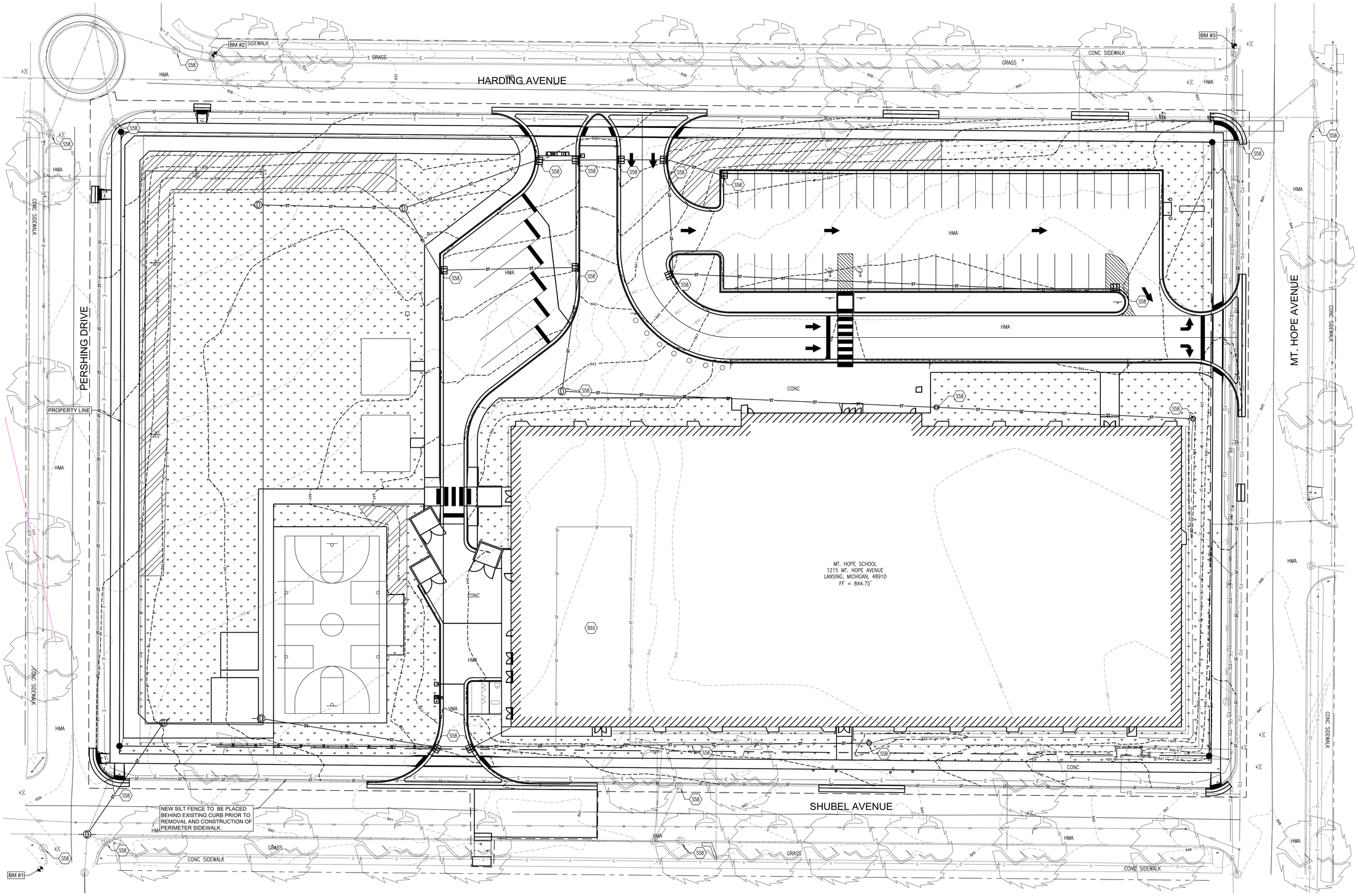
TOTAL AREA OF DISTURBANCE
188,407 SFT = 4.33 ACRES

BM #1 2173 – ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 – ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 – ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE

0 10 20 40 Feet
5 15 30



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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

SESC PLAN

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-101

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK
WE RECYCLE

PLOTTED BY: MEVER, GABRIEL 5/23/2023 4:42 PM
FILE: C:\Users\gabriel.meyer\AppDataLocal\Temp\AcPublish_12520\MT HOPE\SHEETS\220116_LSD_MTHOPE_GRAD_SUR-PRT\SESC PLAN - SESC PLAN
CAD STANDARDS: STD
DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

DEMOLITION LEGEND

- CONSTRUCTION LIMITS
- REMOVE EXISTING CONCRETE CURB AND GUTTER
- REMOVE EXISTING CONCRETE SURFACE, SAWCUT AT REMOVAL LIMITS, INCLUDING BASE MATERIAL
- REMOVE EXISTING HMA SURFACE, SAWCUT AT REMOVAL LIMITS, INCLUDING BASE MATERIAL
- TREES TO BE REMOVED

SITE PROTECTION KEY

1. PROTECT EX. UTILITY STRUCTURE TO REMAIN.
2. PROTECT EX. UNDERGROUND UTILITY TO REMAIN.
3. PROTECT EX. TREE TO REMAIN. SEE SHEET C-505 FOR DETAIL.
4. PROTECT EX. PROPERTY CORNER

SITE REMOVAL KEY

1. REMOVE EX. CONCRETE SURFACE
2. REMOVE EX. TREE.
3. REMOVE EX. HMA SURFACE
4. REMOVE EX. GATE

DEMOLITION NOTES

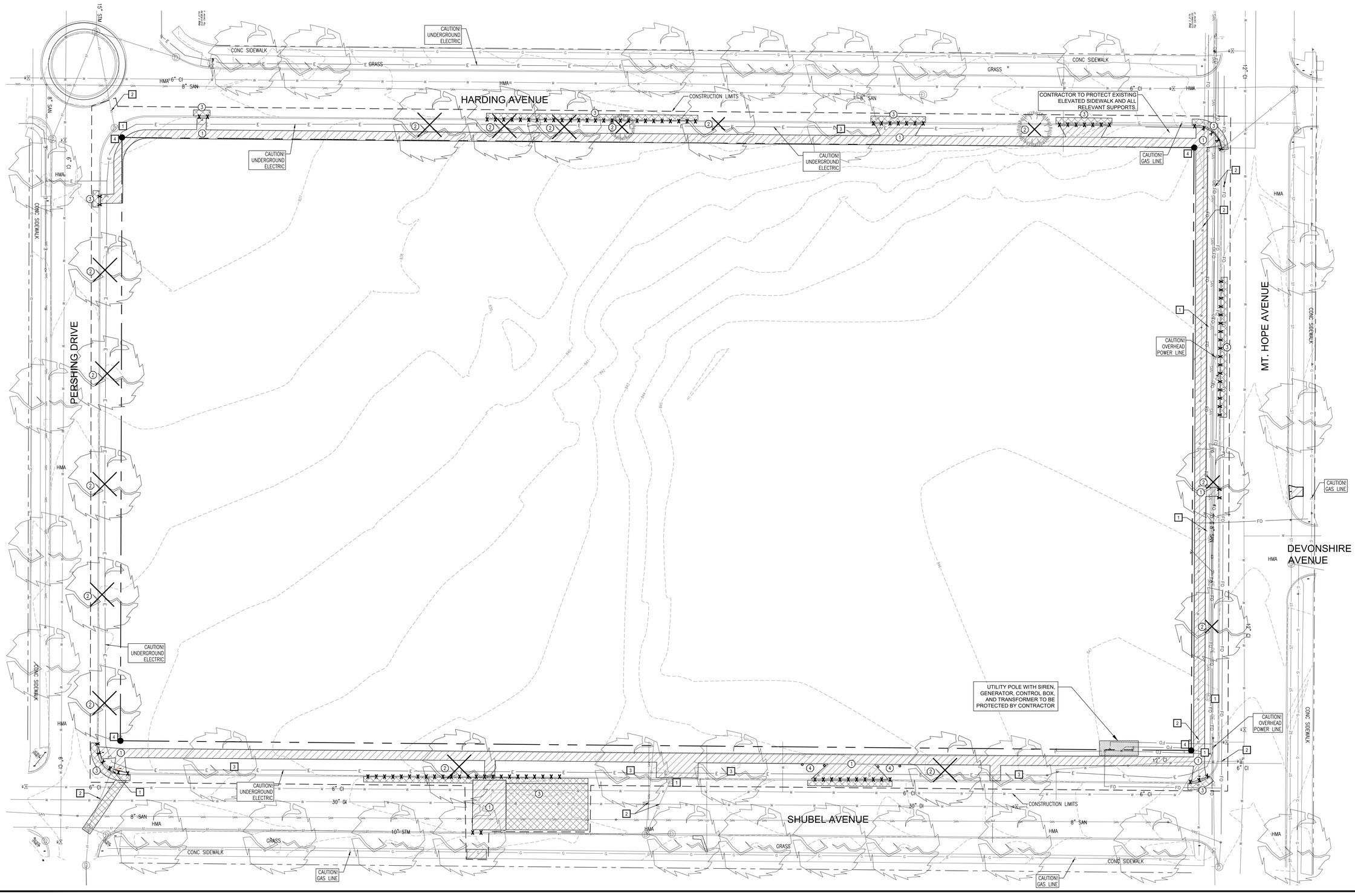
1. THE INFORMATION CONTAINED ON THESE DRAWINGS PERTAINING TO EXISTING CONDITIONS, SUCH AS BUT NOT LIMITED TO, UTILITIES, AND TOPOGRAPHY IS FURNISHED SOLELY AS THE BEST INFORMATION AVAILABLE, ITS ACCURACY IS NOT GUARANTEED AND IS CONSIDERED "INCOMPLETE". THE USE OF THIS INFORMATION DOES NOT PROVIDE THE CONTRACTOR RELIEF FROM ANY RESPONSIBILITY FOR DAMAGES DUE TO ANY INACCURACIES.
2. CONTRACTOR IS RESPONSIBLE FOR ESTABLISHING AND MAINTAINING HORIZONTAL AND VERTICAL CONTROL POINTS, BENCHMARKS, ETC. CONTRACTOR IS RESPONSIBLE FOR PROVIDING CONSTRUCTION STAKING AND FIELD LAYOUT. IT IS RECOMMENDED THAT TWO (2) BENCHMARKS BE USED FOR VERIFICATION OF ALL CONSTRUCTION ELEVATIONS. SET ADDITIONAL BENCHMARKS, AS NEEDED, TO COMPLY WITH THIS REQUIREMENT.
3. CONTRACTOR SHALL CONDUCT ALL EXCAVATION, FILLING, GRADING, AND CLEAN-UP OPERATIONS IN A MANNER SUCH THAT SEDIMENT GENERATED BY WIND OR WATER IS NOT DISCHARGED OFF SITE INTO THE AIR, ANY STORM SEWER OR UNDERGROUND UTILITY SYSTEM, DRAINAGE DITCH, RIVER, OR LAKE. STAGE THE WORK TO MINIMIZE THE AREA OF EXPOSED SOIL, THEREBY REDUCING THE OPPORTUNITY FOR SOIL EROSION.
4. CONCRETE PAVEMENT REMOVALS SHALL BE TO THE NEAREST EXISTING CONTROL JOINT OR ISOLATION JOINT BEYOND AREA INDICATED ON THE PLANS TO BE REMOVED. CONCRETE AND BITUMINOUS PAVEMENT SHALL BE SAWCUT FULL DEPTH AND SQUARE TO EX. CURB WHEN PRESENT. REMOVALS WILL BE MADE TO PROVIDE FOR PROPER GRADE TRANSITIONS AND CONNECTIONS.
5. ALL AREAS DISTURBED OUTSIDE OF THE CONSTRUCTION LIMITS SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN EXISTED PRIOR TO CONSTRUCTION AND TO THE SATISFACTION OF THOSE HAVING JURISDICTION, UNLESS NOTED OTHERWISE ON THE PLANS.
6. ALL ESTABLISHED LAWN AREAS DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE SEEDED AND MULCHED. SEEDING AND MULCHING SHALL BE DONE IN ACCORDANCE WITH THE GENERAL SPECIFICATIONS.
7. THE CONTRACTOR WILL PROVIDE HAUL ROADS AS REQUIRED TO ACCESS THE SITE.
8. EXISTING CONTOURS ARE BASED ON PREVIOUS BUILDING DEMOLITION CONTRACT, CONTRACTOR TO VERIFY

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE

0 10 20 40 Feet
5 15 30



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LANSING SCHOOL DISTRICT
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LANSING, MI

SITE DEMOLITION PLAN

REVISIONS

REV	DESCRIPTION	DATE
-	-	-

PROJ. #: 220118
DATE: 23-JUNE-2023
SHEET
C-102

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK
WE RECYCLE

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DWG: C:\PROJECTS\PROJECTS\LANSING SCHOOL DISTRICT\220118 LSD MT HOPE\SHEETS\220118_LSD_MT HOPE_SITE PLAN.DWG
LAYOUT: C-102 DEMOLITION SITE PLAN
DESIGNED BY: -
APPROVED BY: -
CHECKED BY: -

SITE IMPROVEMENT NOTES

1. ALL AREAS SHOWN NOT BUILT, PAVED OR OTHERWISE COVERED BY CONSTRUCTION SHALL BE HYDROMULCH SEEDED, REFER TO SPECS FOR DETAILS.
2. ALL AREAS DISTURBED BY CONSTRUCTION WHICH ARE OUTSIDE THE CONSTRUCTION LIMITS SHALL BE RESTORED TO A CONDITION EQUAL TO, OR BETTER THAN EXISTING CONDITIONS.
3. THE SITE CONTRACTOR SHALL COORDINATE WORK WITH ALL ADJACENT CONSTRUCTION BY OTHERS.
4. REFER TO SHEET C-104 FOR SITE GRADING DESIGN.
5. REFER TO SHEET C-105 FOR SITE UTILITY DESIGN.

CONSTRUCTION NOTES

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF LANSING'S CURRENT STANDARDS AND SPECIFICATIONS.
2. THE CONTRACTOR SHALL NOTIFY THE LANSING SCHOOL DISTRICT AND/OR THE AUTHORITY HAVING JURISDICTION, 48 HOURS PRIOR TO BEGINNING CONSTRUCTION.
3. WHERE CURB AND GUTTER IS ADJACENT TO CONCRETE SIDEWALK THE CONTRACTOR SHALL ALIGN THE EXPANSION JOINTS WITH ON ANOTHER.

SITE IMPROVEMENT LEGEND

- CONSTRUCTION LIMITS
- MDOT TYPE F4 CONCRETE CURB AND GUTTER — 6 / C-501
- MDOT TYPE F4 CONCRETE CURB AND GUTTER – WASH OUT GUTTER PAN. TRANSITION FROM STANDARD GUTTER TO WASH OUT 10' EACH SIDE OF LIMITS NOTED. — 5 / C-501
- MDOT TYPE D2 MOUNTABLE CURB AND GUTTER — 1 / C-501
- HMA PAVEMENT — 30 / C-504
- CONCRETE PAVEMENT 6" THICK OVER SAND SUBBASE
- CONCRETE SIDEWALK — 4 / C-501
- × 1 SITE LAYOUT POINT COORDINATE NUMBER SEE SHEET C-503

SITE IMPROVEMENT KEY

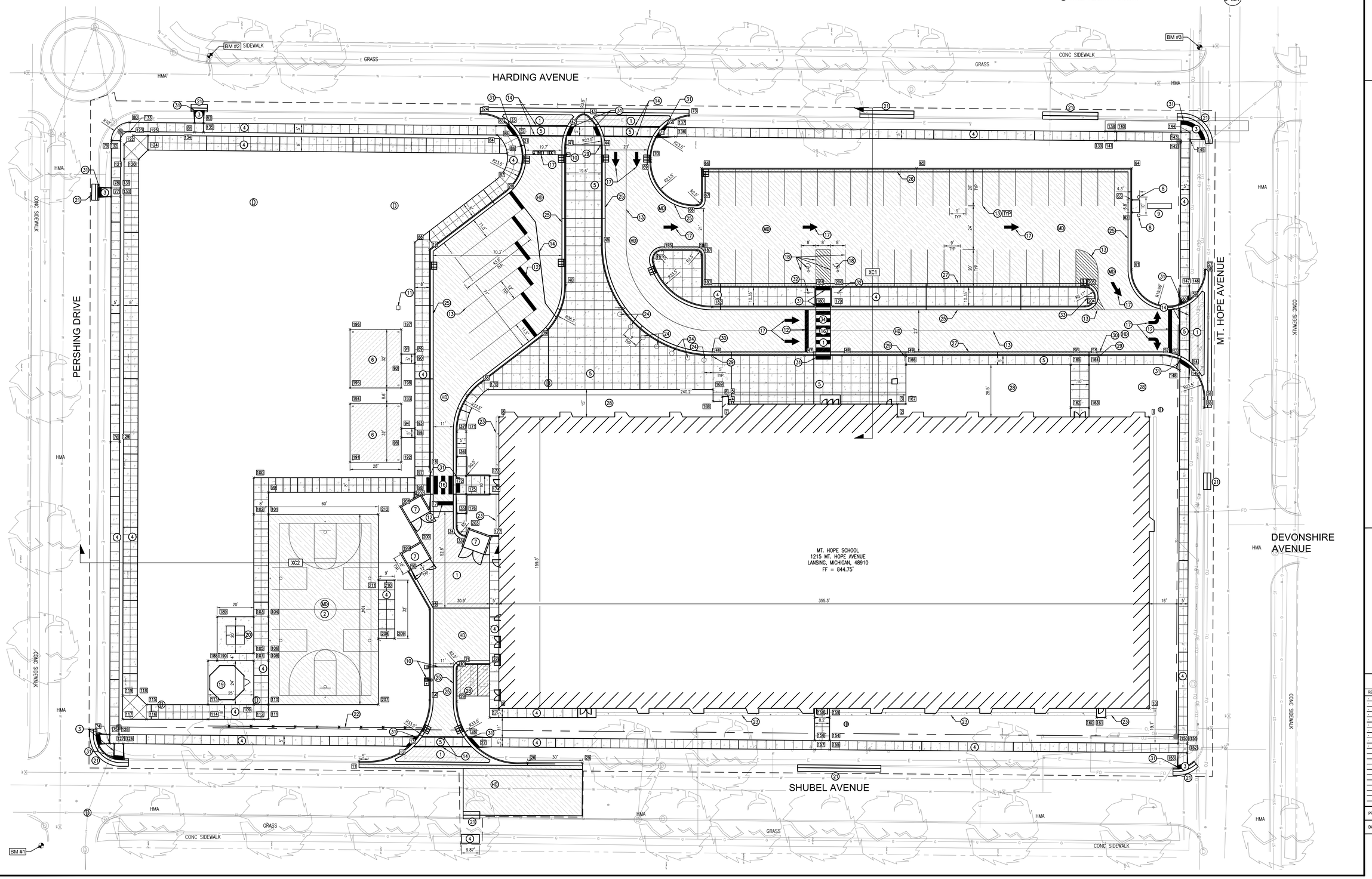
1. CONCRETE PAVEMENT — 28-29 / C-504
2. BASKETBALL COURT — 31 / C-503
3. ADA RAMPS — 1-10 / C-500
4. 4" THICK CONCRETE SIDEWALK — 4 / C-501
5. 6" THICK CONCRETE SIDEWALK — 4 / C-501
HD. HEAVY DUTY PAVEMENT STRUCTURAL SECTION — 30 / C-504
MD. MEDIUM DUTY PAVEMENT STRUCTURAL SECTION — 30 / C-504
XC1. DROP-OFF/PICK-UP AND PARKING LOT CROSS SECTION — 30 / C-504
XC2. SIDEWALK CROSS SECTION — 27 / C-504
6. OUTDOOR CLASSROOM, SEE STRUCTURAL PLANS FOR MORE INFORMATION
7. DUMPSTER ENCLOSURE, SEE ARCHITECTURAL SHEET A-131 FOR DETAILS
8. FLAG POLE — 10 / C-501
9. MONUMENT SIGN (SEE ARCHITECTURAL DRAWINGS FOR MORE INFORMATION)
10. SERVICE DRIVE GATE — 12 / C-501
11. YARD HYDRANT WITH UNDERGROUND ENCLOSURE AS MANUFACTURED BY OLDCASTLE OR APPROVED EQUAL
12. PAVEMENT MARKING, WATERBORNE, 12" STOP BAR (2 COATS)
13. PAVEMENT MARKING, WATERBORNE, 4" YELLOW (2 COATS)
14. PAVEMENT MARKING, WATERBORNE, 6" YELLOW CROSSWALK (2 COATS)
15. PAVEMENT MARKING, WATERBORNE, WHITE YIELD BAR (2 COATS)
16. PAVEMENT MARKING, WATERBORNE, WHITE HIGH EMPHASIS CROSSWALK, 12", 3' SPACING ON CENTER (2 COATS)
17. PAVEMENT MARKING, WATERBORNE, WHITE TRAFFIC ARROW SYMBOL (2 COATS)
18. PAVEMENT MARKING, WATERBORNE, BLUE ADA PARKING SYMBOL (2 COATS) — 32 / C-503
19. GAGA PIT — 7 / C-501
20. FOUR SQUARE COURT — 9 / C-501
21. CURB AND GUTTER REPLACEMENT — 11 / C-501
22. 4' CHAIN LINK FENCE AND MAINTENANCE STRIP — 24 / C-503
23. BUILDING MAINTENANCE STRIP (SEE LANDSCAPE SHEETS FOR ADDITIONAL INFORMATION)
24. SPHERE BOLLARD — 4 / L-500
25. CURB AND GUTTER F4 — 6 / C-501
26. CURB AND GUTTER D2 — 1 / C-501
27. CURB AND GUTTER F4 WASHOUT — 5 / C-501
28. GENERATOR AND TRANSFORMER PAD (SEE ELECTRICAL PLAN FOR ADDITIONAL INFORMATION)
29. "NO PARKING FIRE LANE" SIGN MOUNTED ON 13-FT LONG STEEL POST
30. LIMIT OF RED PAINTED CURB (2 COATS)
31. DETECTABLE WARNING SURFACE
32. ACCESSIBLE PARKING SIGN R7-8 MOUNTED ON 13-FT LONG STEEL POST
33. ONE-WAY SIGN R6-1L MOUNTED ON 13-FT LONG STEEL POST
34. RAISED PEDESTRIAN CROSSING — 33 / C-504

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE

0 10 20 40 Feet
5 15 30



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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

SITE IMPROVEMENTS PLAN

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-103

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK
WE RECYCLE

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DWG: C:\PROJWORK\27_0000\220116\CAD\CIVIL\SHEETS\220116_LSD_MTHOPE_SITE IMPROVEMENTS.DWG - SITE IMPROVEMENTS
CAD STANDARDS: STB
DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

GRADING LEGEND

965.0 × EXISTING SPOT ELEVATION (MATCH EXISTING GRADE)

965.00 × PROPOSED SPOT ELEVATION

2.0% PROPOSED SURFACE SLOPE

EXISTING CONTOUR

PROPOSED CONTOUR

CONSTRUCTION LIMITS

FS– FINISHED SURFACE, TC– TOP OF CURB, TW– TOP OF WALK

NOTE: SPOT GRADES REFLECT FINISHED SURFACES FOR PAVEMENT AND WALK UNLESS NOTED OTHERWISE.

H.P. HIGH POINT

G.B. GRADE BREAK

WASH OUT GUTTER PAN. TRANSITION FROM STANDARD GUTTER TO WASH OUT 10' EACH SIDE OF LIMITS NOTED.

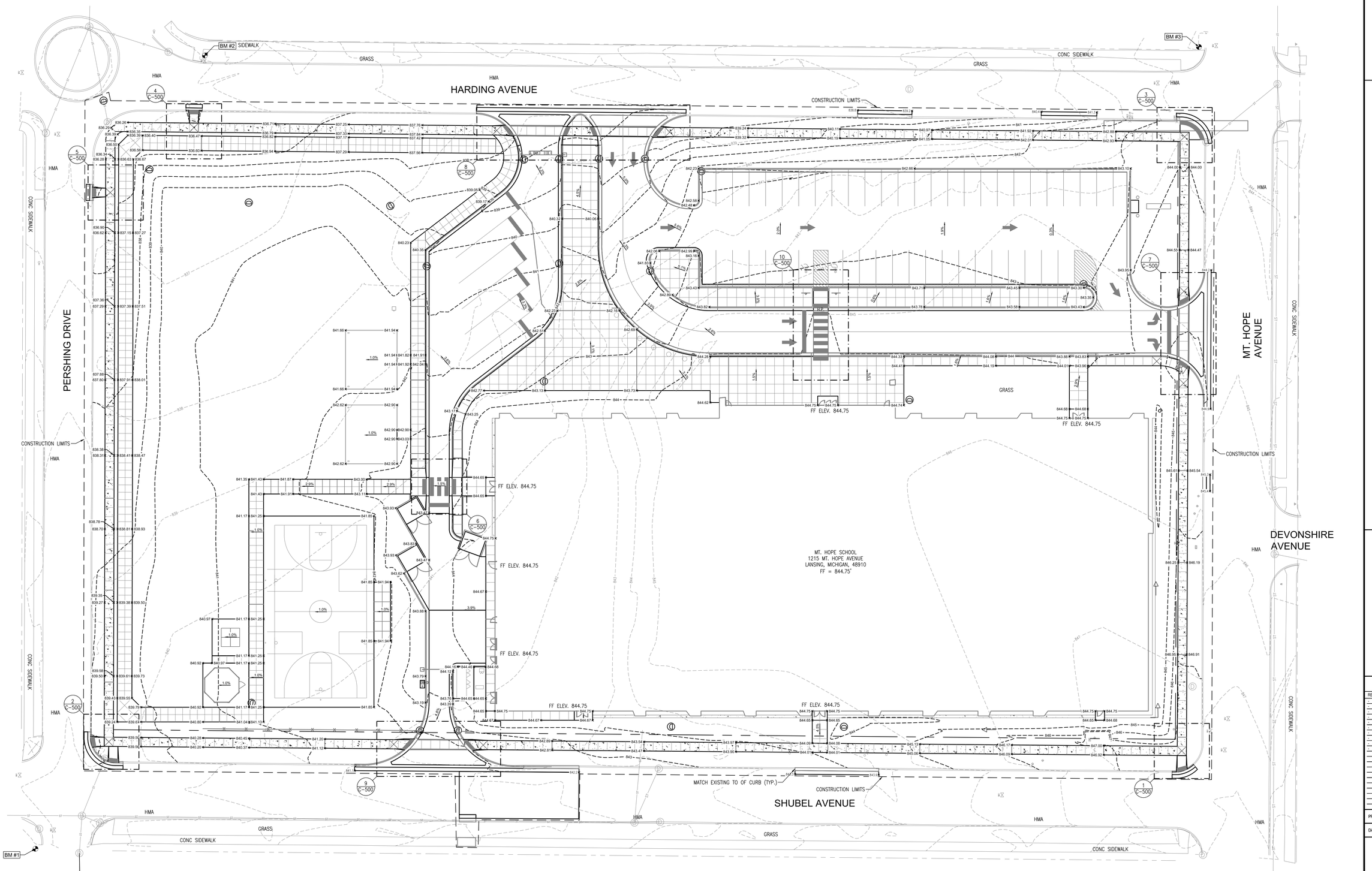
GRADING & DRAINAGE NOTES

1. ALL AREAS DISTURBED OUTSIDE OF THE PROJECT LIMITS SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN EXISTING CONDITIONS PRIOR TO CONSTRUCTION.
2. ALL SPOT GRADES AND GRADE LINES SHOWN ON THE PLANS ARE FINISHED GRADES OF THE PROPOSED SURFACE UNLESS NOTED OTHERWISE.
3. PROPOSED GRADES AND SLOPES SHALL MATCH EXISTING GRADES AND SLOPES AT CONSTRUCTION LIMITS OR AS SHOWN ON DRAWINGS. WHERE INTERSECTING SLOPE ELEVATIONS VARY, PROVIDE SMOOTH TRANSITIONAL EDGE.
4. TRANSITIONS FROM PROPOSED SIDEWALKS AND PAVEMENTS SHALL BE UNIFORM AND SMOOTH WITHOUT ABRUPT CHANGES IN GRADE OR ALIGNMENT.
5. PROPOSED FINISHED GRADES SHALL PROVIDE FOR POSITIVE DRAINAGE AWAY FROM THE BUILDING AND TO A DRAINAGE STRUCTURE, IF PRESENT, OR MATCH EXISTING GRADES. INFORM ARCHITECT OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION.
6. GRADE ALL WALKS AND WALKING SURFACES AS SHOWN ON THE PLANS. MAXIMUM LONGITUDINAL SLOPE OR RUNNING SLOPE WILL NOT EXCEED 5% (1v:20h). CROSS SLOPES WILL NOT EXCEED 1.5%. UNLESS OTHERWISE NOTED ON THE PLANS.

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE



0 10 20 40 Feet
5 15 30

THE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

WHITE BLACK

PLOTTED BY: MEAYER, GARRIE; 10/20/2023 4:48 PM
DWG: P:\0220118\PROJECT\PROJECT\CD\220118-C-500-SITE GRADING PLAN.DWG
LAYOUT: C-104 SITE GRADING PLAN

DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

SITE GRADING PLAN

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220118

DATE: 23-JUNE-2023

SHEET

C-104

100% CONSTRUCTION DOCUMENTS

STORMWATER MANAGEMENT SUMMARY

UNDERGROUND STORMWATER INFILTRATION/DETENTION BASIN
- PROPOSED IMPERVIOUS AREA: 2.736 ACRES
- PROPOSED PERVIOUS AREA: 1.435 ACRES
- STORAGE REQUIRED: 13,630 CFT
- AREA OF INFILTRATION REQUIRED: 18,100 SFT
- ELEVATION OF BOTTOM OF BASIN: 832.60 (832.10 BOTTOM OF STONE)
- ELEVATION OF TOP OF STORAGE: 833.60 (833.10 TOP OF STONE)
- ELEVATION OF EMERGENCY OVERFLOW: 836.41
- EXISTING 10 YEAR PEAK FLOW: 8.04 CFS

UTILITY LEGEND

- EXISTING CONTOUR
- PROPOSED CONTOUR
- CONSTRUCTION LIMITS
- EXISTING OVERHEAD ELECTRICAL
- EXISTING UNDERGROUND ELECTRICAL
- PROPOSED UNDERGROUND ELECTRICAL
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER
- EXISTING WATER MAIN
- PROPOSED WATER MAIN
- PROPERTY LINE
- DITCH (SLOPE: 0.35%)
- EXISTING FIBER OPTIC
- HAND HOLE
- WATER VALVE
- PROPOSED STORM MANHOLE
- PROPOSED CATCH BASIN

UTILITY KEY

1. 6" CONDUIT WITH END CAPS (DEPTH 18") – FOR FUTURE USE
2. ELECTRICAL CONDUIT AND UTILITY POLE, SEE ELECTRICAL PLAN FOR ADDITIONAL INFORMATION
3. PROPOSED UNDERGROUND INFILTRATION BASIN. SEE SHEET C-506 FOR ADDITIONAL INFORMATION
4. PROPOSED LED SCREEN SIGN, SEE ARCHITECTURAL AND STRUCTURAL PLANS FOR ADDITIONAL INFORMATION
5. PROPOSED FLAG POLES WITH LIGHTS (SEE ELECTRICAL PLANS FOR ADDITIONAL INFORMATION)
6. PROPOSED PARKING LOT LIGHTS, (BY OTHERS) SEE ELECTRICAL PLAN FOR ADDITIONAL INFORMATION
7. ROOF DRAIN, CONNECT TO STORM SEWER, COORDINATE W/ MECHANICAL CONTRACTOR TO ENSURE 1% FLOW TO STORM SEWER
8. PROPOSED GAS SERVICE (INSTALLED TO METER BY OTHERS)
9. SERVICE TAP
10. WEIR STRUCTURE
11. 12" OVERFLOW SEWER
12. PROPOSED TELEPHONE/COMMUNICATION/INTERNET CONNECTION
13. PROTECT EXISTING TORNADO SIREN/CIVIL DEFENSE SYSTEM
14. CONNECT FOOTING DRAIN TO DRAINAGE STRUCTURE
15. PROPOSED 6" SANITARY SERVICE (ELEV AT FOUNDATION WALL 839.00, TIE IN ELEV IN SHUBEL AVE: ±833.2)
16. PROPOSED 6" FIRE SUPPRESSION SERVICE, MAINTAIN 18" SEPARATION FROM STORM SEWER
17. PROPOSED 4" DOMESTIC WATER SERVICE, MAINTAIN 18" SEPARATION FROM STORM SEWER
18. OUTDOOR WATER FAUCET AND VAULT — 33 / C-503
19. ABANDONED SERVICE (FOR INFORMATION ONLY)
20. TRANSFORMER AND GENERATOR CONCRETE PAD (18' X 18') SEE ELECTRICAL PLANS FOR ADDITIONAL INFORMATION
21. OUTLET FROM VAULT TO DRAINAGE STRUCTURE

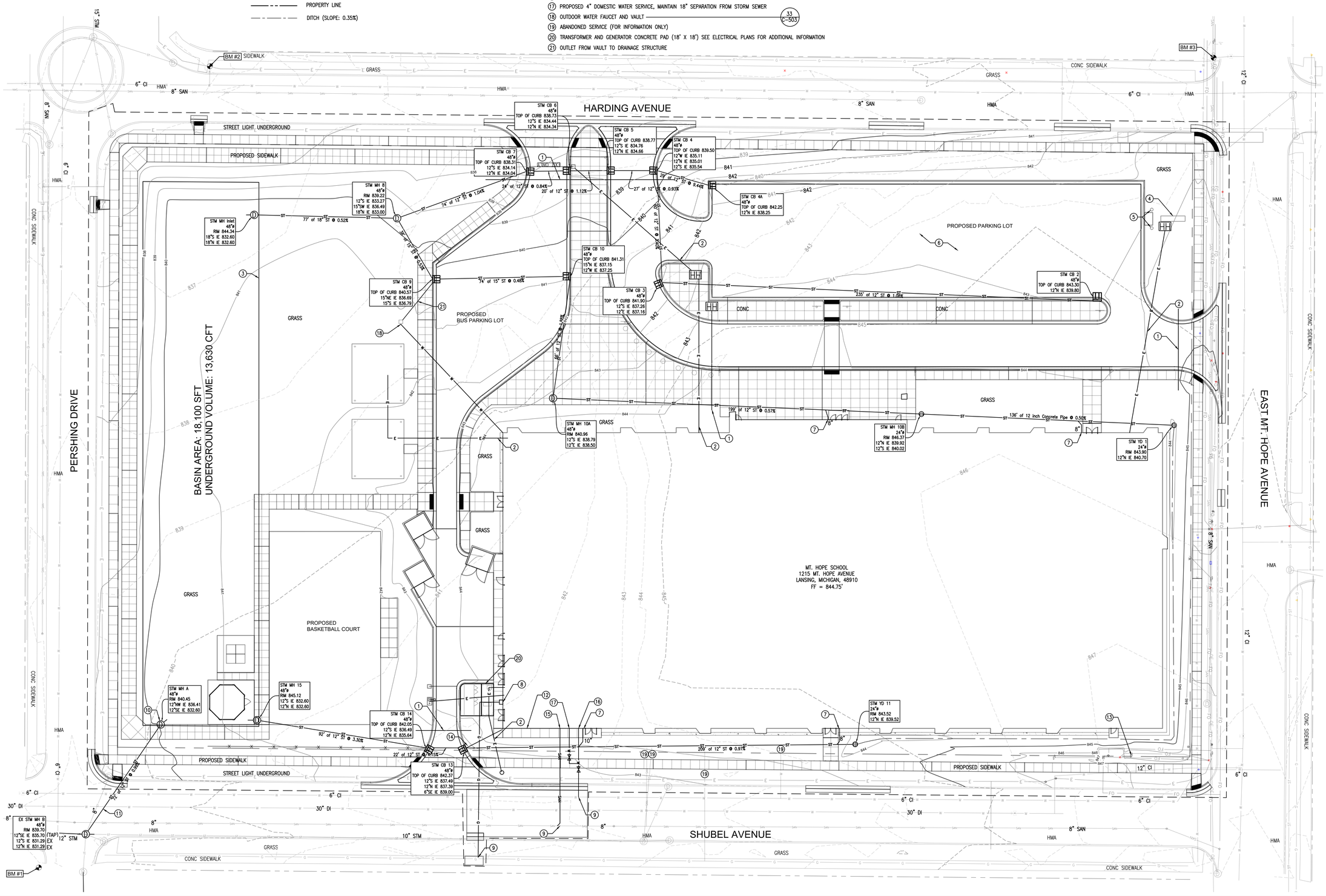
UTILITY NOTES

1. UTILITIES AND UNDERGROUND INFRASTRUCTURE SHOWN ARE APPROXIMATE, FIELD VERIFY UTILITY LOCATION PRIOR TO COMMENCEMENT OF EARTHWORK AND/OR UTILITY ACTIVITIES.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY REPAIR OR REPLACEMENT TO UNDERGROUND INFRASTRUCTURE AND UTILITY LINES DAMAGED DURING CONSTRUCTION.
3. CONTRACTOR SHALL NOTIFY AND HAVE THE UTILITIES LOCATED AT LEAST 3 WORKING DAYS IN ADVANCE PRIOR TO EXCAVATING.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DEWATERING NECESSARY AS PER SPECIFICATIONS. WATER REMOVED BY DEWATERING EQUIPMENT SHALL NOT BE DISPOSED OF INTO EXISTING SANITARY SEWERS, SEE GEOTECH REPORT FOR ADDITIONAL INFORMATION.
5. WORK WITHIN THE CITY'S ROW SHALL BE ARRANGED TO CAUSE AS LITTLE DISTURBANCE TO VEHICULAR TRAFFIC FLOW AS POSSIBLE.
6. SEE UTILITY TRENCH DETAIL C-502
7. REFER TO ELECTRICAL AND MECHANICAL/PLUMBING PLANS FOR ELECTRICAL, GAS, SEWER, AND WATER LAYOUT AND PIPE INVERT ELEVATIONS INSIDE OF BUILDING.
8. ALL PERVIOUS AREAS SHALL BE HYDRO-MULCH SEEDED, REFER TO SHEET C-103

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE



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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

SITE UTILITY PLAN

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220118
DATE: 23-JUNE-2023
SHEET
C-105

100% CONSTRUCTION DOCUMENTS

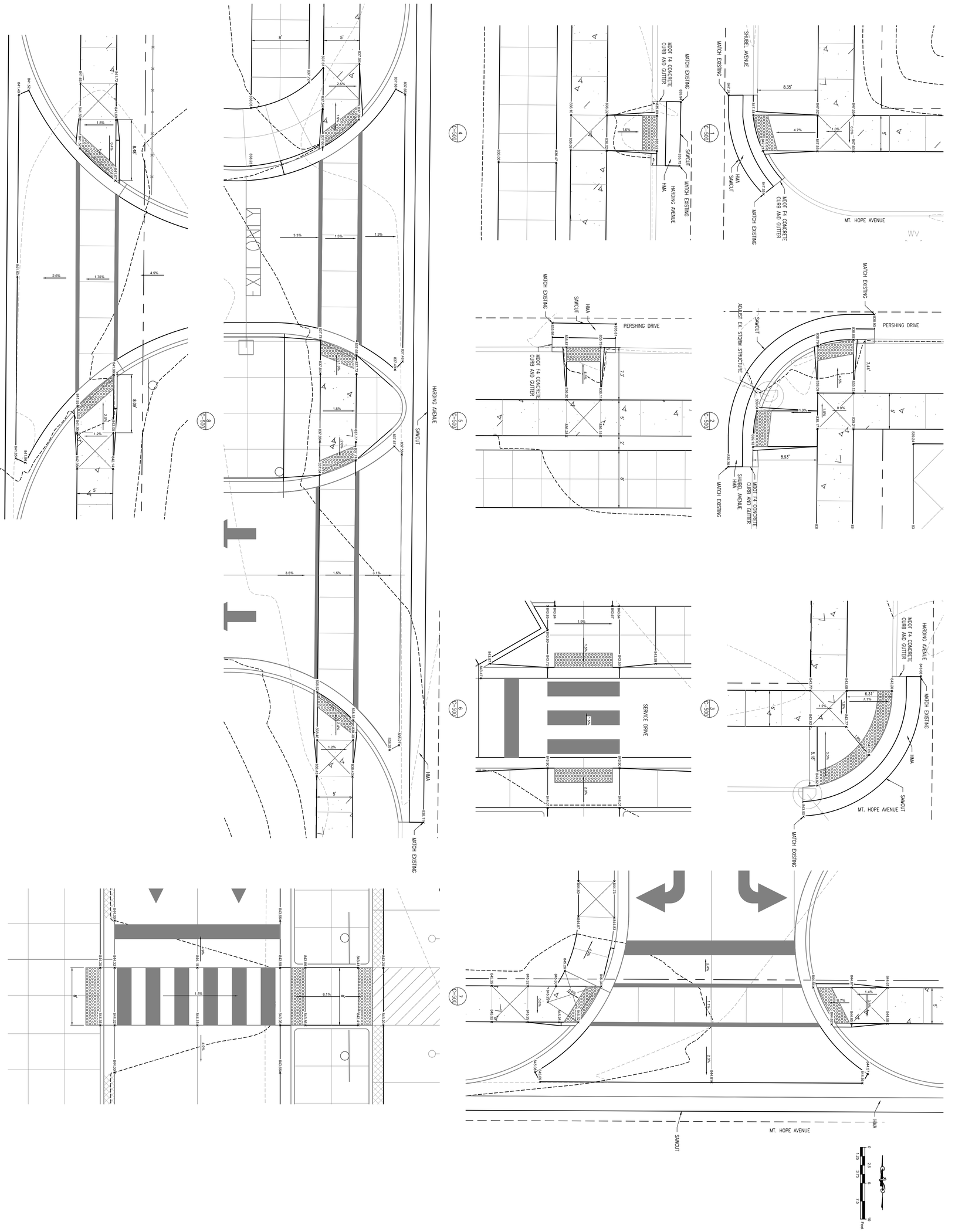
PLOTTED BY: WEAVER, GABRIEL 6/23/2023 5:48 PM
M:\2020\220115_LSD_MTHOPE\DRAWINGS\D05-LSD MT HOPE\SHEETS\220115_LSD MTHOPE_SITE GRADING.DWG - ADA RAMP DETAILS
C2AE.STANDARD.STB

DESIGNED BY: -

CHECKED BY: - APPROVED BY: -

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK

WE RECYCLE



REVISIONS		
REV	DESCRIPTION	DATE

ADA RAMP DETAILS

LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

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PROJ. # 220115
DATE 23-JUNE-2023
SHEET C-500

100% CONSTRUCTION DOCUMENTS

GENERAL NOTES

1. BENCH MARKS
USE TWO BENCH MARKS FOR VERIFICATION OF GRADE FOR ALL CONSTRUCTION. CONTRACTOR SHALL BE RESPONSIBLE FOR SETTING ADDITIONAL BENCH MARKS AS REQUIRED TO MEET THIS REQUIREMENT.

2. UNDERGROUND UTILITIES
FOR LOCATION OF UNDERGROUND UTILITIES, THE CONTRACTOR SHALL DIAL 1-800-482-7171 A MINIMUM OF 72 HOURS PRIOR TO EXCAVATING IN THE VICINITY OF UTILITY LINES. THIS DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY OF NOTIFYING UTILITY OWNERS WHO MAY NOT BE PART OF THE "MISS DIG" ALERT SYSTEM.

3. EXISTING UNDERGROUND UTILITIES
THE LOCATION OF EXISTING UNDERGROUND UTILITIES SHOWN ON THESE PLANS ARE BASED ON FIELD OBSERVATIONS AND AVAILABLE RECORD DRAWINGS. LOCATIONS OF UNDERGROUND UTILITIES SHOULD BE CONSIDERED APPROXIMATE. STORM AND SANITARY SEWER LOCATIONS ARE BASED ON STRAIGHT LINE GRADES AND ALIGNMENT BETWEEN STRUCTURES. THE CONTRACTOR IS REQUIRED TO LOCATE AND PROTECT EXISTING UTILITIES.

4. EXISTING SITE IMPROVEMENTS
UNLESS SPECIFICALLY NOTED FOR REMOVAL ON THE PLANS, ALL SIDEWALKS, DRIVES, CULVERTS, DRAINAGE STRUCTURES, FENCES, AND ABOVE GROUND AND BURIED UTILITIES SHALL BE PROTECTED. ALL SUCH EXISTING UTILITIES AND IMPROVEMENTS DAMAGED OR DESTROYED DURING CONSTRUCTION SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR WITH LIKE MATERIAL EQUAL TO OR BETTER THAN EXISTING AT NO ADDITIONAL EXPENSE TO THE OWNER.

5. LAWN RESTORATION
RESTORATION SHALL CONSIST OF FURNISHING AND PLACING A MINIMUM OF 4 INCHES OF TOPSOIL AND HYDROMULCHING THE THE DISTURBED AREA PER THE SPECIFICATIONS. ALL DISTURBED AREAS SHALL BE RESTORED.

6. CONSTRUCTION STAKING
THE CONTRACTOR WILL BE RESPONSIBLE FOR PROVIDING ALL CONSTRUCTION STAKING REQUIRED FOR THE CONSTRUCTION. OWNER WILL PROVIDE ELECTRONIC FILE WITH DESIGN INFORMATION, IF REQUESTED.

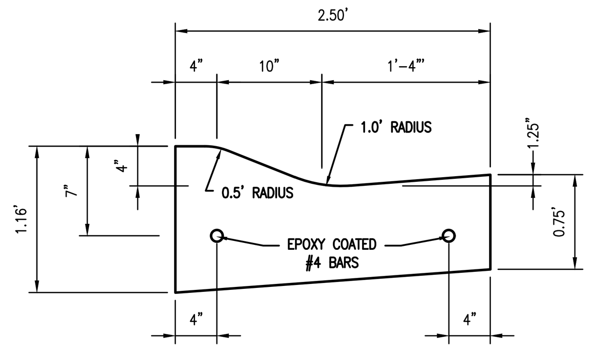
7. SOIL BORINGS
THE SOIL BORING LOGS REPRESENT POINT INFORMATION. PRESENTATION OF THIS INFORMATION IN NO WAY IMPLIES THAT SUBSURFACE CONDITIONS ARE THE SAME OTHER THAN AT THE EXACT LOCATION OF THE BORINGS. THE LOGS ARE CONTAINED IN THE APPENDIX OF THE SPECIFICATIONS.

8. RECORD DRAWINGS
CONTRACTOR SHALL BE RESPONSIBLE FOR RECORDING AND FURNISHING TO THE OWNER AS-BUILT LOCATIONS AND ELEVATIONS OF ALL UTILITY CONSTRUCTION PRIOR TO THE CONTRACTOR'S FINAL PAYMENT APPLICATION.

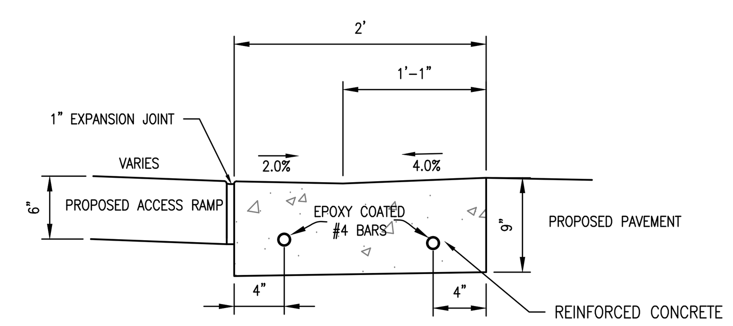
9. UTILITY PROTECTION
THE CONTRACTOR SHALL ASSUME RESPONSIBILITY FOR THE PROTECTION OF ALL EXISTING UTILITIES DURING CONSTRUCTION. THE CONTRACTOR SHALL VERIFY THE DEPTH AND HORIZONTAL LOCATION OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. THE EXACT LOCATION OF EXISTING UTILITIES SHALL BE DETERMINED BY HAND DIGGING. ALL UTILITIES DAMAGED DURING CONSTRUCTION THAT COULD BE USED FOR THE FUTURE CONSTRUCTION SHALL BE REPAIRED WITH LIKE MATERIAL IN ACCORDANCE WITH THE UTILITY OWNER'S REQUIREMENTS.

10. DEWATERING
CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DEWATERING NECESSARY TO COMPLETE THE WORK NOTED ON THESE PLANS. WATER REMOVED BY DEWATERING EQUIPMENT SHALL NOT BE DISPOSED OF INTO EXISTING SANITARY SEWERS. SEE GEOTECH REPORT FOR ADDITIONAL INFORMATION

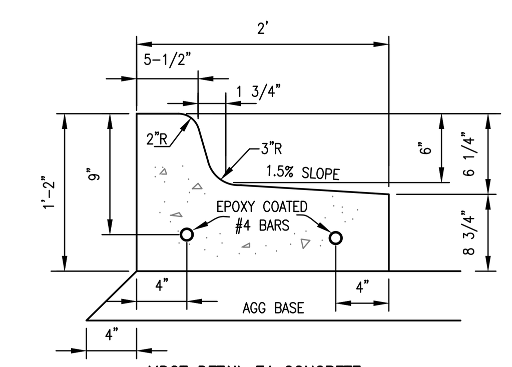
11. PERMITTING
IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO OBTAIN ALL NECESSARY PERMITS REQUIRED FOR CONSTRUCTION.



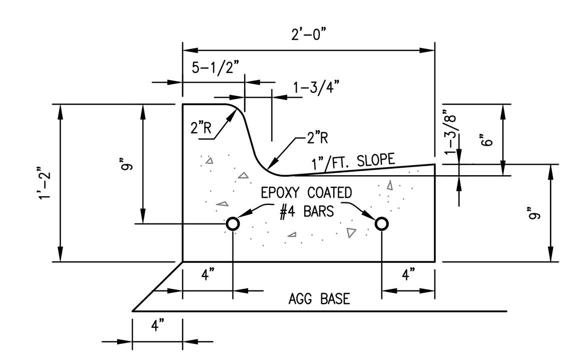
1 / C-501 MDOT DETAIL D2 (MOUNTABLE CURB AND GUTTER)
NO SCALE



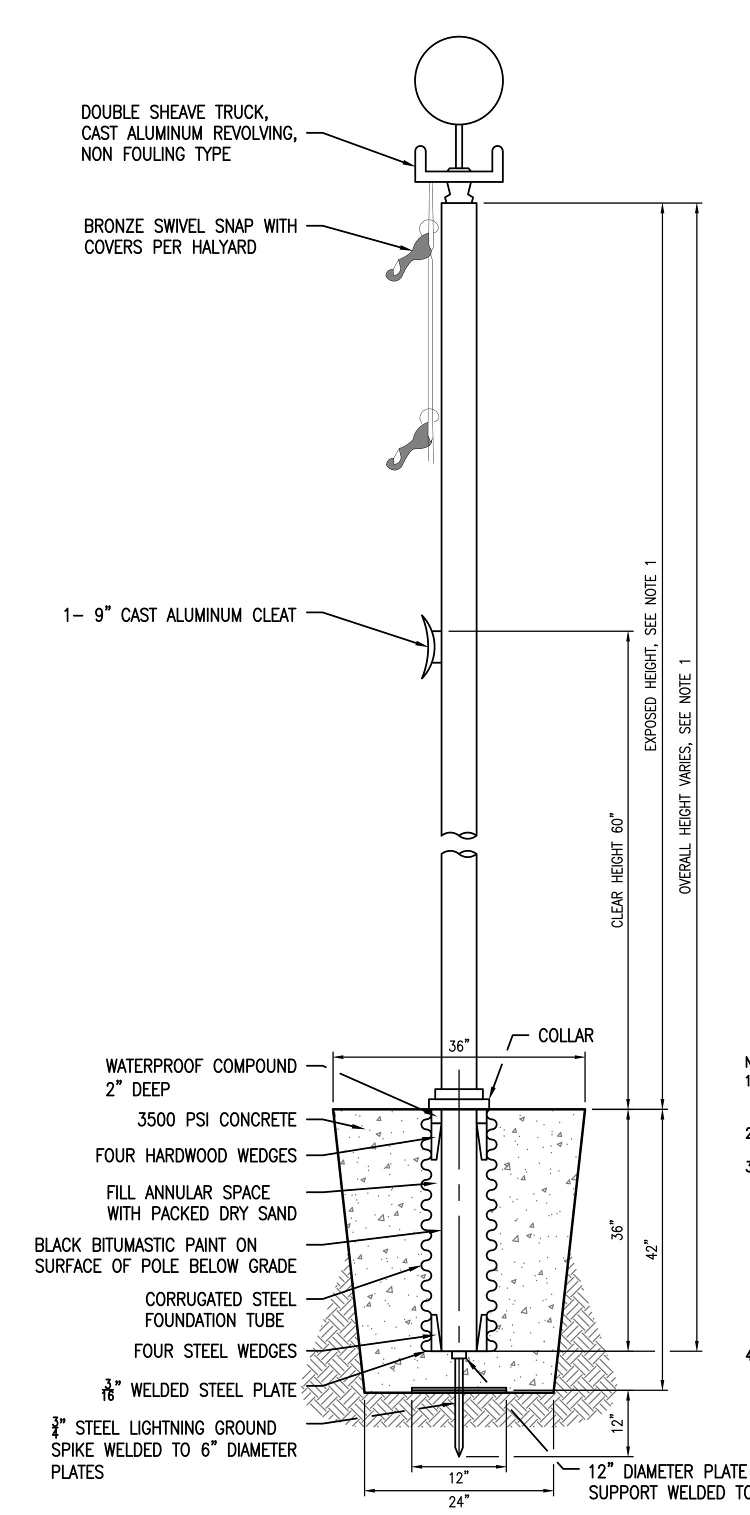
2 / C-501 0" HEIGHT CURB AND GUTTER AT ACCESS RAMP
NO SCALE



5 / C-501 MDOT DETAIL F4 CONCRETE CURB & GUTTER (WASHOUT)
NO SCALE



6 / C-501 MDOT DETAIL F4 CONCRETE CURB & GUTTER
NO SCALE

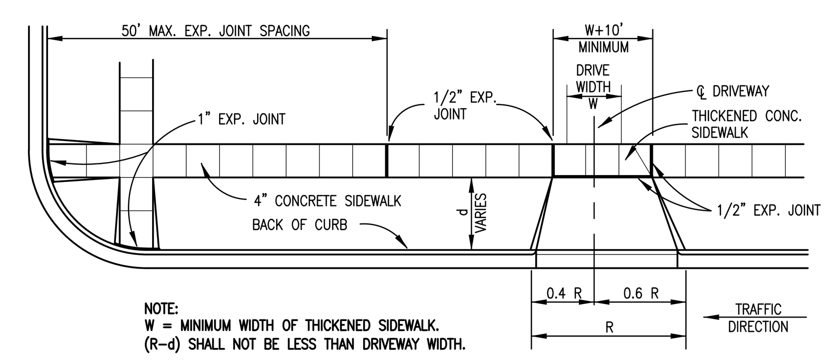


NOTES:
1. CONTRACTOR SHALL FURNISH AND INSTALL ONE (1) 25'-0" TALL POLE AND ONE (1) 30'-0" TALL POLE PER SITE PLAN LOCATION
2. REFER TO ELECTRICAL DRAWINGS FOR LIGHTING REQUIREMENTS
3. FLAGPOLE ELEMENTS:

   NATURAL SATIN FINISH
   HEAVY DUTY CLEAT
   WALL THICKNESS = 3/16" MIN.
   POLE SECTIONS = ONE
   FLAG WIND SPEED = 95 M.P.H.
   SINGLE REVOLVING TRUCK
   EXTERNAL HALYARD

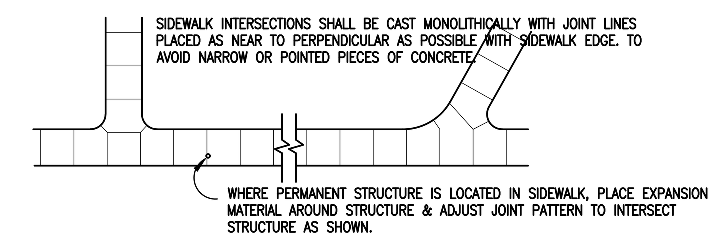
4. FLAGPOLE SEPARATION SHALL BE A MIN. OF 10'

10 / C-501 FLAG POLE DETAIL
NO SCALE

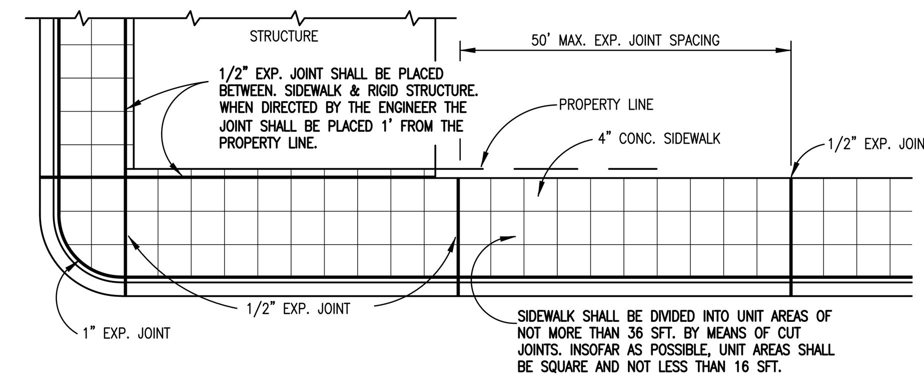


NOTE:
W = MINIMUM WIDTH OF THICKENED SIDEWALK.
(R-d) SHALL NOT BE LESS THAN DRIVEWAY WIDTH.

TYPICAL SIDEWALK JOINT LAYOUT 1

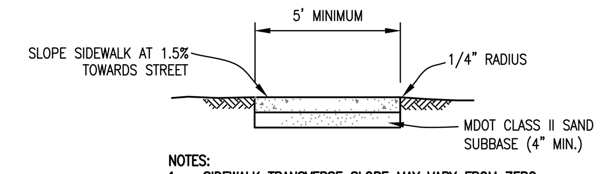


TYPICAL SIDEWALK JOINT LAYOUT 2



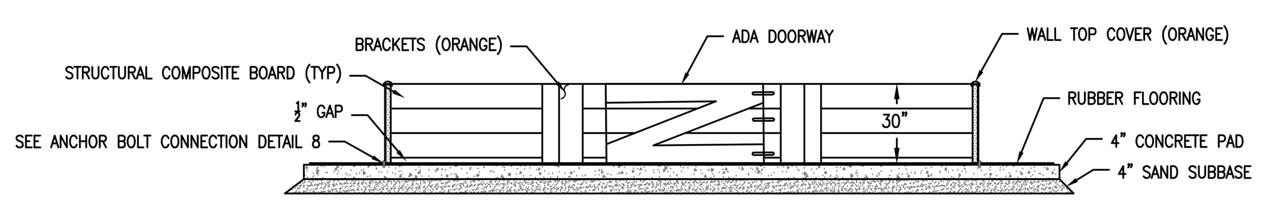
TYPICAL SIDEWALK JOINT LAYOUT 3

3 / C-501 CONCRETE SIDEWALK JOINT LAYOUT
NO SCALE

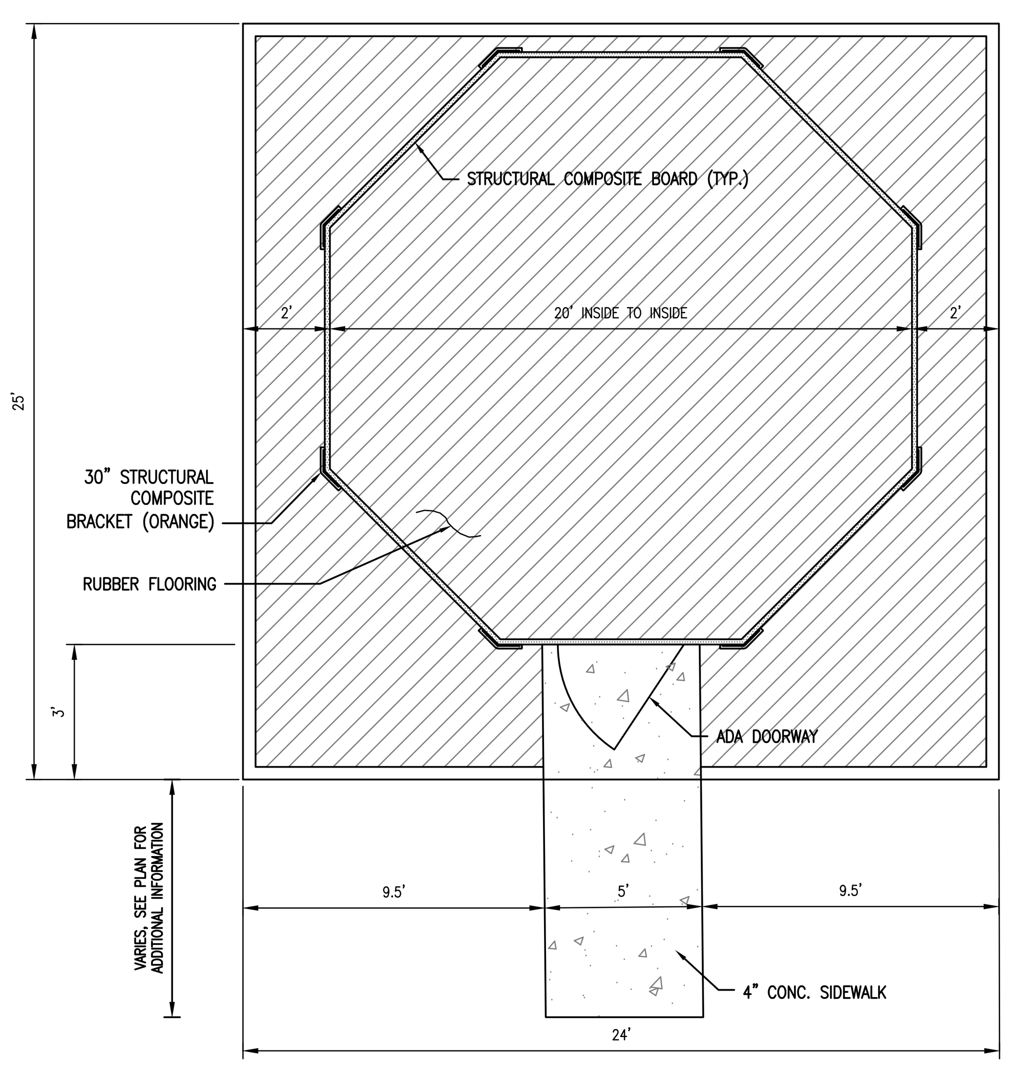


NOTES:
1. SIDEWALK TRANSVERSE SLOPE MAY VARY FROM ZERO TO 1.5% TO MEET SITE CONDITIONS. WHEN TRANSVERSE SLOPE IS LESS THAN 1% PER FT. PROVIDE MINIMUM 0.5% LONGITUDINAL SLOPE
2. SIDEWALK SHALL BE 4" THICK MINIMUM UNLESS OTHERWISE SHOWN ON THE PLANS

4 / C-501 TYPICAL CONCRETE SIDEWALK
NO SCALE



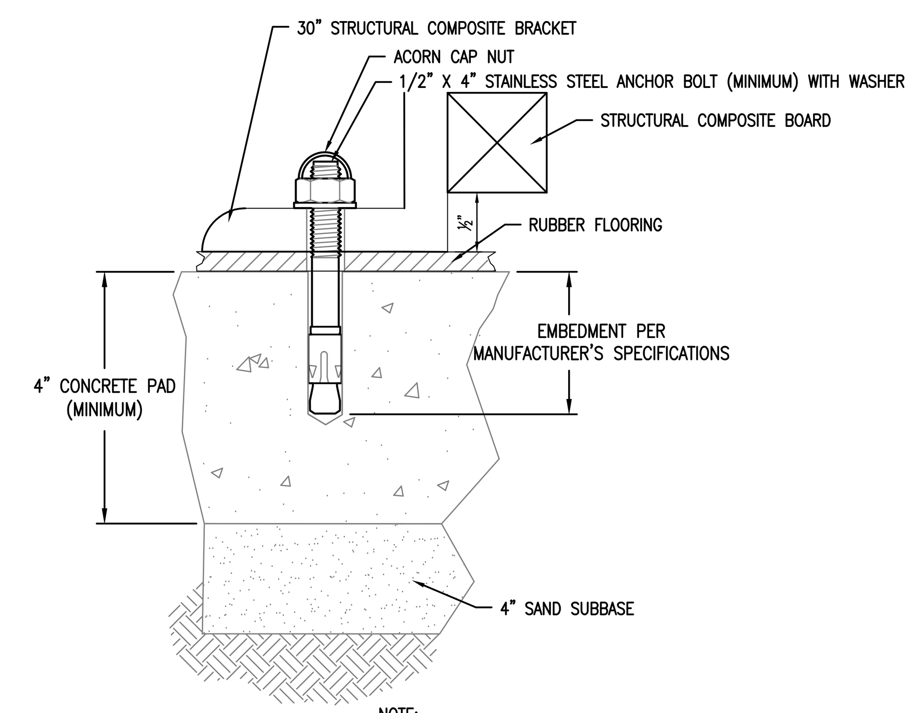
ELEVATION VIEW



NOTE:
FURNISH GAGA BALL PIT ELEMENTS FROM COACH CLIFF'S GAGA BALL PITS OR EQUAL AND INSTALL PER MANUFACTURER'S RECOMMENDATIONS

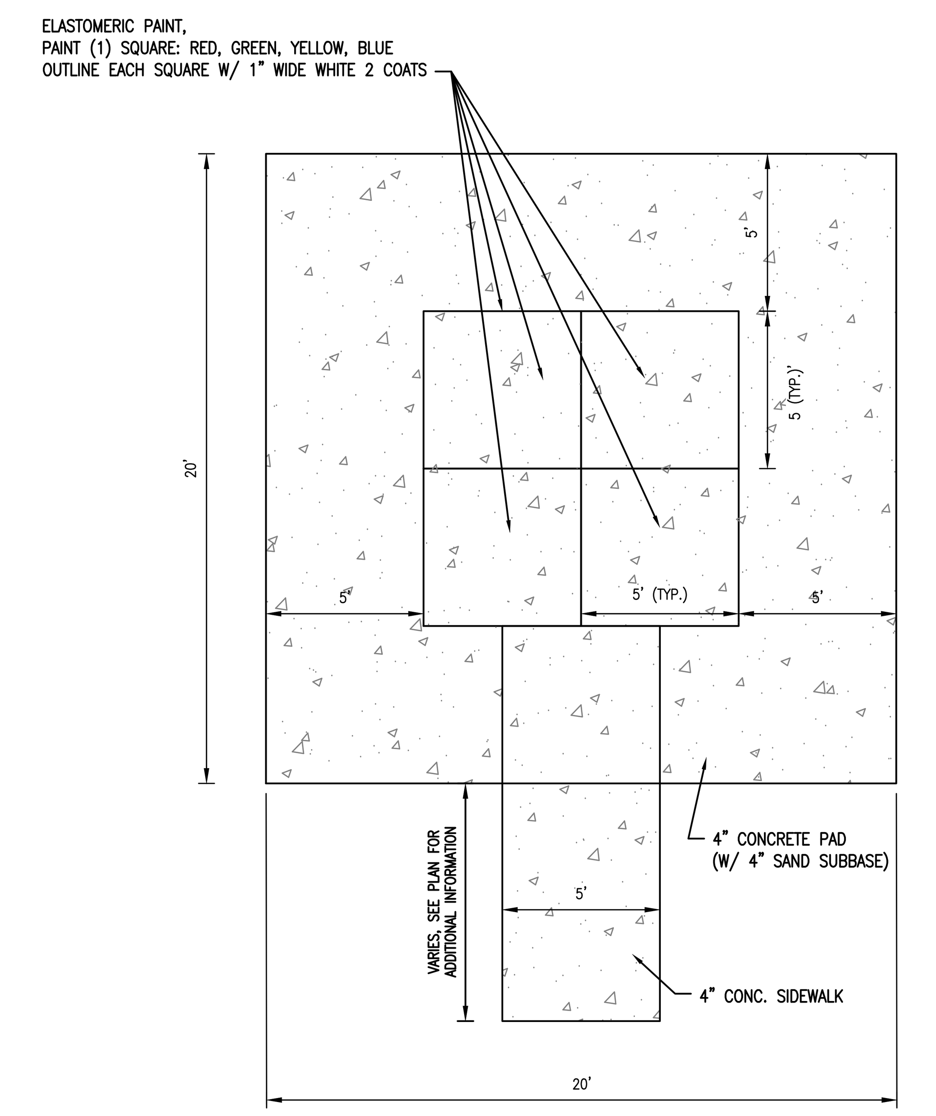
PLAN VIEW

7 / C-501 GAGA BALL PIT DETAIL
NO SCALE

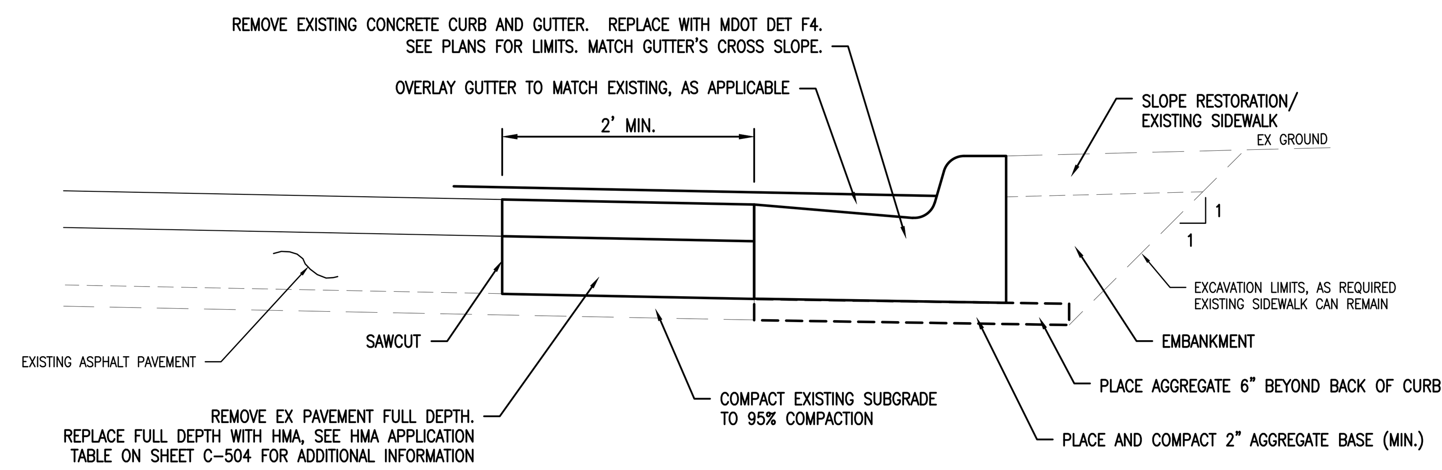


NOTE:
1. SEE PLANS FOR CONCRETE PAD SIZE AND LOCATION.

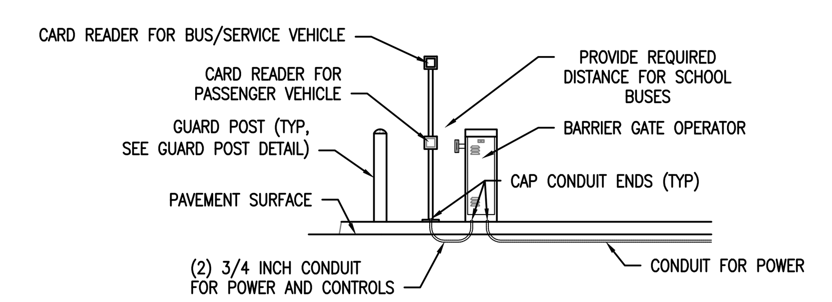
8 / C-501 ANCHOR BOLT CONNECTION DETAIL
NO SCALE



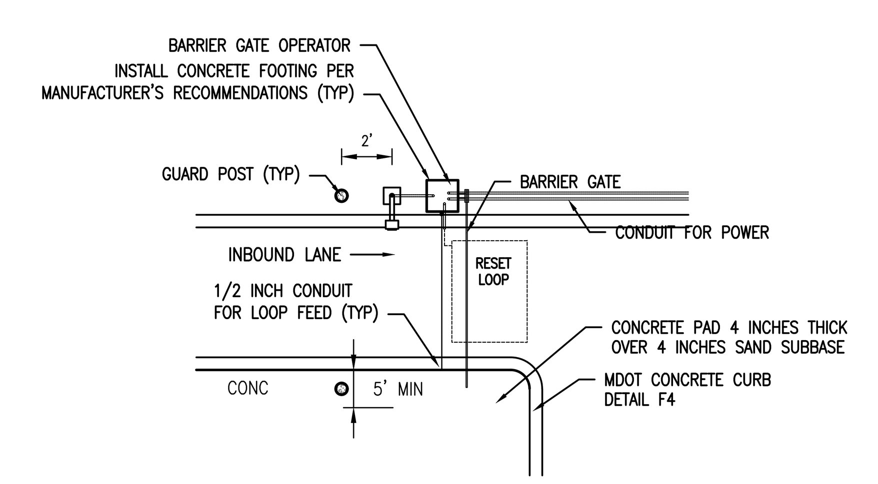
9 / C-501 FOUR SQUARE COURT DETAIL
NO SCALE



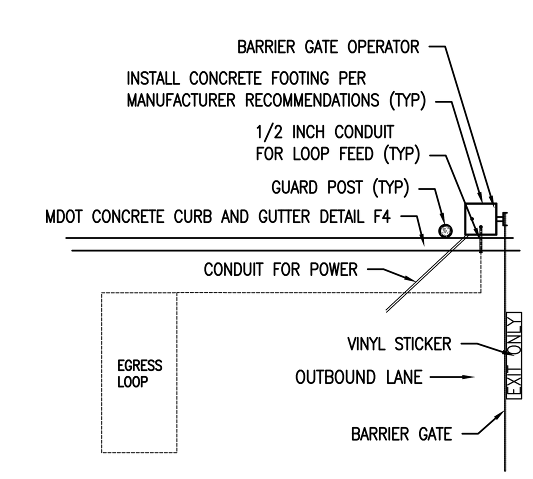
11 / C-501 CURB AND GUTTER REPLACEMENT DETAIL
TO APPLY: AT ALL LOCATIONS OF CURB REMOVAL AND REPLACEMENT



ELEVATION OF BARRIER GATE (TYP)



PLAN OF INGRESS BARRIER GATE LAYOUT



PLAN OF EGRESS BARRIER GATE LAYOUT

12 / C-501 SERVICE DRIVE GATE LAYOUT
NO SCALE

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LANSING, MI

CIVIL NOTES AND DETAILS

REVISIONS

REV	DESCRIPTION	DATE
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PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-501

100% CONSTRUCTION DOCUMENTS

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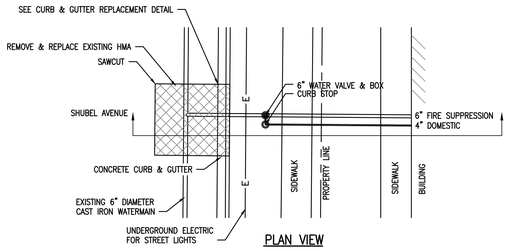
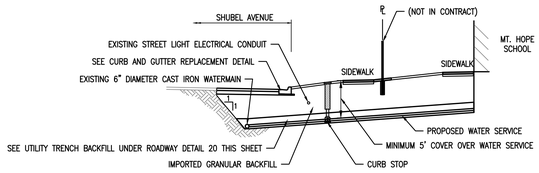
M:\2022\220116_LSD_MTHOPE\DRAWINGS\DS-LSD MT HOPE\SHEETS\220116_LSD MTHOPE_SITE IMPROVEMENTS.DWG - CIVIL NOTES AND DETAILS
C2AE.STANDARD.STB
DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
BLACK
WHITE



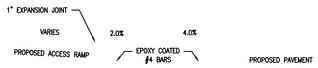
PLAN VIEW

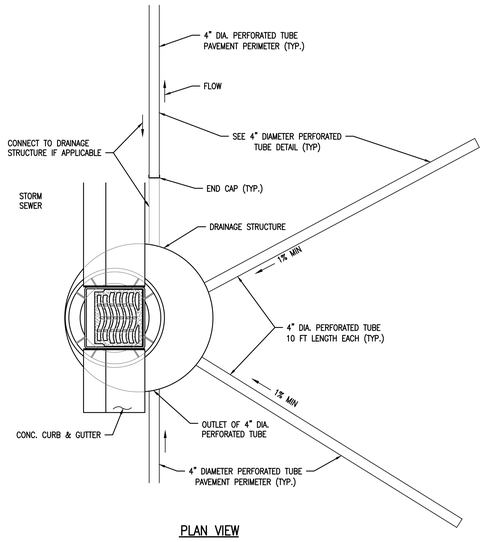


PROPOSED PROFILE VIEW

13 / C-502 — NOT USED
NO SCALE

13A / C-502 — WATER SERVICE LAYOUT
NO SCALE

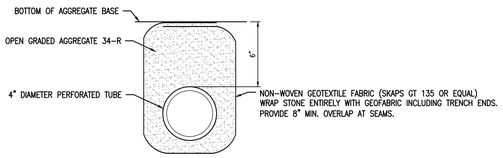




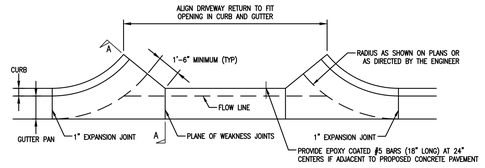
PLAN VIEW

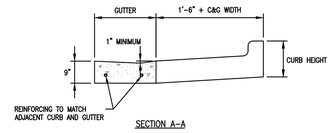
JOINT SPACING

1. CONTRACTION JOINTS – 10' SPACING
2. 1" FIBER JOINTS
   - AT SPRING POINTS OF RADIUS AT INTERSECTIONS
   - AT CONTRACTION JOINTS EACH SIDE OF CATCH BASINS
   - MAXIMUM 400' INTERVALS



16 / C-502 — 4" DIA. PERFORATED TUBE DETAIL
NO SCALE

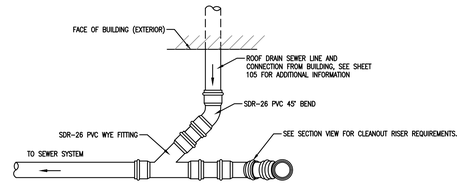




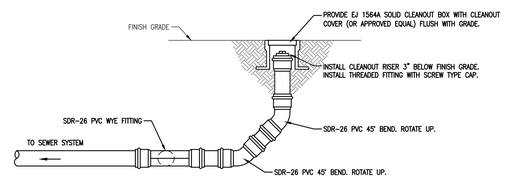
SECTION A–A

NOTE:
1. SEE MDOT STANDARD PLAN R-29 FOR ADDITIONAL INFORMATION

14 / C-502 — TYPE M DRIVEWAY OPENING
NO SCALE



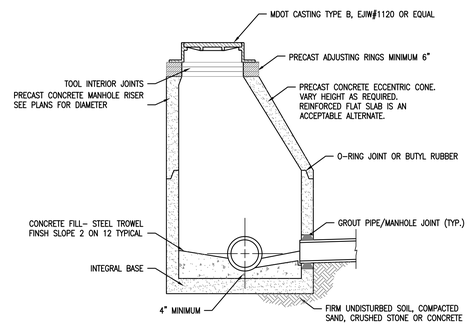
PLAN VIEW



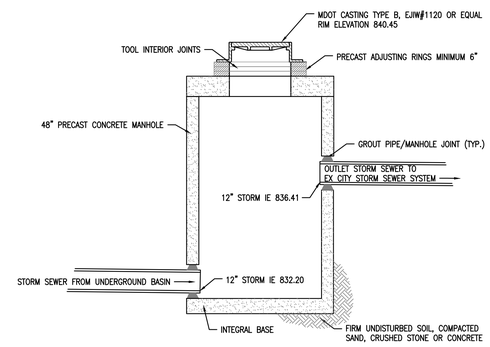
SECTION VIEW

NOTE:
1. ALSO APPLICABLE FOR SANITARY SEWER CONNECTION FROM BUILDING

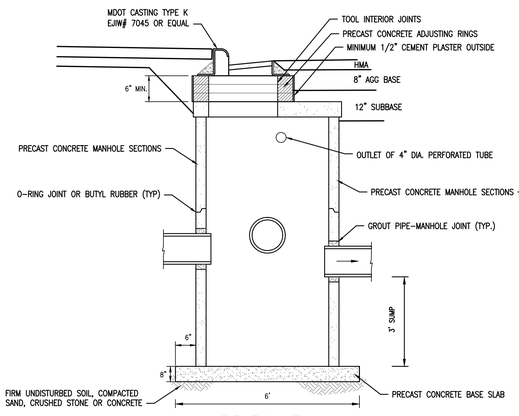
15 / C-502 — SEWER CLEANOUT DETAIL
NO SCALE



17 / C-502 — STANDARD STORM MANHOLE DETAIL
NO SCALE



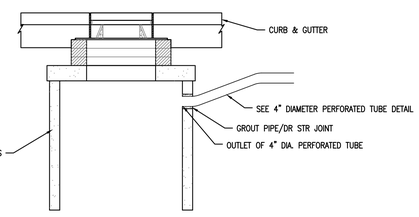
18 / C-502 — OUTLET DRAINAGE STRUCTURE DETAIL
NO SCALE



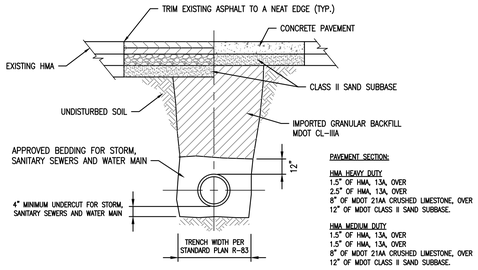
ELEVATION VIEW

NOTE:
INTEGRAL BASE AND PRECAST CONCRETE FLAT TOP SECTION ARE AN ACCEPTABLE ALTERNATE.

19 / C-502 — CATCH BASIN DETAIL
NO SCALE



PERFORATED TUBE CONNECTION DETAIL



PAVEMENT SECTION:

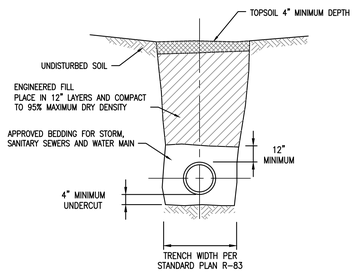
HMA HEAVY DUTY
1.5" OF HMA, 13A, OVER
2.5" OF HMA, 13A, OVER
8" OF MDOT 21AA CRUSHED LIMESTONE, OVER
12" OF MDOT CLASS II SAND SUBBASE.

HMA MEDIUM DUTY
1.5" OF HMA, 13A, OVER
1.5" OF HMA, 13A, OVER
8" OF MDOT 21AA CRUSHED LIMESTONE, OVER
12" OF MDOT CLASS II SAND SUBBASE.

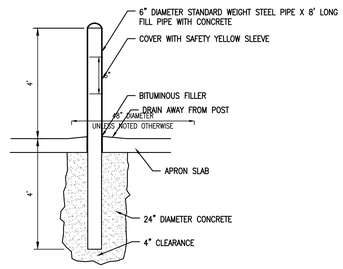
CONCRETE PAVEMENT SECTION:
6" CONCRETE (MDOT P1), OVER
6" OF MDOT CLASS II SAND SUBBASE

NOTE:
IN EXISTING STREETS, RESTORE SURFACE TO ORIGINAL OR BETTER CONDITION.

20 / C-502 — UTILITY TRENCH BACKFILL UNDER ROADWAY DETAIL
NO SCALE



21 / C-502 — NORMAL UTILITY TRENCH BACKFILL DETAIL
NO SCALE



22 / C-502 — GUARD POST DETAIL
NO SCALE

THE BARS BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK

THE RECYCLE

PLOTTED BY: MARVIN, DARRIL OCTOBER 3, 2023 3:00 PM
DWG: P:\0220118\CIVIL\PROPOSED\C502-CIVIL NOTES AND DETAILS.DWG
LAYOUT: C-502
CASE: ENGINEER-ESTB

DESIGNED BY: -
DRAWN BY: -
CHECKED BY: -
APPROVED BY: -

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Stantec

LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

CIVIL NOTES AND DETAILS

REVISIONS

REV	DESCRIPTION	DATE
-	-	-

PROJ. #: 220118
DATE: 23-JUNE-2023
SHEET
C-502

100% CONSTRUCTION DOCUMENTS

WE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
BLACK
WHITE

Point Table

Point #	Northing	Easting	Description
1	441736.26	13078238.87	BLD
2	441873.88	13078238.87	BLD
3	441873.88	13078245.87	BLD
4	441966.20	13078245.87	BLD
5	441966.20	13078250.22	BLD
6	441969.55	13078249.87	BLD
7	441969.55	13078238.87	BLD
8	442091.52	13078238.87	BLD
9	442091.52	13078079.57	BLD
10	441736.26	13078079.57	BLD
11	442167.90	13078050.76	BOC
12	442141.38	13078058.50	BOC
13	442135.83	13078064.43	BOC
14	442129.40	13078084.17	BOC
15	442129.40	13078133.91	BOC
16	442141.16	13078154.43	BOC
17	442129.40	13078188.57	BOC
18	442129.40	13078211.65	BOC
19	442129.40	13078330.41	BOC
20	442087.98	13078362.20	BOC
21	442079.60	13078386.96	BOC
22	442081.79	13078392.34	BOC
23	442086.58	13078398.32	BOC
24	442101.70	13078404.33	BOC
25	442045.88	13078049.86	BOC
26	442075.90	13078049.97	BOC
27	442102.99	13078058.19	BOC
28	442108.34	13078064.15	BOC
29	442114.40	13078083.38	BOC
30	442114.40	13078101.12	BOC
31	442111.90	13078103.62	BOC
32	442096.55	13078103.62	BOC
33	442109.55	13078174.07	BOC
34	442114.40	13078179.07	BOC
35	442114.40	13078186.15	BOC
36	442114.40	13078217.15	BOC
37	442114.40	13078230.87	BOC
38	442101.29	13078257.44	BOC
39	442069.37	13078281.94	BOC
40	442055.09	13078310.90	BOC
41	442055.09	13078385.84	BOC
42	442047.68	13078402.97	BOC
43	442042.89	13078402.97	BOC
44	442035.48	13078385.84	BOC
45	442035.48	13078332.89	BOC
46	441974.98	13078272.39	BOC
47	441924.55	13078272.39	BOC
48	441904.21	13078272.39	BOC
49	441869.21	13078272.39	BOC
50	441779.21	13078272.39	BOC
51	441769.21	13078272.39	BOC
52	441729.91	13078272.39	BOC
53	441724.96	13078271.87	BOC
54	441714.12	13078266.30	BOC
55	441706.41	13078243.89	BOC
56	441706.41	13078248.89	BOC
57	441706.09	13078319.44	BOC
58	441706.11	13078317.17	BOC
59	441714.46	13078303.11	BOC
60	441719.97	13078300.39	BOC
61	441745.89	13078319.44	BOC
62	441745.89	13078350.61	BOC
63	441745.89	13078357.46	BOC
64	441745.89	13078374.74	BOC
65	441863.39	13078374.74	BOC
66	441980.89	13078374.74	BOC
67	441980.89	13078357.24	BOC
68	441983.39	13078354.74	BOC
69	442008.48	13078378.24	BOC
70	442008.49	13078380.00	BOC
71	442005.40	13078391.60	BOC
72	442000.57	13078397.56	BOC
73	441987.65	13078403.32	BOC
74	442304.07	13078060.38	TOW
75	442304.06	13078065.35	TOW

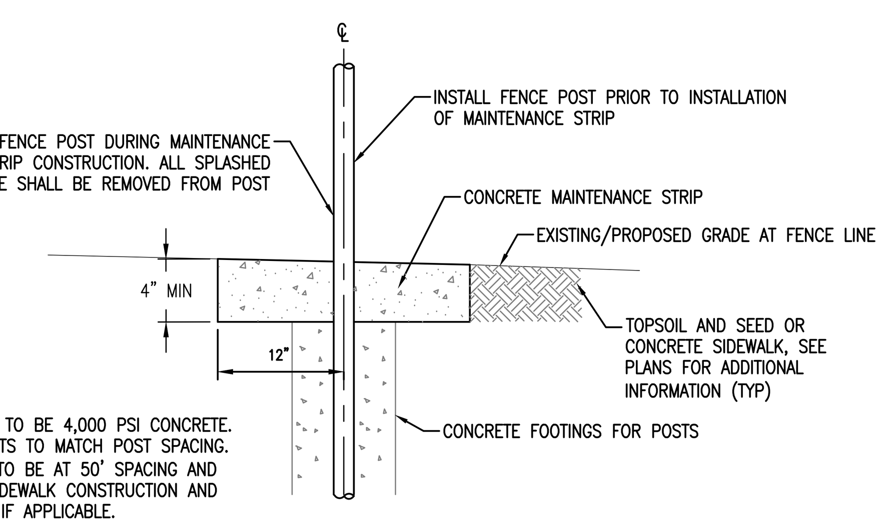
Point Table

Point #	Northing	Easting	Description
76	442303.64	13078225.09	TOW
77	442303.28	13078359.27	TOW
78	442303.27	13078364.01	TOW
79	442303.20	13078389.84	TOW
80	442293.11	13078399.78	TOW
81	442257.73	13078399.45	TOW
82	442252.82	13078399.41	TOW
83	442093.12	13078397.92	TOW
84	442092.56	13078392.91	TOW
85	442090.49	13078390.89	TOW
86	442086.92	13078382.86	TOW
87	442092.85	13078368.54	TOW
88	442137.40	13078334.36	TOW
89	442137.40	13078273.20	TOW
90	442137.40	13078268.20	TOW
91	442144.82	13078273.20	TOW
92	442144.82	13078268.20	TOW
93	442137.40	13078232.57	TOW
94	442144.82	13078232.57	TOW
95	442144.82	13078227.57	TOW
96	442137.40	13078227.57	TOW
97	442137.40	13078205.65	TOW
98	442137.40	13078197.65	TOW
99	442217.40	13078197.65	TOW
100	442225.40	13078205.65	TOW
101	442217.40	13078185.65	TOW
102	442225.40	13078185.65	TOW
103	442225.40	13078129.65	TOW
104	442217.40	13078129.65	TOW
105	442225.40	13078109.65	TOW
106	442217.40	13078109.65	TOW
107	442225.40	13078105.65	TOW
108	442217.40	13078105.65	TOW
109	442225.40	13078081.65	TOW
110	442217.40	13078081.65	TOW
111	442217.40	13078073.65	TOW
112	442225.40	13078073.65	TOW
113	442250.40	13078081.65	TOW
114	442250.40	13078073.65	TOW
115	442284.00	13078081.65	TOW
116	442284.00	13078073.65	TOW
117	442297.01	13078073.65	TOW
118	442289.00	13078086.59	TOW
119	442296.98	13078086.61	TOW
120	442288.23	13078379.74	TOW
121	442296.23	13078379.76	TOW
122	442296.21	13078387.81	TOW
123	442291.19	13078392.76	TOW
124	442283.21	13078384.69	TOW
125	442283.14	13078392.69	TOW
126	442296.68	13078060.32	TOW
127	442301.58	13078060.36	TOW
128	442299.06	13078065.34	TOW
129	442298.64	13078225.34	TOW
130	442298.28	13078359.25	TOW
131	442298.27	13078364.00	TOW
132	442298.20	13078389.82	TOW
133	442293.16	13078394.72	TOW
134	442257.78	13078394.45	TOW
135	442252.82	13078394.41	TOW
136	441995.11	13078392.01	TOW
137	441995.07	13078397.01	TOW
138	441760.38	13078394.82	TOW
139	441760.38	13078389.82	TOW
140	441754.88	13078394.77	TOW
141	441754.88	13078389.77	TOW
142	441719.10	13078389.44	TOW
143	441719.05	13078394.40	TOW
144	441714.05	13078394.41	TOW
145	441714.06	13078390.35	TOW
146	441714.42	13078310.35	TOW
147	441719.43	13078310.37	TOW
148	441719.63	13078264.27	TOW
149	441714.65	13078259.99	TOW
150	441720.55	13078060.37	TOW

Point Table

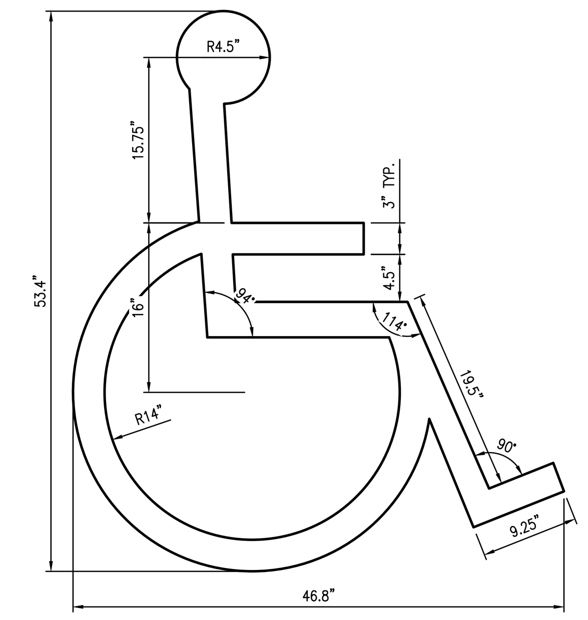
Point #	Northing	Easting	Description
151	441715.55	13078060.34	TOW
152	441715.57	13078055.34	TOW
153	441720.59	13078055.37	TOW
154	441910.87	13078062.00	TOW
155	441910.87	13078057.00	TOW
156	441919.04	13078062.07	TOW
157	441919.04	13078057.07	TOW
158	441919.04	13078074.57	TOW
159	441910.87	13078074.57	TOW
160	441765.09	13078074.57	TOW
161	441760.09	13078074.57	TOW
162	441779.21	13078243.87	TOW
163	441769.21	13078243.87	TOW
164	441769.21	13078267.39	TOW
165	441779.21	13078267.39	TOW
166	441869.21	13078267.39	TOW
167	441869.21	13078245.91	TOW
168	441974.55	13078247.39	TOW
169	441974.55	13078253.90	TOW
170	442097.68	13078253.90	TOW
171	442109.40	13078230.87	TOW
172	442109.40	13078206.65	TOW
173	442096.55	13078206.65	TOW
174	442096.55	13078196.65	TOW
175	442109.40	13078196.65	TOW
176	442109.40	13078186.15	TOW
177	442095.55	13078173.57	TOW
178	442096.55	13078074.57	TOW
179	441909.39	13078299.39	BOC
180	441919.39	13078299.39	BOC
181	441919.39	13078309.74	BOC
182	441974.98	13078298.89	BOC
183	441980.89	13078309.74	BOC
184	442007.08	13078323.31	BOC
185	442002.29	13078329.74	BOC
186	441983.39	13078329.74	BOC
187	441980.89	13078327.24	BOC
188	442250.40	13078105.65	EOP
189	442245.40	13078129.65	EOP
190	442245.40	13078105.65	EOP
191	442172.82	13078214.07	EOP
192	442144.82	13078214.07	EOP
193	442144.82	13078246.07	EOP
194	442172.82	13078246.07	EOP
195	442172.82	13078254.70	EOP
196	442172.82	13078286.70	EOP
197	442144.82	13078286.70	EOP
198	442144.82	13078254.70	EOP
199	442145.41	13078164.30	EOP
200	442134.69	13078170.61	EOP
201	442145.61	13078189.98	EOP
202	442137.90	13078194.44	EOP
203	442108.07	13078178.13	EOP
204	441771.46	13078299.39	BOC
205	441771.46	13078309.74	BOC
206	441909.39	13078309.74	BOC
207	442157.37	13078081.68	EOP
208	442157.38	13078117.69	EOP
209	442148.38	13078117.69	EOP
210	442148.39	13078149.69	EOP
211	442157.39	13078149.69	EOP
212	442157.39	13078185.68	EOP

LEGEND
BLD – BUILDING
BOC – BACK OF CURB
DMP – DUMPSTER
TOW – TOP OF WALK

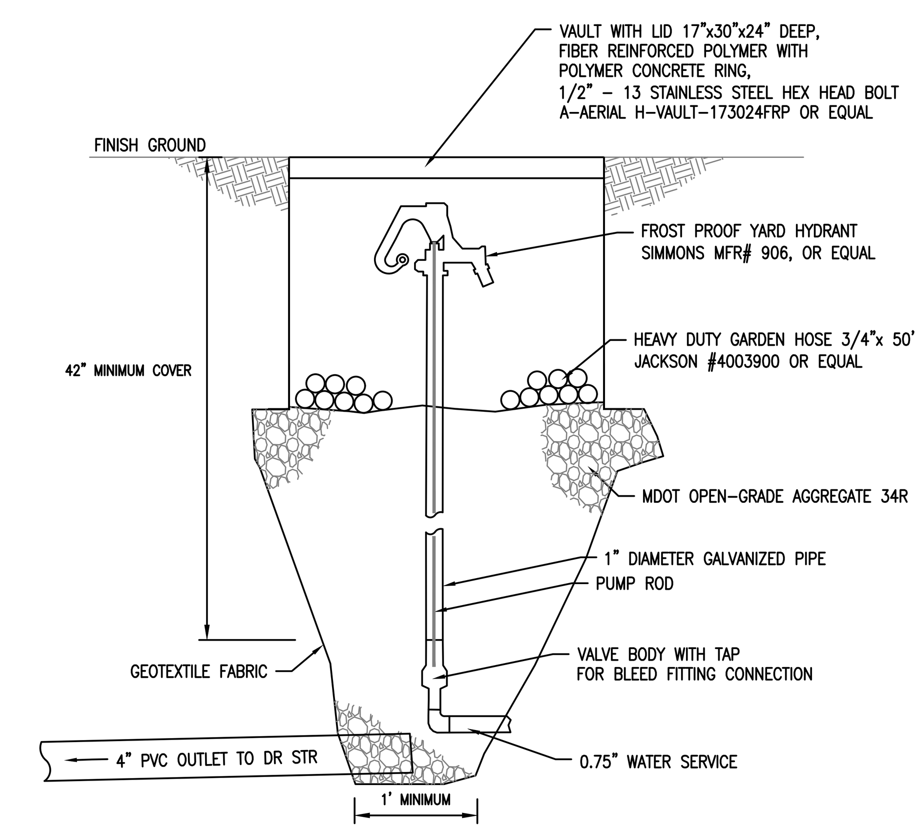


NOTES:
1. MAINTENANCE STRIP TO BE 4,000 PSI CONCRETE.
2. CONSTRUCTION JOINTS TO MATCH POST SPACING.
3. EXPANSION JOINTS TO BE AT 50' SPACING AND MATCH ADJACENT SIDEWALK CONSTRUCTION AND EXPANSION JOINTS, IF APPLICABLE.

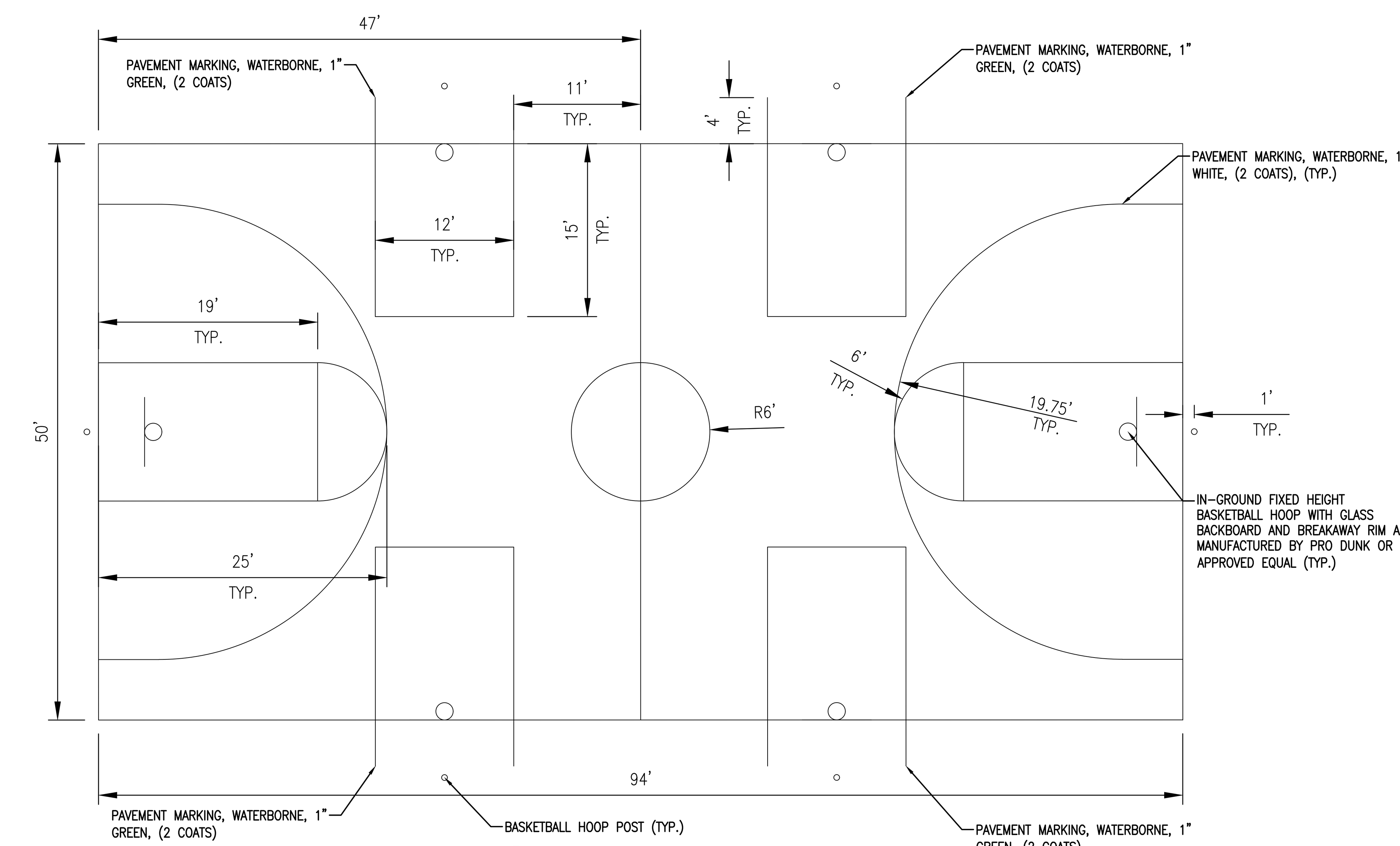
24 / C-503 FENCE CONCRETE MAINTENANCE STRIP DETAIL
NO SCALE



32 / C-503 ACCESSIBLE PAVEMENT MARKING SYMBOL
NO SCALE



33 / C-503 YARD HYDRANT VAULT DETAILL
NO SCALE



31 / C-503 BASKETBALL COURT MARKINGS
NO SCALE

PLOTTED BY: WEAVER, GABRIEL 6/23/2023 5:50 PM
M:\2022\220116_LSD_MTHOPE\DRAWINGS\DS-LSD MT HOPE\SHEETS\220116_LSD MTHOPE_SITE IMPROVEMENTS.DWG - CIVIL NOTES AND DETIALS (3 OF 3)
C2AE STANDARD.STB
DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

CIVIL NOTES AND DETAILS

REVISIONS

REV	DESCRIPTION	DATE
-	----	----
-	----	----
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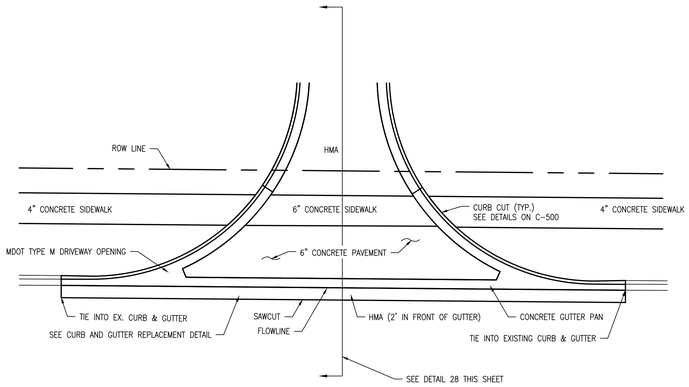
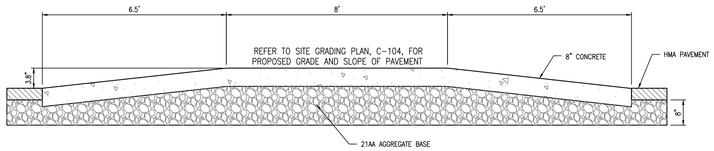
PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-503

100% CONSTRUCTION DOCUMENTS

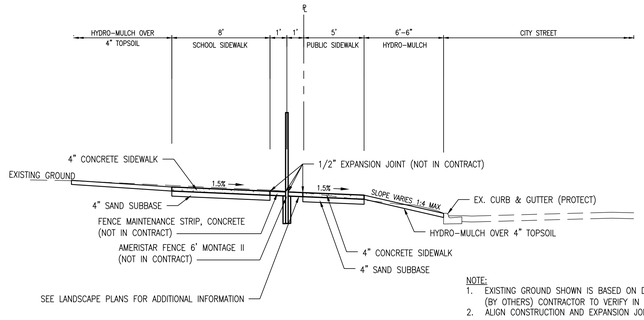


PLAN VIEW

26 C-504 SHUBEL AVENUE DRIVEWAY LAYOUT
NO SCALE

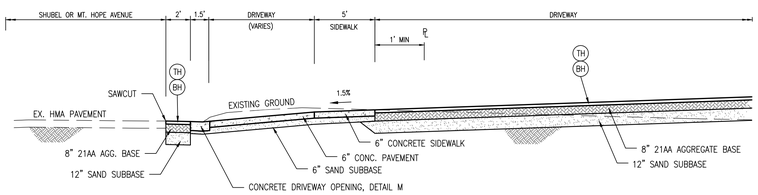


33 C-504 RAISED PEDESTRIAN CROSSING SECTION
NO SCALE



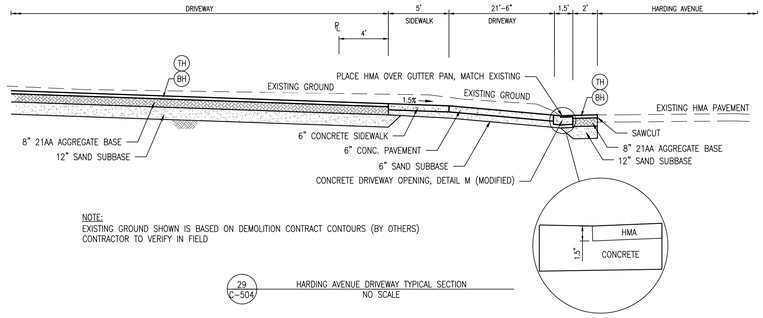
NOTE:
1. EXISTING GROUND SHOWN IS BASED ON DEMOLITION CONTRACT CONTOURS (BY OTHERS) CONTRACTOR TO VERIFY IN FIELD.
2. ALIGN CONSTRUCTION AND EXPANSION JOINTS BETWEEN SIDEWALKS

27 C-504 SCHOOL SIDEWALK ADJACENT TO PUBLIC SIDEWALK SECTION
NO SCALE



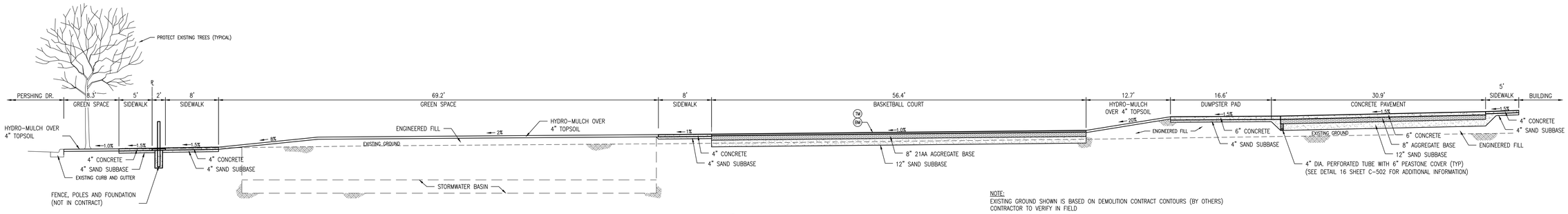
NOTE:
EXISTING GROUND SHOWN IS BASED ON DEMOLITION CONTRACT CONTOURS (BY OTHERS)
CONTRACTOR TO VERIFY IN FIELD

28 C-504 SHUBEL AVENUE AND EAST MT. HOPE AVENUE DRIVEWAY ENTRANCE TYPICAL SECTION
NO SCALE



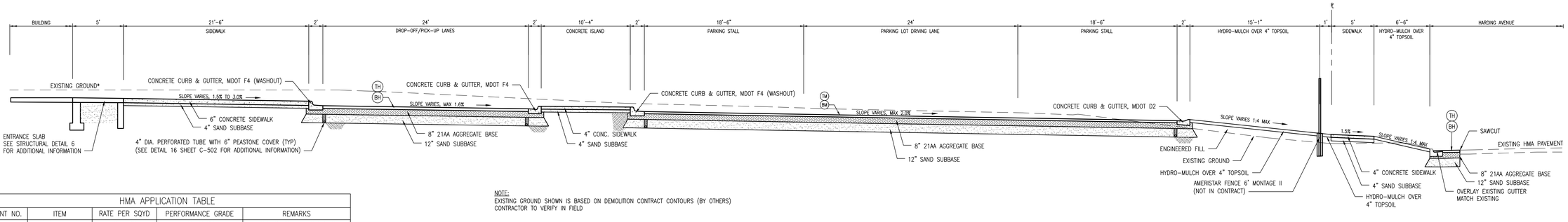
NOTE:
EXISTING GROUND SHOWN IS BASED ON DEMOLITION CONTRACT CONTOURS (BY OTHERS)
CONTRACTOR TO VERIFY IN FIELD

29 C-504 HARDING AVENUE DRIVEWAY TYPICAL SECTION
NO SCALE



NOTE:
EXISTING GROUND SHOWN IS BASED ON DEMOLITION CONTRACT CONTOURS (BY OTHERS)
CONTRACTOR TO VERIFY IN FIELD

31 C-504 SERVICE DRIVE AND BASKETBALL COURT TYPICAL SECTION
NO SCALE



NOTE:
EXISTING GROUND SHOWN IS BASED ON DEMOLITION CONTRACT CONTOURS (BY OTHERS)
CONTRACTOR TO VERIFY IN FIELD

30 C-504 DROP-OFF/PICK-UP AND PARKING LOT TYPICAL SECTION
NO SCALE

HMA APPLICATION TABLE				
IDENT NO.	ITEM	RATE PER SQYD	PERFORMANCE GRADE	REMARKS
TH	MDOT HMA, 13A	165 LBS	PG 58-28	TOP COURSE – HEAVY DUTY
BH	MDOT HMA, 13A	275 LBS	PG 58-28	BASE COURSE – HEAVY DUTY
TM	MDOT HMA, 13A	165 LBS	PG 58-28	TOP COURSE – MEDIUM DUTY
BM	MDOT HMA, 13A	165 LBS	PG 58-28	BASE COURSE – MEDIUM DUTY
	HMA BOND COAT	0.10 GAL		FOR INFORMATION ONLY
HP	MDOT HMA, 13A	275 LBS (MAXIMUM)	PG 58-28	HAND PATCHING

NOTES:
1. THE MIX DESIGNS SHALL TARGET 3.0 PERCENT AIR VOIDS.
2. ALL BITUMINOUS MATERIAL SHALL BE COMPACTED TO A DENSITY OF 94 TO 97 PERCENT OF THE MAXIMUM DENSITY AS DETERMINED BY THE RICE METHOD. A BOND COAT OF SS-1H EMULSION SHALL BE REQUIRED BETWEEN THE BASE AND TOP COURSE AND BETWEEN LIFTS IN THE LEVELING COURSE. THE BOND COAT SHALL BE APPLIED IN A UNIFORM MANNER OVER THE SURFACE AT A RATE OF 0.1 GALLONS PER SQUARE YARD.
3. JOINTS IN THE TOP COURSE SHALL BE OFFSET A MINIMUM OF 12 INCHES FROM THE JOINTS IN THE BASE COURSE.

THE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK

PLOTTED BY: MEAGHER, CARRIE, 6/23/2023 3:51 PM
PLOT SCALE: 1:1 DWG: P:\0220116\000\00000\CADD\C-500 SERIES\SHEETS\220116_LSD MT HOPE\SHEET\220116_LSD MT HOPE_TYPICALS.DWG - TYPICAL CROSS SECTIONS
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DESIGNED BY: -
DRAWN BY: -
CHECKED BY: -
APPROVED BY: -

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TYPICAL CROSS SECTIONS

REVISIONS

REV	DESCRIPTION	DATE
-	-	-

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-504

100% CONSTRUCTION DOCUMENTS

GENERAL NOTES

1. THE CONTRACTOR(S), AND ANY AGENT INVOLVED IN OBTAINING OR EXERCISING AND PERFORMING THE EARTH DISTURBANCE WORK AUTHORIZED BY A SOIL EROSION PERMIT, ARE ALL HELD RESPONSIBLE TO ENSURE THAT THE WORK IS PERFORMED IN ACCORDANCE WITH ALL APPROVED PLANS, SPECIFICATIONS, AND CONDITIONS CONTAINED AND PERMITTED THEREIN. PRIOR TO INITIATING EARTH DISTURBANCE AUTHORIZED THEREIN, THE PERMITTEE IS REQUIRED TO PROVIDE A COPY OF THE PERMIT AND APPROVED SESC PLAN TO ANY CONTRACTOR(S) AND AGENTS INVOLVED WITH EARTH DISTURBANCE WORK. THE CONTRACTOR(S) AND AGENTS ARE REQUIRED TO PROVIDE A COPY OF THE PERMIT AND APPROVED SESC PLAN TO CALL SUBCONTRACTORS INVOLVED WITH EARTH DISTURBANCE WORK.

2. APPROVAL OF THIS SOIL EROSION PERMIT DOES NOT AUTHORIZE ANY EARTH DISTURBANCE ACTIVITY OFF-SITE, INCLUDING BUT NOT LIMITED TO REMOVAL OF EXCAVATED MATERIAL. SHOULD IT BECOME NECESSARY THAT EXCAVATED MATERIAL FROM THIS SITE NEEDS TO BE DEPOSITED OFF-SITE, THAT MATERIAL SHALL NOT BE REMOVED UNTIL THE DEPOSIT LOCATION AND RESULTING EARTH DISTURBANCE IS EVALUATED BY THE SESC FOR A SOIL EROSION PERMIT, AND, IF NECESSARY, THOSE SOIL EROSION PERMITS HAVE BEEN ISSUED. THE PERMITTEE IS TO INFORM THE SESC OF THE NEED TO REMOVE SOILS FROM THE SITE IN A TIMELY MANNER SO THAT OTHER PERMITS, IF NEEDED, CAN BE ISSUED.

3. IN ACCORDANCE WITH RULE 1709 PROMULGATED UNDER THE AUTHORITY OF PART 91, SOIL EROSION AND SEDIMENTATION CONTROL, OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451, AS AMENDED, AND IN ADDITION TO THE INFORMATION ON THE ATTACHED PLAN(S) AND SPECIAL CONDITIONS, THE FOLLOWING GENERAL CONDITIONS APPLY TO THE EARTH CHANGED AUTHORIZED BY THIS PERMIT:

- DESIGN, CONSTRUCT, AND COMPLETE EARTH CHANGE IN A MANNER THAT LIMITS THE EXPOSED AREA OF DISTURBED LAND FOR THE SHORTEST PERIOD OF TIME.
- REMOVE SEDIMENT CAUSED BY ACCELERATED SOIL EROSION FROM RUNOFF WATER BEFORE IT LEAVES THE SITE OF THE EARTH CHANGE.
- TEMPORARY OR PERMANENT CONTROL MEASURES SHALL BE DESIGNED AND INSTALLED TO CONVEY WATER AROUND, THROUGH, OR FROM THE EARTH CHANGE AT A NON-EROSIVE VELOCITY.
- INSTALL TEMPORARY SOIL EROSION AND SEDIMENTATION CONTROL MEASURES BEFORE OR UPON COMMENCEMENT OF THE EARTH CHANGE ACTIVITY AND MAINTAIN THE MEASURES ON A DAILY BASIS. REMOVE TEMPORARY SOIL EROSION AND SEDIMENTATION CONTROL MEASURES AFTER PERMANENT SOIL EROSION MEASURES ARE IN PLACE AND THE AREA IS STABILIZED. ("STABILIZED" MEANS THE ESTABLISHMENT OF VEGETATION OR THE PROPER PLACEMENT, GRADING, OR COVERING OF SOIL TO ENSURE ITS RESISTANCE TO SOIL EROSION, SLIDING, OR OTHER EARTH MOVEMENT.)
- COMPLETE PERMANENT SOIL EROSION CONTROL MEASURES FOR THE EARTH CHANGE WITHIN FIVE CALENDAR DAYS AFTER FINAL GRADING OR UPON COMPLETION OF THE FINAL EARTH CHANGE. IF IT IS NOT POSSIBLE TO PERMANENTLY STABILIZE THE EARTH CHANGE, THEN MAINTAIN TEMPORARY SOIL AND SEDIMENTATION CONTROL MEASURES UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IN PLACE AND THE AREA IS STABILIZED.
- THE CONTRACTOR SHALL VERIFY PROPER INSTALLATION OF THE SESC MEASURES PRIOR TO COMMENCEMENT OF EARTH DISTURBANCE AS SHOWN ON THE PLANS AND IN ACCORDANCE WITH THE SPECIFICATIONS.
- POST THE ENCLOSED SOIL EROSION AND SEDIMENTATION POLLUTION CONTROL PERMIT ON SITE SO THAT IT IS CLEARLY VISIBLE FROM A PUBLIC ROAD UNTIL THE LAND IS PERMANENTLY STABILIZED AND THE PERMIT IS CLOSED.
- THE SESC SHALL BE COPIED THE NPDES WEEKLY LOG REPORTS BY THE SECOND AND FOURTH FRIDAY EACH MONTH UNTIL THE SITE IS PERMANENTLY STABILIZED AND THE PERMIT IS CLOSED.
- THE PRIME CONTRACTOR SHALL PROVIDE CONTACT INFORMATION OF ALL CONTRACTORS WHO WILL BE DISTURBING THE EARTH WITHIN THE PROJECT LIMITS.
- THE CONTRACTOR SHALL PROVIDE THE ON-SITE CONTACT PERSON, OFFICE LOCATION, MOBILE PHONE NUMBER AND EMAIL ADDRESS TO THE SESC, PRIOR TO COMMENCEMENT OF ANY EARTH DISTURBANCE AUTHORIZED BY THE SESC PERMIT.

4. ALL EROSION CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE SESC REQUIREMENTS AND PROJECT SPECIFICATIONS.

5. ANY EROSION OR SEDIMENT FROM WORK ON THIS SITE SHALL BE CONTAINED ON THE SITE AND NOT ALLOWED TO COLLECT ON ANY OFF SITE AREAS OR IN WATERWAYS: WATERWAYS INCLUDE BOTH NATURAL AND MAN-MADE OPEN DITCHES, STREAMS, STORM DRAINS, LAKES AND PONDS.

6. CONTRACTOR SHALL APPLY TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES AS REQUIRED AND AS DIRECTED ON THESE PLANS. HE SHALL REMOVE TEMPORARY MEASURES AS SOON AS PERMANENT STABILIZATION OF SLOPES, DITCHES AND OTHER EARTH CHANGES HAVE BEEN ESTABLISHED. THE PERMIT WILL NOT BE CLOSED, IT WILL BE TRANSFERRED TO THE FUTURE SITE CONTRACTOR.

7. IF DEWATERING IS NECESSARY, CONTRACTOR SHALL SUBMIT A DEWATERING PLAN TO THE SESC FOR APPROVAL.

8. THE CONTRACTOR SHALL PLACE THE TEMPORARY SILT FENCE AND CATCH BASIN SILT TRAPS PRIOR TO COMMENCING GRADING OPERATIONS.

9. INSTALL FABRIC DROP BETWEEN THE FRAME AND COVER OF ALL EXISTING YARD BASINS OR INLETS WHICH MAY BE SUSCEPTIBLE TO SEDIMENT EROSION FROM THE PROPOSED CONSTRUCTION AS SHOWN IN THESE PLANS.

10. WHILE MAINTAINING A VEGETATIVE BUFFER WHENEVER POSSIBLE, STRIP AND STOCKPILE TOPSOIL ABOVE AREAS OF PROPOSED EXCAVATION OR GRADING FOR LATER USE ON SITE. PLACE STOCKPILED TOPSOIL IN AREAS WHICH ARE NEITHER SUBJECT TO HIGH RUNOFF NOR ALONG STEEP SLOPES. SEED AND MULCH STOCKPILES IMMEDIATELY TO PREVENT WIND BLOWN SEDIMENT POLLUTION AND EXCESSIVE DUST.

11. DO NOT EXPOSE AREAS FAR IN ADVANCE OF THE PROPOSED CONSTRUCTION FOR THAT AREA. ROUGHEN AND SCARIFY EXPOSED SURFACES TO REDUCE RUNOFF VELOCITY AND SEDIMENTATION. MAINTAIN VEGETATION WHENEVER POSSIBLE TO PROVIDE A NATURAL BUFFER.

12. TOPSOIL, SEED, FERTILIZE & MULCH EXPOSED AREAS WITHIN 5 CALENDAR DAYS OF ACHIEVING FINAL GRADE TO PROTECT AND RESTORE PERMANENT VEGETATION.

13. IN NON-TRAFFIC AREAS WHERE THE ROUGH GRADING OPERATIONS HAVE BEEN STOPPED BY THE CONTRACTOR FOR A PERIOD LONGER THAN 3 WORKING DAYS, THE CONTRACTOR SHALL STABALIZE THE AREA WITH APPLIED POLYMER SYSTEMS, INC., "SILT STOP" OR APPROVED EQUAL.

14. THE CONTRACTOR SHALL WATER EXPOSED GROUND, AS REQUIRED, TO CONTROL AIRBORNE PARTICULATE MATTER.

15. THE CONTRACTOR SHALL MAINTAIN ALL TEMPORARY AND PERMANENT SOIL EROSION AND SEDIMENTATION CONTROL MEASURES THROUGHOUT THE ENTIRE CONSTRUCTION PROCESS AND UNTIL PERMANENT VEGETATION IS ESTABLISHED. REMOVE ACCUMULATED SEDIMENT FROM ALL DRAINAGE AND UTILITY STRUCTURES.

16. THE SITE WILL BE PERIODICALLY INSPECTED BY THE STAFF OF THE SESC. THE CONTRACTOR SHALL BECOME FAMILIAR WITH THE RULES AND REGULATIONS OF THAT OFFICE.

17. DAILY INSPECTIONS SHALL BE MADE BY THE CONTRACTOR TO DETERMINE EFFECTIVENESS OF EROSION AND SEDIMENTATION CONTROL MEASURES, AND ANY NECESSARY REPAIRS SHALL BE PERFORMED WITHOUT DELAY.

18. AFTER EACH RAINFALL EVENT, CONTRACTOR SHALL INSPECT AND MAINTAIN ALL SOIL EROSION CONTROL MEASURES AND CLEAN AND REPLACE CATCH BASIN FILTERS.

19. DUST CONTROL WILL BE EXERCISED AT ALL TIMES WITHIN THE PROJECT BY THE CONTRACTORS. SPRINKLING TANK TRUCKS SHALL BE AVAILABLE AT ALL TIMES TO BE USED ON HAUL ROUTES OR OTHER PLACES WHERE DUST BECOMES A PROBLEM.

20. ALL MUD, DIRT AND DEBRIS TRACKED ONTO EXISTING ROADS SHALL BE PROMPTLY REMOVED BY THE CONTRACTOR NO LESS THAN ON A DAILY BASIS. ALL MUD, DIRT AND DEBRIS TRACKED OR SPILLED ONTO PAVED SURFACES WITHIN THIS SITE SHALL BE PROMPTLY REMOVED BY THE CONTRACTOR.

21. UPON COMPLETION OF THE DEMOLITION, ALL TEMPORARY SOIL EROSION AND SEDIMENTATION CONTROL DEVICES WILL BE LEFT IN PLACE AND THE FUTURE SITE CONTRACTOR WILL OPERATE AND MAINTAIN THE PERMANENT SOIL EROSION AND SEDIMENTATION CONTROL DEVICES, INCLUDING, BUT NOT LIMITED TO THE FOLLOWING ITEMS:

- DRIVES, CURB AND GUTTER, AND OTHER HARD SURFACES
- ON SITE DITCHES AND SWALES

THE OWNER SHALL BE RESPONSIBLE FOR THE CONTINUED MAINTENANCE PROGRAM. THE MAINTENANCE PROGRAM SHALL CONSIST OF, BUT NOT BE LIMITED TO, THE FOLLOWING ITEMS:

- LAWN AREAS - MOWING OF LAWNS AND PERIODIC WEED CONTROL AND FERTILIZING.
- DRIVES, CURB AND GUTTER, AND OTHER HARD SURFACES - PERIODIC INSPECTION AND REPAIR OF DAMAGED SURFACES.
- ON SITE DITCHES AND SWALES - PERIODIC INSPECTION, REPAIR OF ERODED AREAS IF ANY, AND RE-ESTABLISHMENT OF TURF

E7 TEMPORARY SEEDING SPECIFICATIONS

TEMPORARY SEEDING DATES

Seed Type	Zone 1 Lower Peninsula (South of U.S. 10)	Zone 2 Lower Peninsula (North of U.S. 10)	Zone 3 Upper Peninsula	Amount per 1,000 Sft	
Oats, barley lbs.	4/1 - 9/15	4/15 - 8/1	5/1 -8/1	2 lbs.	96
Annual Rye lbs.	8/1 - 10/15	8/1 - 10/10	8/1 - 11/1	3 lbs.	120
Wheat lbs.	9/20 - 10/15	9/10 - 10/10	9/10 - 10/1	3 lbs.	120
Buckwheat	6/1 - 7/15	6/1 - 7/15	6/15 - 7/15	2 lbs.	75 lbs.
Perennial Ryegrass	8/1 - 10/15	6/1 - 8/1	8/1 - 10/1	1 lbs.	20 lbs.

Source: Adapted from USDA NRCS Technical Guide #342 (1999)

E6 MULCHING

WHEN
- WHEN AREAS ARE SUBJECT TO EROSIVE SURFACE SHEET FLOWS OR SEVERE WIND.

WHY
- TEMPORARILY PROTECTS SEEDED AREAS AND SLOPES AGAINST EROSION FROM RAIN OR WIND. HOLDS SOIL MOISTURE TO ALLOW FOR SEED GERMINATION AND REDUCES WIND DESICCATION OF GERMINATED SEEDS. INHIBITS SEED CONSUMPTION BY BIRDS.

WHERE
- USE ON EXPOSED SLOPES, NEWLY SEEDED AREAS AND OTHER AREAS SUBJECT TO EROSION.

HOW
1. OTHER SURFACE RUNOFF CONTROL MEASURES SHOULD BE INSTALLED PRIOR TO MULCHING.
2. PREPARE SURFACE TO PROPER GRADE AND COMPACTION REQUIREMENTS.
3. IF TREATMENT AREA IS TO BE REVEGETATED IMMEDIATELY, SPREAD OR DRILL SEED, OR INSTALL VEGETATIVE SPRIGS INTO PLANTING SURFACE.
4. SELECT MULCH MATERIAL APPROPRIATE FOR SITE CHARACTERISTICS, INCLUDING GRADE, LEVEL OF TRAFFIC, INSTALLATION METHOD, AND ACCESSIBILITY:
   a. STRAW - MOST COMMON AND WIDELY USED MATERIAL. PROVIDES ORGANIC MATTER AS IT BREAKS DOWN. EFFECTIVENESS OF SEDIMENT REDUCTION HIGH FOR AT LEAST 3 MONTHS. SUBJECT TO WINDBLOW AND WASHOUT. FOR STRAW, APPLY A MIN OF 2 TONS/ACRE OR APPROX. 50 LBS/1000 SFT TO COVER THE SURFACE. INCREASE APPLICATION RATES 50% FOR DORMANT SEEDING.
   b. ROCK - CRUSHED STONE AND GRAVEL MAINTAIN EFFECTIVENESS INDEFINITELY IF MAINTAINED TO REPAIR COMPACTION. COVER 2-3" IN DEPTH (APPROX. 2.27 TONS/1000 SQ. FT.).
   c. WOOD CHIPS/BARK - CHIPS DECOMPOSE SLOWLY BUT MAY REQUIRE NITROGEN FERTILIZER APPLICATION TO AVOID NUTRIENT DEFICIENCY. TEND TO WASH DOWN SLOPES OVER 6% AND MAY CLOG INLET GRATES. COVER 2-3" IN DEPTH.
5. MULCHES SHOULD NOT BE APPLIED IF STANDING WATER IS PRESENT BUT MAY BE APPLIED TO WET SOIL.
6. MULCHES (PARTICULARLY STRAW) MAY NEED ANCHORING. COMMON METHODS INCLUDE CRIMPING, DISKING, OR PUNCHING INTO SOIL; COVERING WITH NETTING; SPRAYING WITH A BINDER/TACKIFIER, OR KEEPING MOIST.
7. IF USING A TACKIFIER TO ANCHOR MULCH IN PLACE, APPLY IMMEDIATELY AFTER MULCH HAS BEEN PLACED. TACKIFIERS INCLUDE:
   a. LATEX-BASE. MIX 37 GALLONS OF ADHESIVE OR THE MANUFACTURER'S RECOMMENDED RATE WITH A MINIMUM OF 620 LBS. OF RECYCLED NEWSPRINT AS A TRACER WITH 925 GALLONS OF WATER.
   b. RECYCLED NEWSPRINT. MIX 1850 LBS. OF NEWSPRINT WITH 3700 GALLONS OF WATER.
   c. WOOD FIBER. MIX 1850 LBS. OF WOOD FIBER WITH 3700 GALLONS OF WATER.
   d. GUAR GUM. MIX 120 LBS. OF DRY ADHESIVE AND A MINIMUM OF 620 LBS. RECYCLED NEWSPRINT AS A TRACER WITH 3225 GALLONS OF WATER.
   e. OTHER TACKIFIERS. MIX 240 LBS. OF DRY ADHESIVE OR THE MANUFACTURER'S RECOMMENDED RATE AND A MIN OF 620 LBS. OF RECYCLED NEWSPRINT AS A TRACER WITH 3,225 GALLONS OF WATER.

MAINTENANCE
- INSPECT MULCHED AREAS PERIODICALLY AND AFTER ANY STORM EVENT. REPAIR DAMAGED AREAS, RESEED OR REPLACE VEGETATION (IF NECESSARY), AND REPLACE LOST MULCH IMMEDIATELY.
- KEEP ERODED SOIL, VEHICULAR AND PEDESTRIAN TRAFFIC, AND CONCENTRATED RUNOFF AWAY FROM THE MULCHED AREA.

LIMITATIONS
- MULCH CAN BE BLOWN OR WASHED AWAY IF NOT SECURED.
- ORGANIC MULCHES, PARTICULARLY THICK APPLICATIONS OF WOOD CHIPS, CAN REDUCE NITROGEN AVAILABILITY TO DESIRED PLANTS, MAY INHIBIT GOOD SURFACE COVERAGE BY VEGETATION, AND SHOULD BE SUPPLEMENTED WITH FERTILIZER.
- TACKIFIERS ARE SLIPPERY WHEN WET. EQUIPMENT MUST BE KEPT CLEAN TO PREVENT ACCIDENTS.
- TACKIFIERS CAN MARK VEHICLES, SIGNS, OR OTHER OBJECTS IF THESE ITEMS ARE NOT PROTECTED.
- HAY MULCH SHOULD NOT BE USED, AS IT CAN CONTAIN NOXIOUS WEEDS.

E7 TEMPORARY SEEDING SPECIFICATIONS

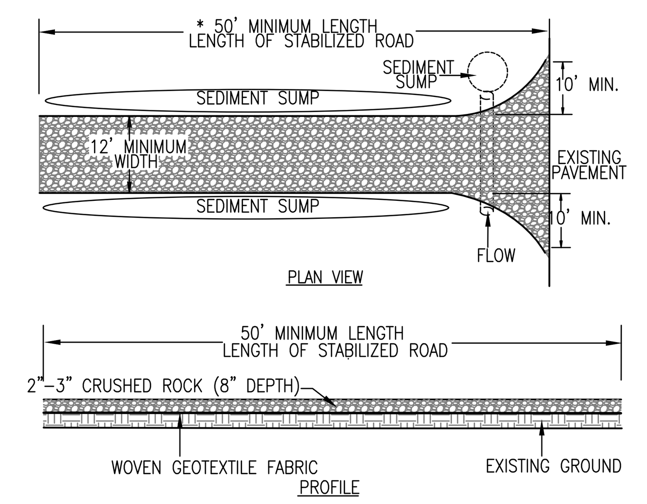
WHEN
- WHEN AN AREA NEEDS STABILIZATION DURING A BREAK IN CONSTRUCTION, THIS WILL STABILIZE SOIL. PREVENTS EROSION/SEDIMENTATION PROBLEMS FROM DEVELOPING. ALLOWS RUNOFF TO INFILTRATE SOIL.

WHERE
- USED ON CONSTRUCTION AND EARTH CHANGE SITES WHERE EARTH CHANGE HAS BEEN INITIATED BUT WILL NOT BE COMPLETED WITHIN TWO NORMAL WORK WEEKS.
- A TEMPORARY MEASURE WHEN AN AREA NEEDS STABILIZATION DURING A BREAK IN CONSTRUCTION.

HOW
1. REVIEW CONSTRUCTION PHASING AND SOIL EROSION CONTROL PLAN TO IDENTIFY AREAS REQUIRING TEMPORARY SEEDING.
2. SELECT ANNUAL GRASS SEED FOR TEMPORARY COVER AREAS.
3. SEED MIXES MAY VARY, SHOULD ONLY CONTAIN ANNUAL, NON-AGGRESSIVE SPECIES, AND GENERALLY INCLUDE RYE, WHEAT, OR OAT SPECIES.
4. SEED MIXES SHOULD BE OBTAINED FROM A SEED SUPPLIER AS SEED MIXES ARE DEPENDENT ON SOIL TYPE, LIGHT, MOISTURE, AND USE APPLICATION.
5. PREPARE SEEDBED BY REMOVAL OF CONSTRUCTION/WOODY DEBRIS.
6. THEN SCARIFY OR RAKE SEEDBED.
7. SLOPES STEEPER THAN 1:3 SHOULD BE ROUGHENED.
8. APPLY SEED AS SOON AS POSSIBLE AFTER SEEDBED PREPARATION.
9. MULCH IMMEDIATELY AFTER SEEDING ALL SLOPES, UNSTABLE SOILS, HEAVY CLAY SOILS, AND ALL AREAS ADJACENT TO WETLANDS, WATERCOURSES, OR SENSITIVE AREAS.
10. THE TIME TO SEED IS DEPENDENT ON THE CLIMATE OF THE AREA. MICHIGAN HAS THREE CLIMATIC ZONES.
11. PROTECT SEEDED AREAS FROM PEDESTRIAN/VEHICULAR TRAFFIC.
12. DIVERT CONCENTRATED FLOWS AWAY FROM SEEDED AREA UNTIL VEGETATION IS ESTABLISHED.
13. INSPECT TEMPORARY SEEDED AREAS WEEKLY AND FOLLOWING EACH RAIN EVENT UNTIL FINAL GRADING AND STABILIZATION ACTIVITIES ARE COMPLETED.
14. MUST BE FOLLOWED BY PERMANENT SEEDING.

WHY
- SEEDS NEED ADEQUATE TIME TO ESTABLISH.
- MAY NOT BE APPROPRIATE IN AREAS WITH FREQUENT TRAFFIC.
- SEEDED AREA MAY REQUIRE IRRIGATION IN DRY PERIODS.

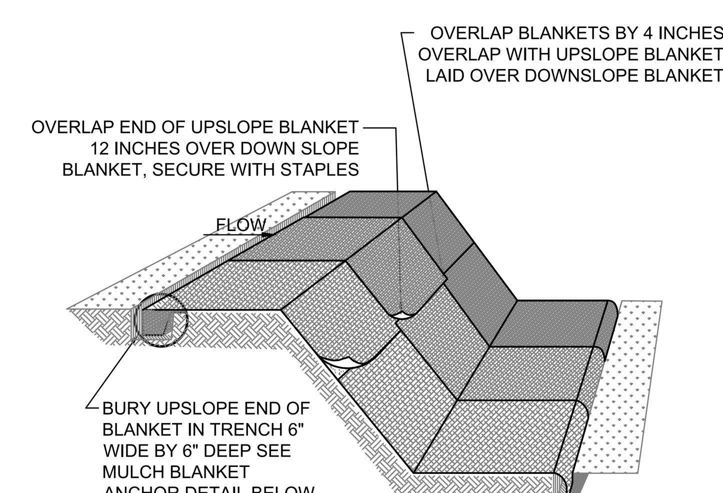
S53 STABILIZED CONSTRUCTION ACCESS

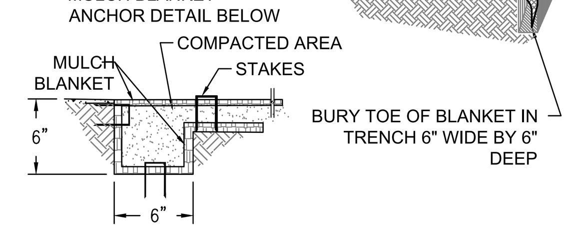


1. STABILIZED CONSTRUCTION ACCESS ROAD SHOULD BE ESTABLISHED AT THE ONSET OF THE CONSTRUCTION ACTIVITIES AND MAINTAINED IN PLACE FOR THE DURATION OF THE CONSTRUCTION PROJECT.
2. INSTALLATION OF THIS PRACTICE SHOULD BE THE RESPONSIBILITY OF THE SITE CLEARING OR EXCAVATING CONTRACTOR.
3. ACCESS LOCATION SHOULD BE CLEARED OF WOODY VEGETATION.
4. NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED OVER THE EXISTING GROUND PRIOR TO PLACING STONE.
5. ACCESS SIZE SHOULD BE A MINIMUM OF 50'. (30' FOR SINGLE RESIDENCE LOT).
6. ACCESS WIDTH SHOULD BE 12' MINIMUM, FLARED AT THE EXISTING ROAD TO PROVIDE A TURNING RADIUS.
7. CRUSHED AGGREGATE (2" TO 3"), OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT, SHALL BE PLACED AT LEAST 8" DEEP OVER THE LENGTH AND WIDTH OF THE INGRESS/EGRESS CORRIDOR.

- PERIODIC INSPECTION AND NEEDED MAINTAINENCE SHALL BE PROVIDED AFTER EACH RAIN EVENT.
- STABILIZED ENTRANCES SHALL BE REPAIRED AND ROCK ADDED AS NECESSARY.
- SEDIMENT DEPOSITED ON PUBLIC RIGHTS-OF-WAY SHALL BE REMOVED IMMEDIATELY AND RETURNED TO THE CONSTRUCTION SITE.
- IF SOILS ARE SUCH THAT WASHING OF TIRES IS REQUIRED, IT SHALL BE DONE IN A WASH RACK AREA, STABILIZED WITH STONE, IMMEDIATELY PRIOR TO THE CONSTRUCTION ACCESS STABILIZED CORRIDOR.
- AT THE PROJECT COMPLETION, ROCK ACCESS ROAD SHOULD BE REMOVED AND DISPOSED OF UNLESS UTILIZED AS SUBGRADE FOR FINAL ROAD.

E9 MULCH BLANKETS

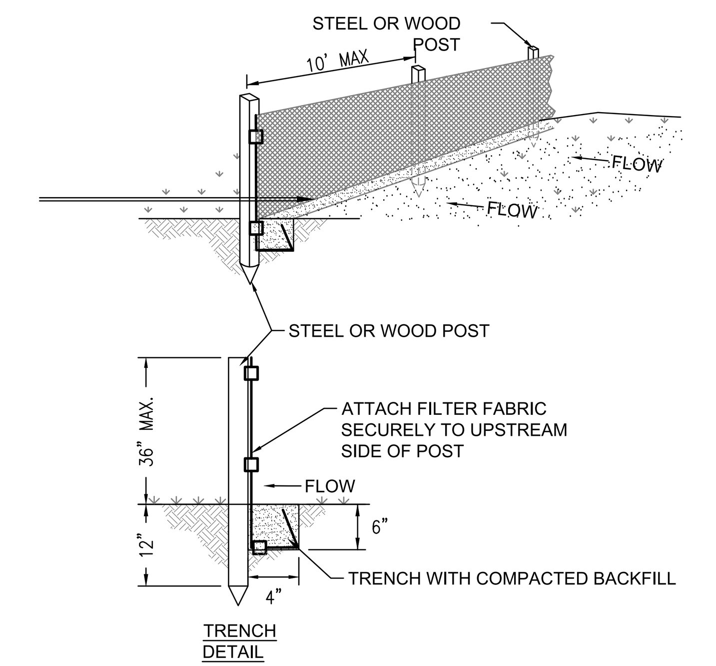




MULCH BLANKET ANCHOR DETAIL

NOTES
1. PLACE MULCH BLANKET PARALLEL TO FLOW AND ANCHOR SECURELY.
2. WHEN BLANKETS ARE USED IN FLOWING DITCH, BLANKETS SHOULD NOT OVERLAP IN DITCH CENTER PARALLEL TO FLOW.
3. STAPLES INSTALLED/SECURED ACCORDING TO MANUFACTURER'S SPECIFICATIONS.

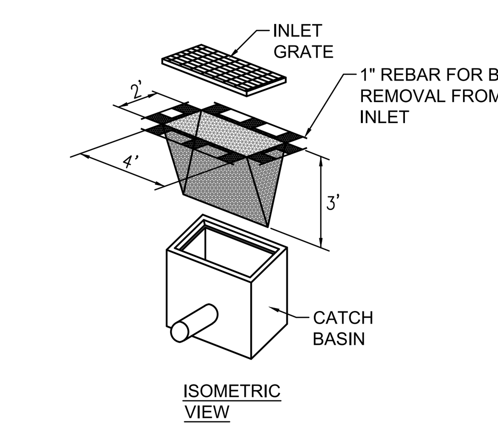
S51 SILT FENCE

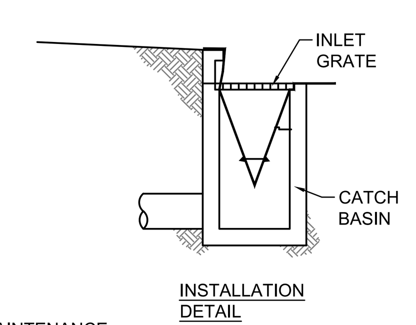


NOTES:
1. PLACE SILT FENCE ON SLOPE CONTOURS TO MAXIMIZE EFFICIENCY.
2. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY. MAXIMUM STORAGE HEIGHT: 9"
3. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTLY STABILIZED.
4. 10' MAX. SPACING WITH WIRE SUPPORTED FENCE, 6' MAX SPACING WITHOUT WIRE SUPPORTED FENCE.

MAINTENANCE
- INSPECT FREQUENTLY AND IMMEDIATELY AFTER EACH STORM EVENT. CHECK SEVERAL TIMES DURING PROLONGED STORM EVENTS. IF NECESSARY, REPAIR IMMEDIATELY.
- IF THE SEDIMENT HAS REACHED 1/3 THE HEIGHT OF THE FENCE, THE SOIL SHOULD BE REMOVED AND DISPOSED OF IN A STABLE UPLAND SITE.
- THE FENCE SHOULD BE RE-INSTALLED IF WATER IS SEEPING UNDERNEATH IT OR IF THE FENCE HAS BECOME INEFFECTIVE.
- SILT FENCE SHOULD BE REMOVED ONCE VEGETATION IS ESTABLISHED AND UP-SLOPE AREA HAS STABILIZED.

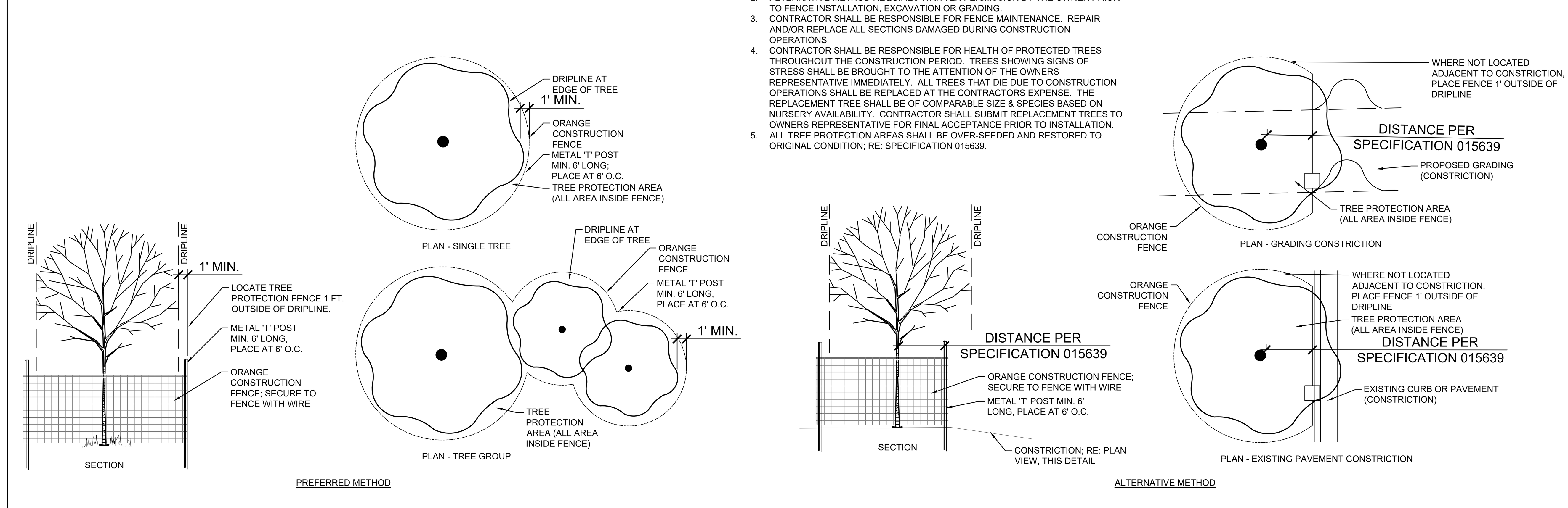
S58 INLET PROTECTION – FABRIC DROP





MAINTENANCE
- DROP INLET FILTERS SHOULD BE INSPECTED ROUTINELY AND AFTER EACH RAIN EVENT.
- DAMAGED FILTER BAGS SHOULD BE REPLACED.
- CLEAN AND/OR REPLACE FILTER BAG WHEN 1/2 FULL.
- REPLACE CLOGGED FABRIC IMMEDIATELY.
- IF NEEDED, INITIATE REPAIRS IMMEDIATELY UPON INSPECTION.
- REMOVE INLET PROTECTION WHEN AREAS ARE STABILIZED AND STREETS HAVE BEEN SWEPT.

TREE PROTECTION NOTES:
1. CONSTRUCTION FENCE SHALL BE INSTALLED PRIOR TO CONSTRUCTION OPERATIONS
2. ALTERNATIVE METHOD REQUIRES WRITTEN PERMISSION BY THE OWNER PRIOR TO FENCE INSTALLATION, EXCAVATION OR GRADING.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR FENCE MAINTENANCE. REPAIR AND/OR REPLACE ALL SECTIONS DAMAGED DURING CONSTRUCTION OPERATIONS
4. CONTRACTOR SHALL BE RESPONSIBLE FOR HEALTH OF PROTECTED TREES THROUGHOUT THE CONSTRUCTION PERIOD. TREES SHOWING SIGNS OF STRESS SHALL BE BROUGHT TO THE ATTENTION OF THE OWNERS REPRESENTATIVE IMMEDIATELY. ALL TREES THAT DIE DUE TO CONSTRUCTION OPERATIONS SHALL BE REPLACED AT THE CONTRACTORS EXPENSE. THE REPLACEMENT TREE SHALL BE OF COMPARABLE SIZE & SPECIES BASED ON NURSERY AVAILABILITY. CONTRACTOR SHALL SUBMIT REPLACEMENT TREES TO OWNERS REPRESENTATIVE FOR FINAL ACCEPTANCE PRIOR TO INSTALLATION.
5. ALL TREE PROTECTION AREAS SHALL BE OVER-SEEDED AND RESTORED TO ORIGINAL CONDITION; RE: SPECIFICATION 015639.



TREE PROTECTION DETAIL - NTS

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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

SESC NOTES & DETAILS

REVISIONS

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PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
C-505

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
BLACK
WHITE

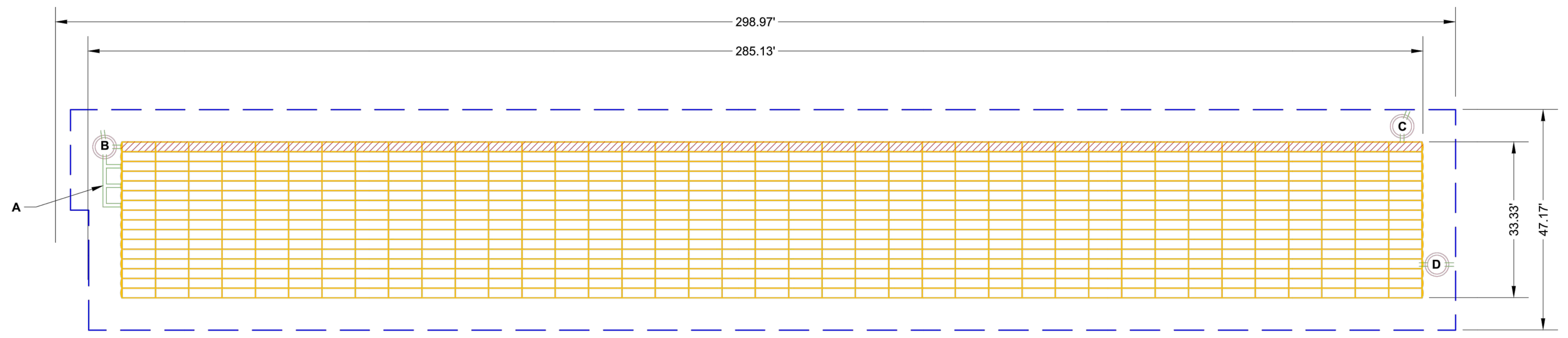
PLOTTED BY: WEAVER, GABRIEL 6/23/2023 5:51 PM
M:\2022\220116_LSD_MTHOPE\DRAWINGS\DS-LSD MT HOPE\SHEETS\220116_LSD MTHOPE_DEMO_SURVEYSESC.DWG - SESC NOTES & DETAILS
C2AE STANDARD.STB
DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

PROPOSED LAYOUT		PROPOSED ELEVATIONS:	
625	STORMTECH SC-160LP CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	845.50
32	STORMTECH SC-160LP END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	837.17
6	STONE ABOVE (in)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	836.67
6	STONE BELOW (in)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	836.67
40	STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	836.67
13740	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	TOP OF STONE:	834.10
		TOP OF SC-160LP CHAMBER:	833.60
		8" x 8" BOTTOM MANIFOLD INVERT:	832.68
		8" BOTTOM CONNECTION INVERT:	832.68
13962	SYSTEM AREA (SF)	BOTTOM OF SC-160LP CHAMBER:	832.60
700.0	SYSTEM PERIMETER (ft)	BOTTOM OF STONE:	832.10

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
MANIFOLD	A	8" x 8" BOTTOM MANIFOLD, MOLDED FITTINGS	0.96"	
CONCRETE STRUCTURE	B	48" MANHOLE, SEE UTILITY PLAN FOR ADDITIONAL INFORMATION		6.2 CFS OUT
CONCRETE STRUCTURE	C	48" MANHOLE, SEE UTILITY PLAN FOR ADDITIONAL INFORMATION		1.9 CFS OUT
CONCRETE STRUCTURE	D	48" MANHOLE, SEE UTILITY PLAN FOR ADDITIONAL INFORMATION		4.3 CFS OUT

CONTRACTOR TO PROVIDE THIS TYPE OF SYSTEM OR EQUAL.



PLAN VIEW OF PROPOSED UNDERGROUND SYSTEM

NOTE: THE LOWER STONE BED SHALL BE A MINIMUM OF 18,100 SFT AND WRAPPED IN GEOTEXTILE FABRIC

ISOLATOR ROW PLUS (SEE DETAIL)

NO WOVEN GEOTEXTILE

BED LIMITS

NOTES: **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

MT HOPE SCHOOL
LANSING, MI, USA
DATE: | DRAWN: MA
PROJECT #: | CHECKED: N/A
DATE | DRW | CHK | DESCRIPTION
StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM
ADS 4640 TRUEMAN BLVD HILLIARD, OH 43026 1-800-733-7473
0 25 50

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

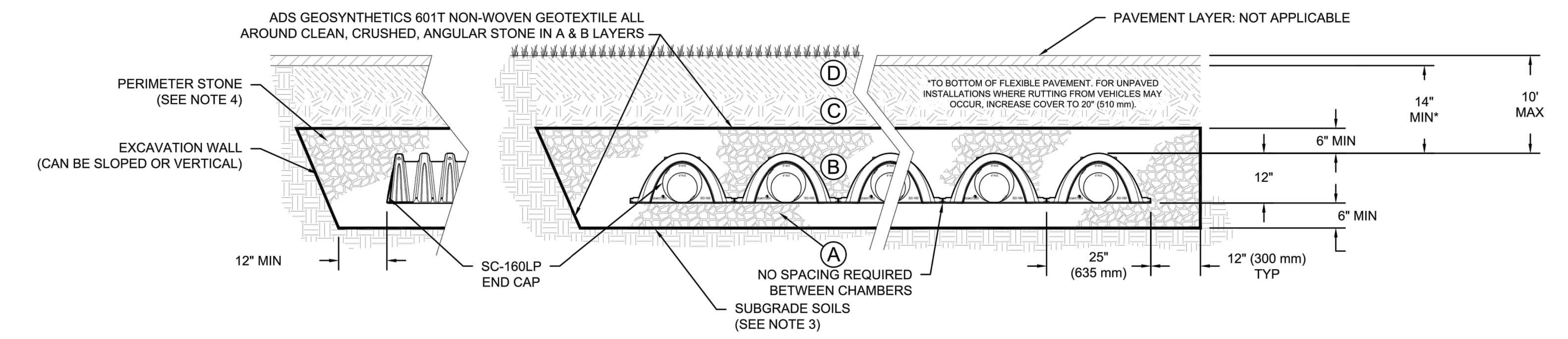
SHEET 2 OF 5

ACCEPTABLE FILL MATERIALS: STORMTECH SC-160LP CHAMBER SYSTEMS

	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 14" (355 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 6" (150 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.

NOTE: THE LOWER STONE BED SHALL BE A MINIMUM OF 18,100 SFT AND WRAPPED IN GEOTEXTILE FABRIC



NOTES: CONTRACTOR TO PROVIDE THIS TYPE OF SYSTEM OR EQUAL

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 1.5"
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 400 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

MT HOPE SCHOOL
LANSING, MI, USA
DATE: | DRAWN: MA
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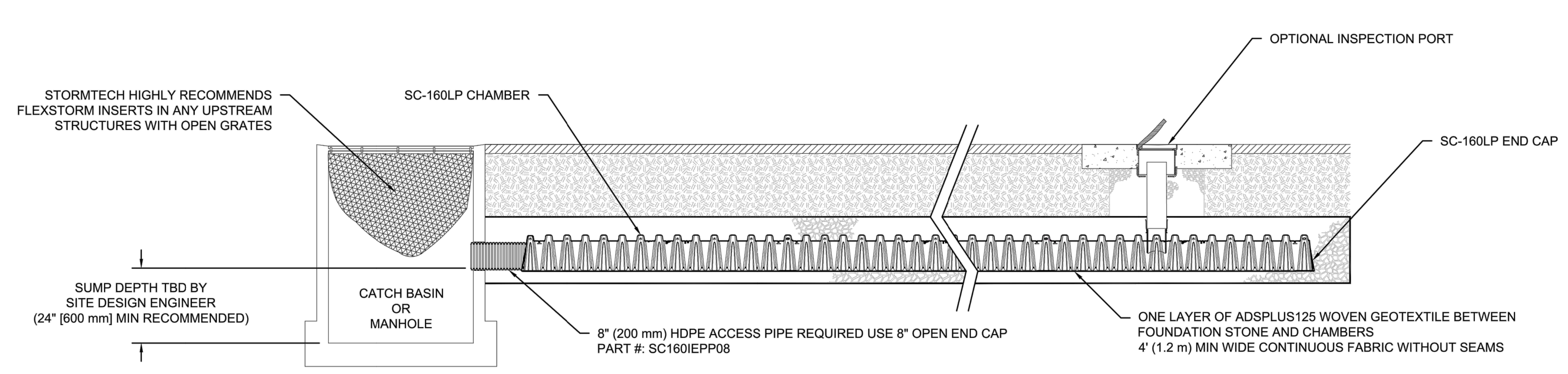
SHEET 3 OF 5



SC-160LP ISOLATOR ROW PLUS DETAIL

NTS

CONTRACTOR TO PROVIDE THIS TYPE OF SYSTEM OR EQUAL.

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

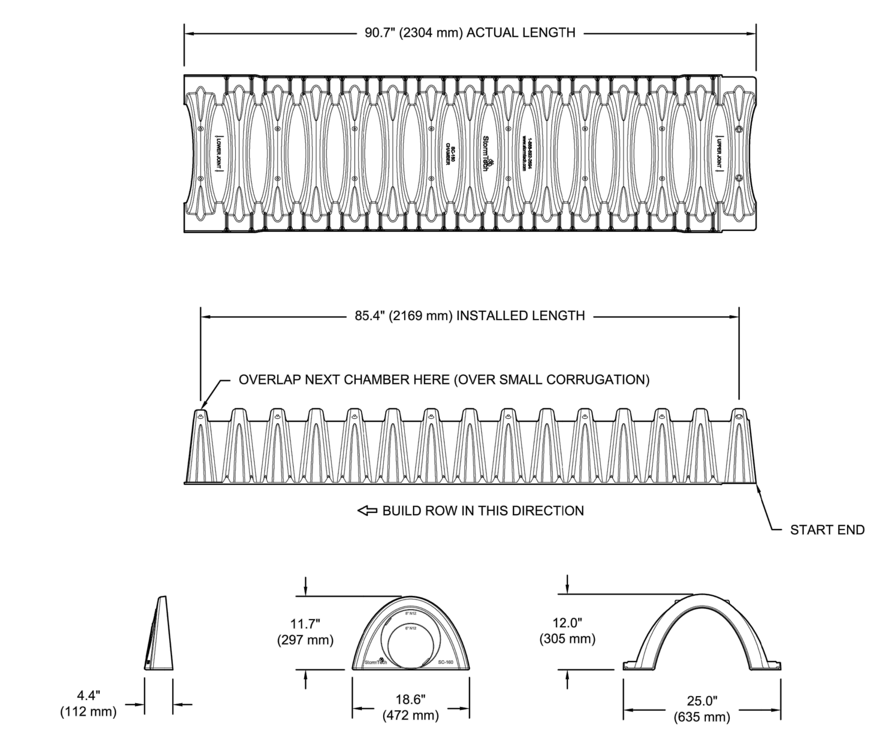
NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

SHEET 4 OF 5

SC-160LP TECHNICAL SPECIFICATION

NTS

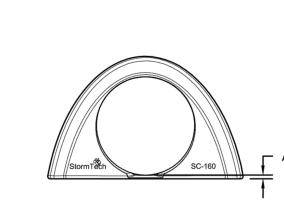


NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	25.0" X 12.0" X 85.4"	(635 mm X 305 mm X 2169 mm)
CHAMBER STORAGE	6.85 CUBIC FEET	(0.19 m³)
MINIMUM INSTALLED STORAGE*	16.0 CUBIC FEET	(0.45 m³)
WEIGHT	24.0 lbs.	(10.9 kg)

*ASSUMES 6" (152 mm) ABOVE, 6" (152 mm) BELOW, AND STONE BETWEEN CHAMBERS WITH 40% STONE POROSITY.

PART #	STUB	A
SC160EPP	6" (150 mm)	0.66" (16 mm)
	8" (200 mm)	0.80" (20 mm)
SC160EPP08	8" (200 mm)	0.96" (24 mm)



ALL STUBS ARE PLACED AT BOTTOM OF END CAP SUCH THAT THE OUTSIDE DIAMETER OF THE STUB IS FLUSH WITH THE BOTTOM OF THE END CAP. FOR ADDITIONAL INFORMATION CONTACT STORMTECH AT 1-888-892-2694.

NOTE: ALL DIMENSIONS ARE NOMINAL

CONTRACTOR TO PROVIDE THIS TYPE OF SYSTEM OR EQUAL.

SHEET 5 OF 5

SAMPLE UNDERGROUND STORM WATER BASIN
CONTRACTOR TO PROVIDE THIS TYPE OF SYSTEM OR EQUAL

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LANSING, MI

CIVIL NOTES AND DETAILS

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PROJ. #: 220116

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100% CONSTRUCTION DOCUMENTS

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
BLACK WHITE

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C2AE STANDARD.STB
DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

LANDSCAPE LEGEND

- DECIDUOUS TREE
- EVERGREEN TREE
- DECIDUOUS SHRUB
- EVERGREEN SHRUB
- PERENNIAL
- LANDSCAPE EDGING
- TURF
- SHREDDED HARDWOOD MULCH
- MIXED GROUNDCOVERS
- SYNTHETIC TURF

LANDSCAPE KEYNOTES

1. TURF AREA; SEE LANDSCAPE NOTES (4) FOR ADDITIONAL INFORMATION
2. CONCRETE BUILDING MAINTENANCE STRIP; SEE LANDSCAPE DETAILS SHEET L-500
3. MULCH RING, 3' DIA. MIN., AROUND TREES IN LAWN, SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION.
4. EXISTING SIREN AND UTILITIES; DND
5. FLAG POLE; SEE CIVIL DETAILS SHEET C-501
6. NATURAL V-CUT BED EDGE; SEE LANDSCAPE DETAILS SHEET L-500
7. OUTDOOR CLASSROOM
8. SYNTHETIC TURF BETWEEN SIDEWALKS; SEE LANDSCAPE DETAILS SHEET L-500
9. CONCRETE SPHERE BOLLARD, SEE LANDSCAPE DETAILS SHEET L-500
10. BIKE RACKS

LANDSCAPE NOTES

1. REFER TO SPECIFICATIONS FOR SOIL TESTING, INSTALLATION, MAINTENANCE AND GUARANTEE REQUIREMENTS.
2. REFER TO PLANT SCHEDULE FOR PLANT IDENTIFICATION AND PLANTING REQUIREMENTS. REFER TO SESC NOTES AND DETAILS FOR SEEDING WINDOWS.
3. CONTRACTOR SHALL FIELD STAKE ALL PLANT LOCATIONS FOR REVIEW BY OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION. THE OWNER'S REPRESENTATIVE RESERVES THE RIGHT TO ADJUST FINAL PLANT LOCATIONS.
4. ALL AREAS DISTURBED BY CONSTRUCTION, NOT BUILT PAVED OR OTHERWISE COVERED BY CONSTRUCTION SHALL BE HYDRO-MULCH SEEDED AT THE FOLLOWING RATE AND MIXTURE. REFER TO SPECIFICATIONS FOR SPECIES LIST AND PROPORTIONS.
   RATE = 8 LBS PER 1000 SFT
   WEED SEED SHALL NOT EXCEED 0.35% BY WEIGHT IN THE TOTAL AMOUNT SUPPLIED.
5. UTILITIES SHOWN THIS SHEET ARE APPROXIMATE, CONTRACTOR SHALL VERIFY UTILITY LOCATIONS PRIOR TO CONSTRUCTION. TREES SHALL NOT BE PLANTED OVER UTILITIES.
6. ALL AREAS DISTURBED OUTSIDE OF CONSTRUCTION LIMITS SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN EXISTED PRIOR TO CONSTRUCTION.
7. LANDSCAPE CONTRACTOR SHALL COORDINATE REQUIREMENTS AND CONSTRUCTION FEATURES OF ALL ADJACENT WORK BY OTHERS.
8. ALL PLANTING AREAS TO BE COVERED IN 4" OF DOUBLE SHREDDED HARDWOOD MULCH AT TIME OF PLANTING UNLESS OTHERWISE SPECIFIED.
9. PROVIDE 3-4' TOPSOIL IN ALL LAWN AREAS AND 12" PLANTING MIX IN PERENNIAL AND GROUNDCOVER BEDS.

PLANT SCHEDULE

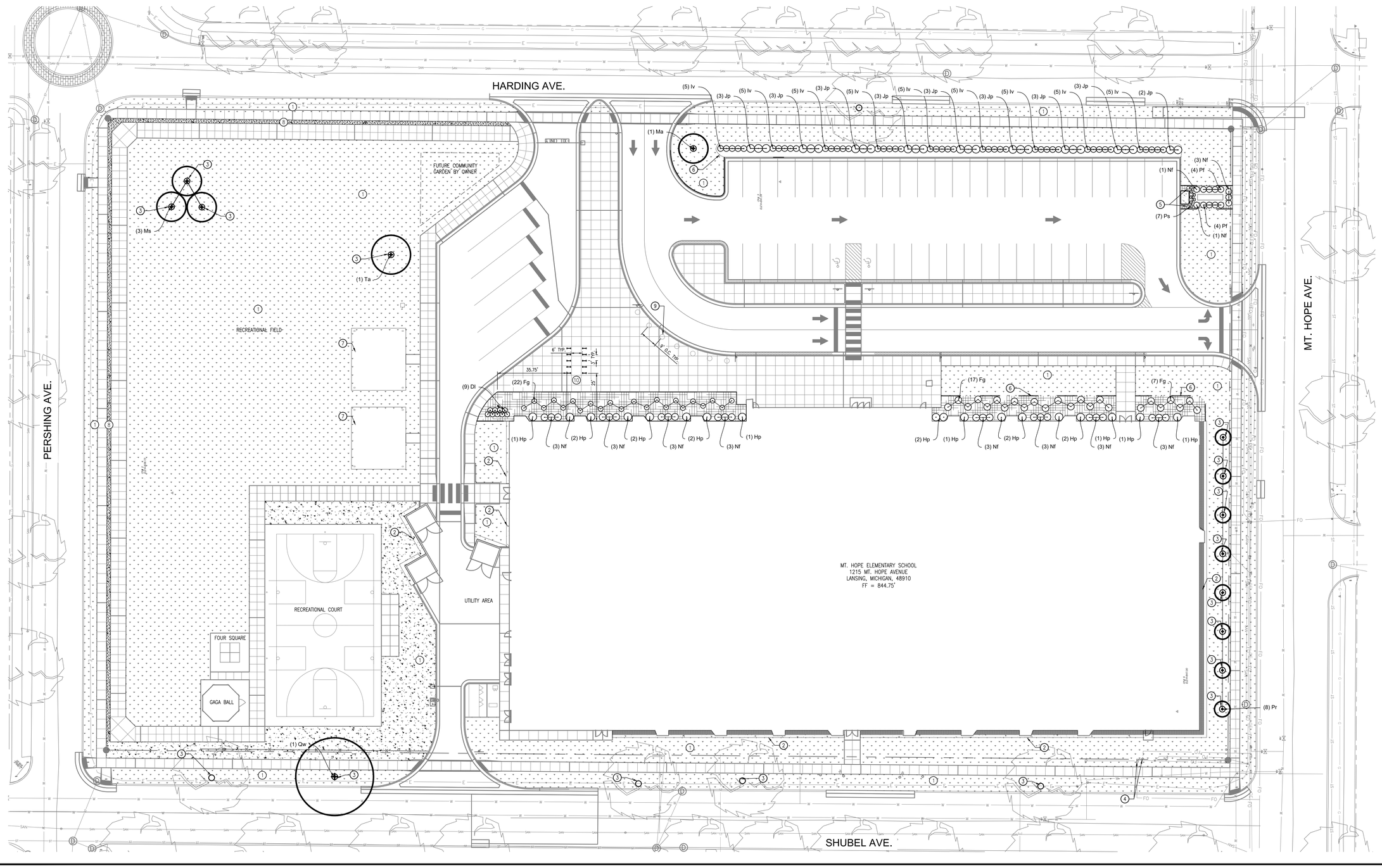
CODE	SCIENTIFIC NAME	COMMON NAME	QTY	SIZE	CONTAINER	COMMENTS
TREES						
Ms	Magnolia x soulangeana	SAUCER MAGNOLIA	3	2" CAL.	B&B	PLANT 11' FROM BLDG, 4' FROM SIDEWALK
Ma	Magnolia stellata	STAR MAGNOLIA	1	6' HT.	B&B	MULTI-STEM; PLANT AS SHOWN ON PLAN
Pr	Prunus serrulata 'Amanogowa'	AMANOGOWA JAPANESE FLOWERING CHERRY	8	1" CAL.	B&B	PLANT 20' O.C.
Qw	Quercus x warei 'Nadler'	KINDRED SPIRIT OAK	1	2" CAL.	B&B	PLANT 20' O.C.
Ta	Tillia americana	AMERICAN LINDEN	1	2" CAL.	B&B	PLANT 45 O.C.
SHRUBS						
Dl	Diervilla lonicera	DWARF BUSH HONEYSUCKLE	9	#2	CONT.	PLANT 2.5' O.C.
Hp	Hydrangea paniculata 'Little Lime'	LITTLE LIME HYDRANGEA	18	#5	CONT.	PLANT 4' O.C.
Iv	Ilex x meserveae 'WillEmer'	EMERALD MAGIC HOLLY	45	#2	CONT.	PLANT 3' O.C.
Jp	Thuja Occidentalis 'Bailjohn' PP15,850	TECNITO ARBORVITAE	26	#5	CONT.	PLANT 4' O.C.
Pf	Potentilla fruticosa 'Lundy'	HAPPY FACE POTENTILLA	8	#5	CONT.	PLANT 3' O.C.
PERENNIALS AND GRASSES						
An	Antennaria neglecta	PRAIRIE PUSSYTOES	20	50 CELL	FLAT	MIXED GROUNDCOVERS, PLANT 6" O.C.
Fv	Fragaria virginiana	WILD STRAWBERRY	20	50 CELL	FLAT	MIXED GROUNDCOVERS, PLANT 6" O.C.
Nf	Nepeta x fassenii 'Junior Walker'	JUNIOR WALKER CATMINT	29	#2	CONT.	PLANT AS SHOWN ON PLAN
Ps	Phlox subulata 'North Hills'	NORTH HILLS CREEPING PHLOX	7	#2	CONT.	PLANT AS SHOWN ON PLAN
Fg	Schizachyrium scoparium 'The Blues'	THE BLUES LITTLE BLUESTEM	46	#1	CONT.	PLANT 6' O.C.
Sc	Sisyrinchium campestre	PRAIRIE BLUE-EYED GRASS	20	50 CELL	FLAT	MIXED GROUNDCOVERS, PLANT 6" O.C.

BM #1 2173 - ELEV. 842.12'
TOP CENTER OF HYDRANT NORTHWEST OF SITE

BM #2 2174 - ELEV. 838.58'
TOP CENTER OF HYDRANT NORTHEAST OF SITE

BM #3 2715 - ELEV. 846.05'
TOP CENTER OF HYDRANT SOUTHEAST OF SITE

0 10 20 40 Feet
5 15 30



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LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

LANDSCAPE PLAN

REVISIONS

REV	DESCRIPTION	DATE
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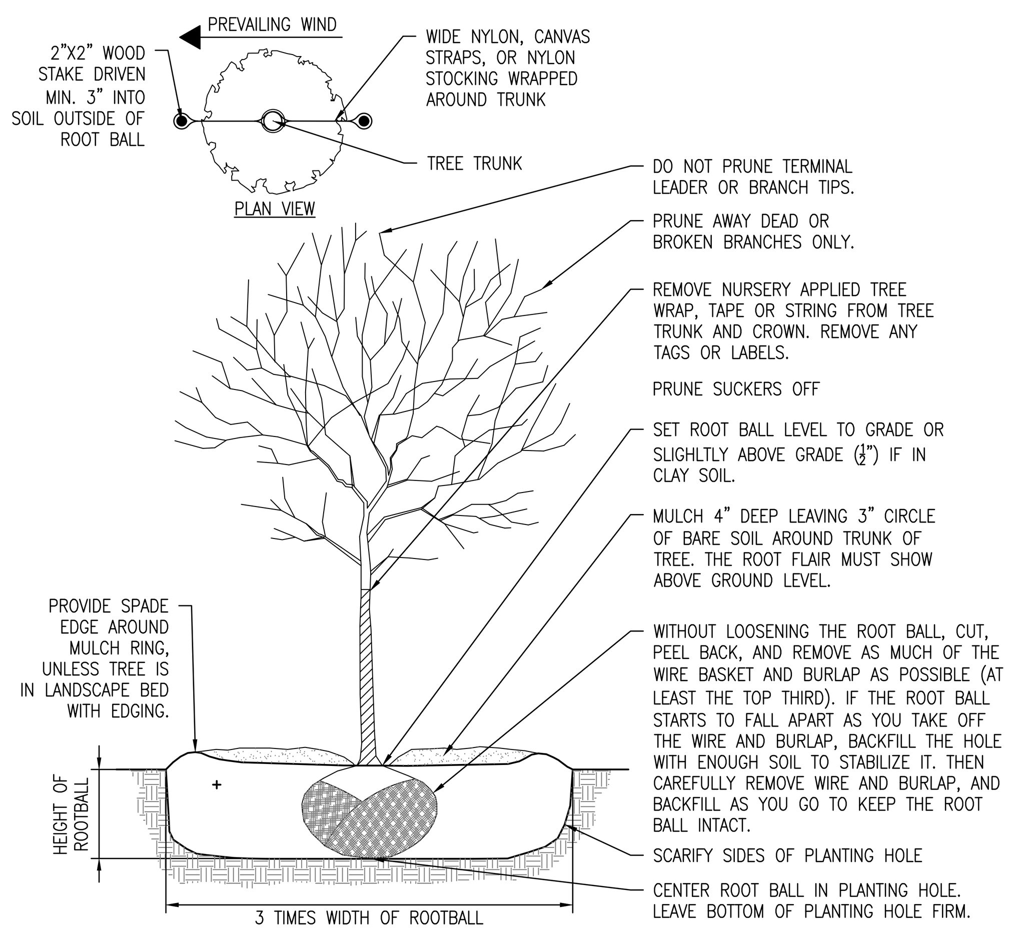
PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
L-100

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK
WE RECYCLE

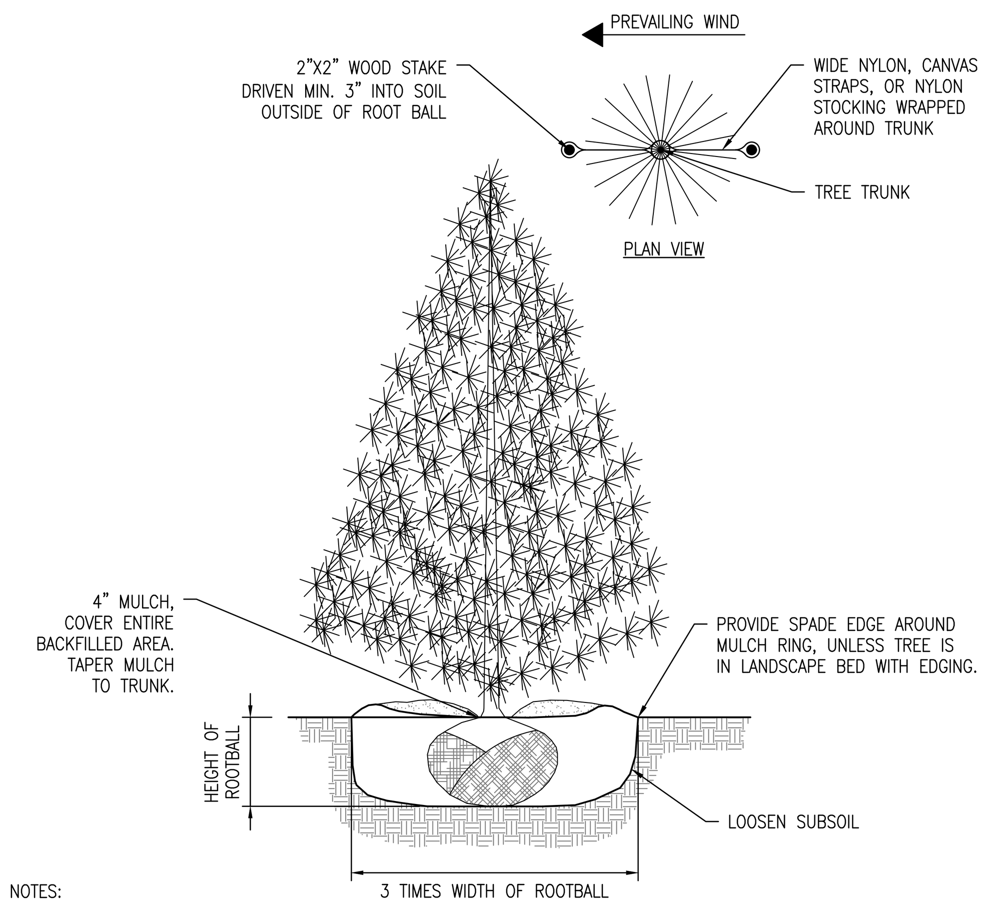
PLOTTED BY: WEAVER, GABRIEL 6/23/2023 3:33 PM
DWG: J:\2022\220116 LANSING SCHOOL DISTRICT\MT HOPE\SHEETS\220116_LSD_MTHOPE_LANDSCAPE.DWG - LANDSCAPE PLAN
DESIGNED BY: #
DRAWN BY: #
CHECKED BY: #
APPROVED BY: #



NOTES:

1. DIG THE PLANT POCKET A MINIMUM OF 3 TIMES WIDER THAN THE WIDTH OF THE ROOT BALL AND ONLY AS DEEP AS THE ROOT SYSTEM, UNLESS OTHERWISE SPECIFIED.
2. LOOSEN SUBSOIL TO A DEPTH OF 4". LOOSEN EARTH ON SIDES OF PLANT POCKET TO BREAK ANY GLAZING CAUSED BY DIGGING.
3. PLACE ROOT BALL IN CENTER OF PLANTING HOLE, PLUMB WITH BOTTOM OF THE HOLE, WITH TREE TRUNK UPRIGHT AND STRAIGHT.
4. BACKFILL PLANTING HOLE WITH ORIGINAL SOIL, MYCORRHIZAL FUNGI AND SOIL MOIST ACCORDING TO MANUFACTURER INSTRUCTIONS, BREAKING UP LARGE CLODS, AND WORKING IT WITH HANDS OR SHOVEL. WATER THE ROOT BALL AND ENTIRE BACKFILLED AREA.
5. STAKE TREE ONLY IF NECESSARY. STAKE WHEN THE ROOT BALL IS UNSTABLE, THE TRUNK IS BENDING, SITES WITH HEAVY PEDESTRIAN TRAFFIC, OR ON WINDY AND EXPOSED SITES. USE WIDE NYLON, CANVAS STRAPS, OR NYLON STOCKINGS. PLACE MINIMUM OF TWO STAKES, OUTSIDE OF THE ROOT BALL, ON OPPOSITE SIDES OF THE TREE. REMOVE AFTER 1 YEAR.
6. APPLY FERTILIZER ONLY IF RECOMMENDED BY SOIL TESTING AGENCY. REFER TO SPECIFICATIONS FOR MORE INFORMATION.

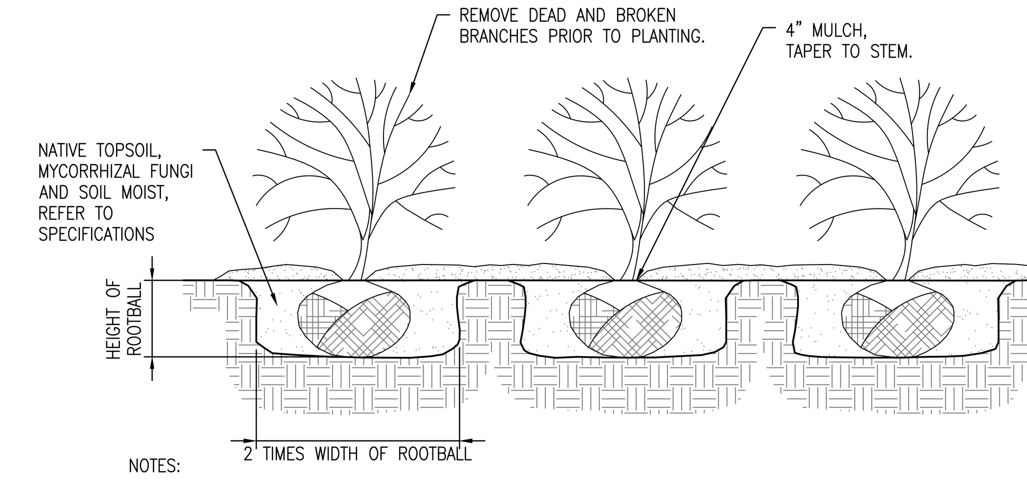
1 / L-500 DECIDUOUS TREE INSTALLATION
NO SCALE



NOTES:

1. DIG THE PLANT POCKET A MINIMUM OF 3 TIMES WIDER THAN THE WIDTH OF THE ROOT BALL AND ONLY AS DEEP AS THE ROOT SYSTEM, UNLESS OTHERWISE SPECIFIED.
2. LOOSEN SUBSOIL TO A DEPTH OF 4". LOOSEN EARTH ON SIDES OF PLANT POCKET TO BREAK ANY GLAZING CAUSED BY DIGGING.
3. PLACE ROOT BALL IN CENTER OF PLANTING HOLE, PLUMB WITH BOTTOM OF THE HOLE, WITH TREE TRUNK UPRIGHT AND STRAIGHT.
4. BALLED AND BURLAP TREES: WITHOUT LOOSENING THE ROOT BALL, CUT, PEEL BACK, AND REMOVE AS MUCH OF THE WIRE BASKET AND BURLAP AS POSSIBLE (AT LEAST THE TOP THIRD) IF THE ROOT BALL STARTS TO FALL APART AS YOU TAKE OFF THE WIRE AND BURLAP, BACKFILL THE HOLE WITH ENOUGH SOIL TO STABILIZE IT. THEN CAREFULLY REMOVE WIRE AND BURLAP, AND BACKFILL AS YOU GO TO KEEP THE ROOT BALL INTACT.
5. BACKFILL PLANTING HOLE WITH ORIGINAL SOIL, MYCORRHIZAL FUNGI AND SOIL MOIST ACCORDING TO MANUFACTURER INSTRUCTIONS, BREAKING UP LARGE CLODS, AND WORKING IT WITH HANDS OR SHOVEL. WATER THE ROOT BALL AND ENTIRE BACKFILLED AREA.
6. PLACE 4" OF MULCH OVER THE BACK FILLED AREA. PULL MULCH AWAY FROM THE TRUNK SO THAT NONE TOUCHES THE BARK.
7. STAKE TREE ONLY IF NECESSARY. STAKE WHEN THE ROOT BALL IS UNSTABLE, THE TRUNK IS BENDING, SITES WITH HEAVY PEDESTRIAN TRAFFIC, OR ON WINDY AND EXPOSED SITES. USE WIDE NYLON, CANVAS STRAPS, OR NYLON STOCKINGS. PLACE MINIMUM OF TWO STAKES, OUTSIDE OF THE ROOT BALL, ON OPPOSITE SIDES OF THE TREE. REMOVE AFTER 1 YEAR.
8. APPLY FERTILIZER ONLY IF RECOMMENDED BY SOIL TESTING AGENCY. REFER TO SPECIFICATIONS FOR MORE INFORMATION.

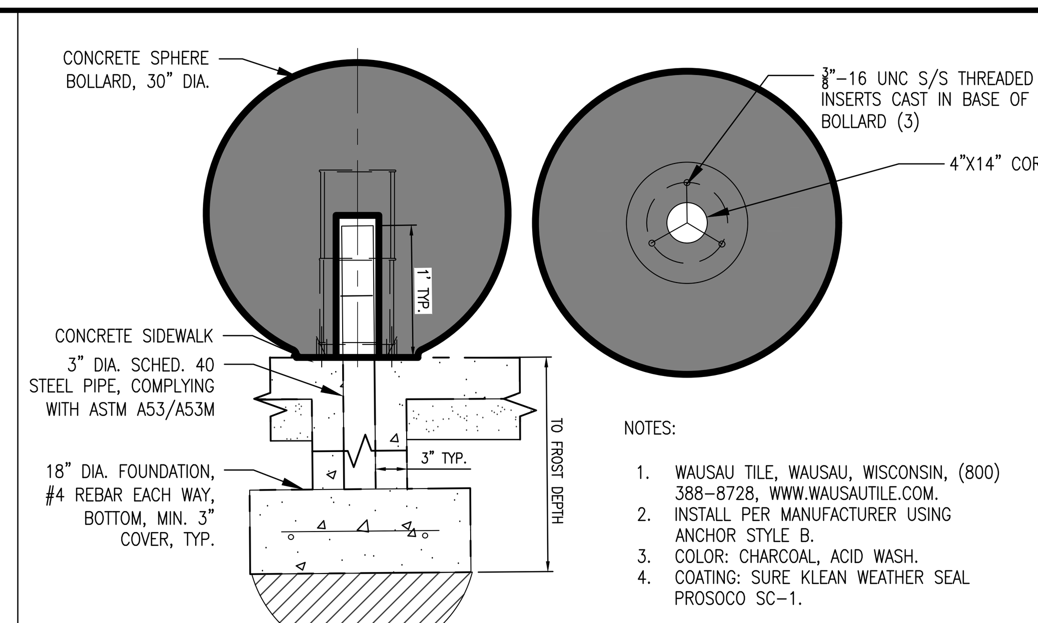
2 / L-500 EVERGREEN TREE INSTALLATION
NO SCALE



NOTES:

1. PREPARE PLANTING BEDS TO SIZE AND SHAPE AS INDICATED ON THE PLANS. INSTALL LANDSCAPE EDGING AS INDICATED ON THE PLANS.
2. PLACE GRANULAR, PRE-EMERGENT WEED PREVENTER ONTO SOIL SURFACE PRIOR TO PLACING MULCH.
3. ALL PLANTS SHALL BE SET PLUMB AND HAVE THE BEST SIDE OF THE PLANT FACING TOWARD THE MAIN DIRECTION OF VIEW.
4. APPLY FERTILIZER ONLY IF RECOMMENDED BY SOIL TESTING AGENCY. REFER TO SPECIFICATIONS FOR MORE INFORMATION.

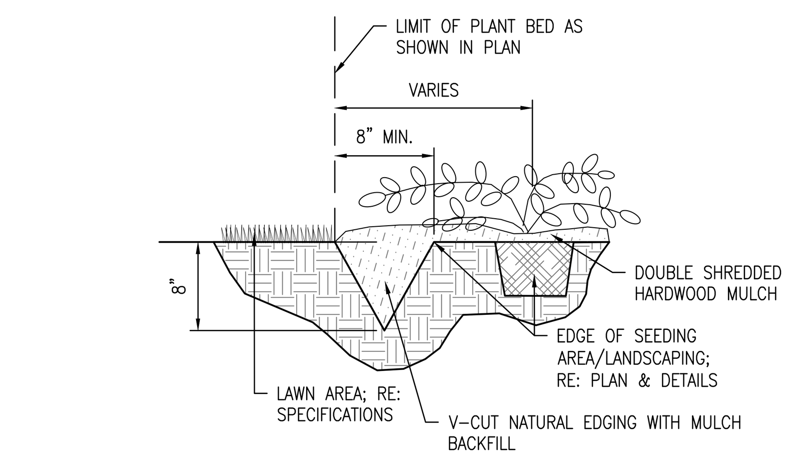
3 / L-500 SHRUB BED INSTALLATION
NO SCALE



NOTES:

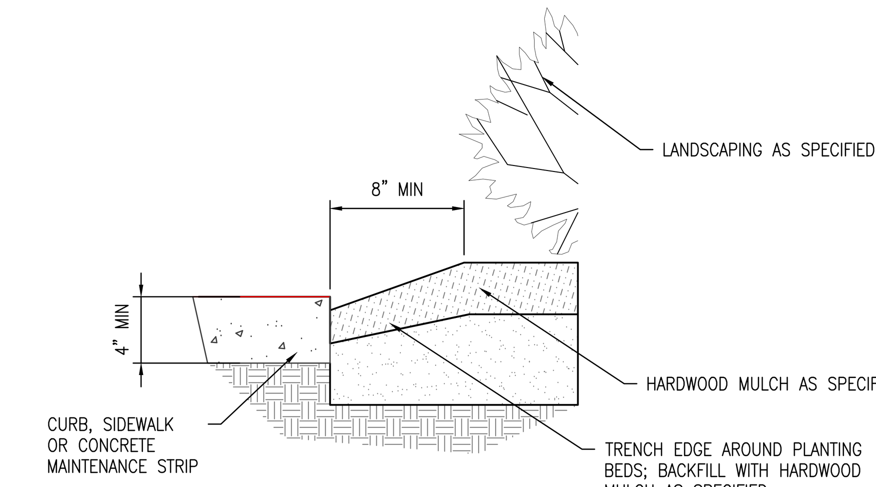
1. WAUSAU TILE, WAUSAU, WISCONSIN, (800) 388-8728, WWW.WAUSAUTILE.COM.
2. INSTALL PER MANUFACTURER USING ANCHOR STYLE B.
3. COLOR: CHARCOAL, ACID WASH.
4. COATING: SURE KLEAN WEATHER SEAL PROSOCO SC-1.

4 / L-500 CONCRETE SPHERE BOLLARD DETAIL
NO SCALE



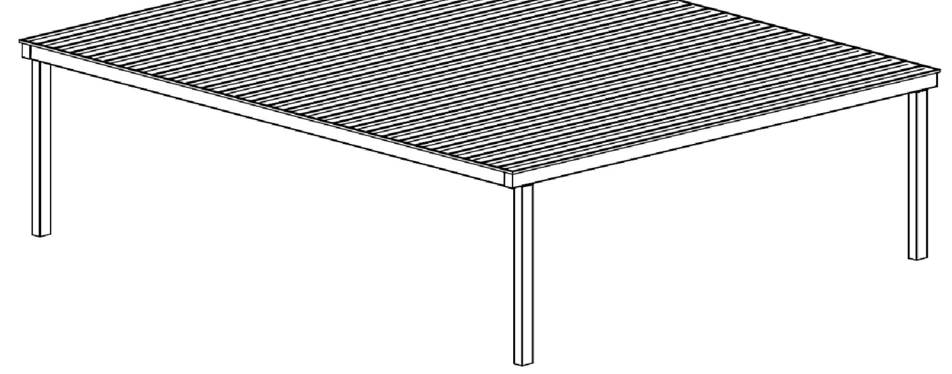
NOTES:
1. TRANSITION TO MULCH CONTAINMENT DETAIL AT ALL LOCATIONS ADJACENT TO CURBS & SIDEWALKS. RE: DETAIL, THIS SHEET.
2. CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS PRIOR TO TRENCHING OR LANDSCAPE INSTALLATION.
3. PERENNIAL AND GROUNDCOVER BEDS SHALL RECEIVE 12" PLANTING MIX; REFER TO SPECIFICATIONS.

5 / L-500 V-CUT NATURAL BED EDGE DETAIL
NO SCALE



NOTES:
1. TRENCH ALL EDGES ADJACENT TO CURB OR OTHER HARDSCAPE SURFACES FOR MULCH CONTAINMENT.

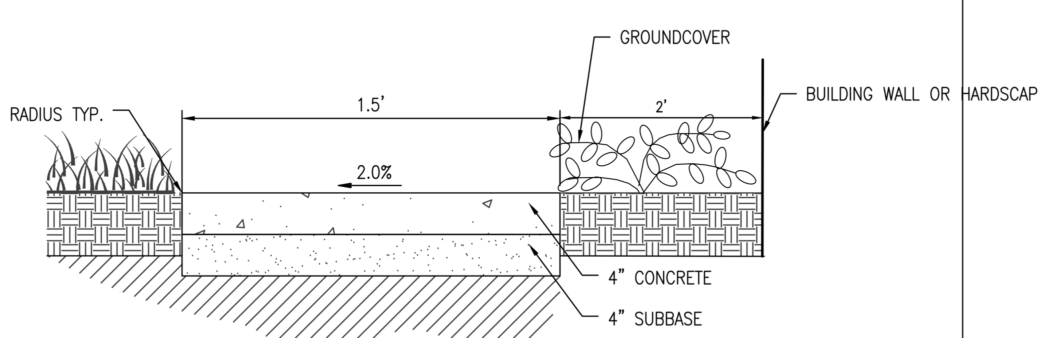
6 / L-500 MULCH CONTAINMENT DETAIL
NO SCALE



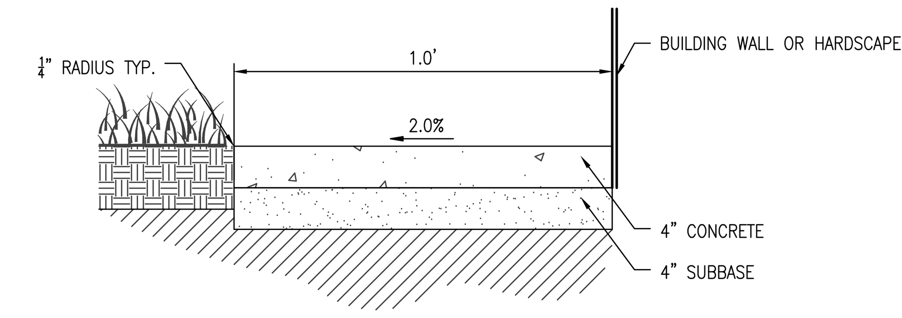
NOTES:

1. MULTI-RIB, MSE, 26X30 STEEL SHADE STRUCTURE, POLI-5000 POWDER COAT FINISH, ROOF: SLATE GRAY, FRAME: ASH GRAY, FROM POLIGON, HOLLAND, MI, (616)399-1963, WWW.POLIGON.COM.
2. INSTALL PER MANUFACTURER.
3. INSTALL WITH SHORTER DISTANCE FROM ROOF TO GROUND FACING SOUTH.

7 / L-500 OUTDOOR CLASSROOM
NO SCALE



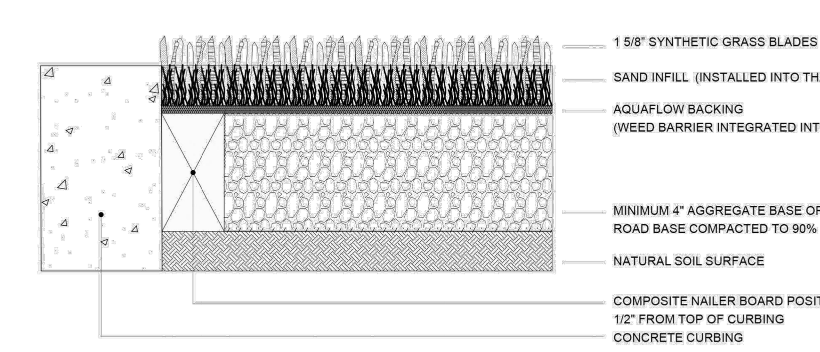
8 / L-500 OFFSET CONCRETE MAINTENANCE STRIP
NO SCALE



9 / L-500 CONCRETE MAINTENANCE STRIP
NO SCALE

FieldTurf COMMERCIAL

A TARKETT SPORTS COMPANY

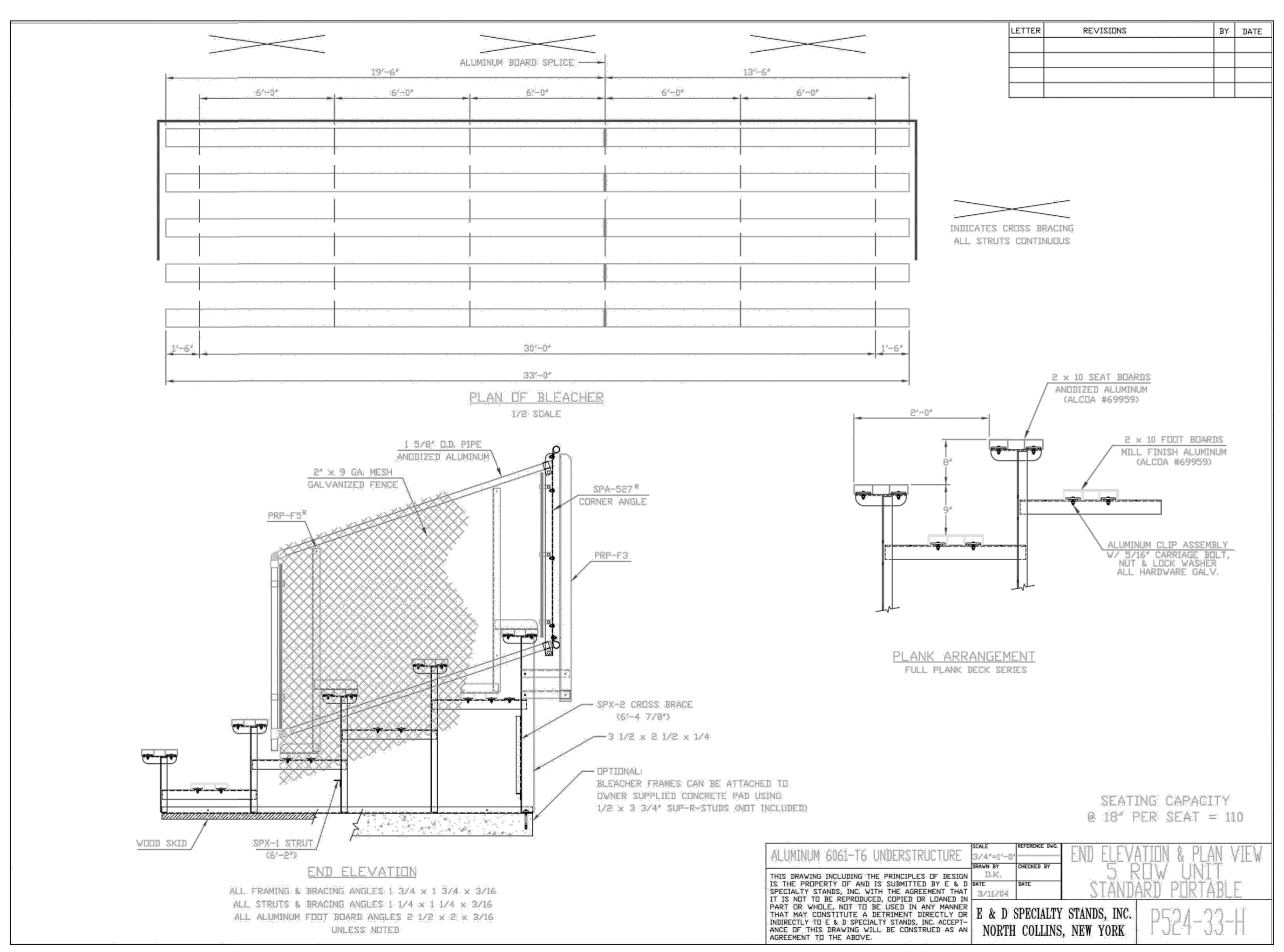


NOTES:
1. 100% POLYETHYLENE GRASS FIBERS.
2. ADA COMPLIANT SYNTHETIC GRASS ACCESSIBLE SURFACE.
3. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
4. ALL DIMENSIONS ARE CONSIDERED TRUE AND REFLECT MANUFACTURER'S SPECIFICATIONS.
5. COMMAND PLAY IS AVAILABLE WITH EITHER NUTMEG THATCH OR OLIVE THATCH LAYER.

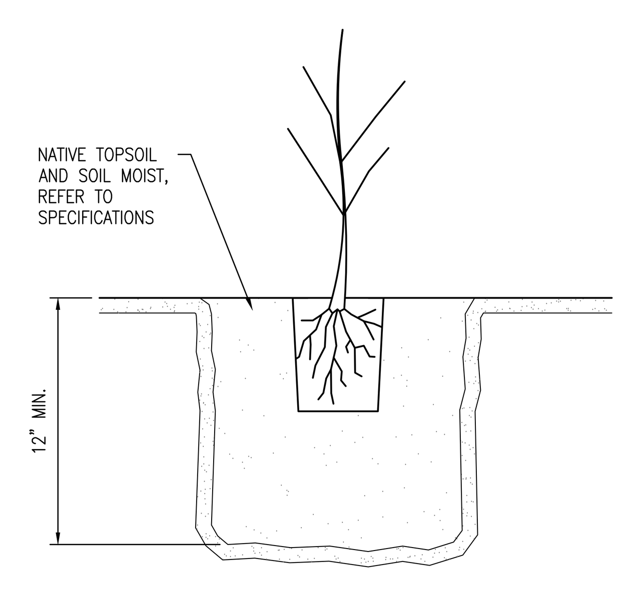
COMMERCIAL
COMMAND PLAY
AGGREGATE BASE

www.fieldturfcommercial.com
REVISION DATE 6/1/2021

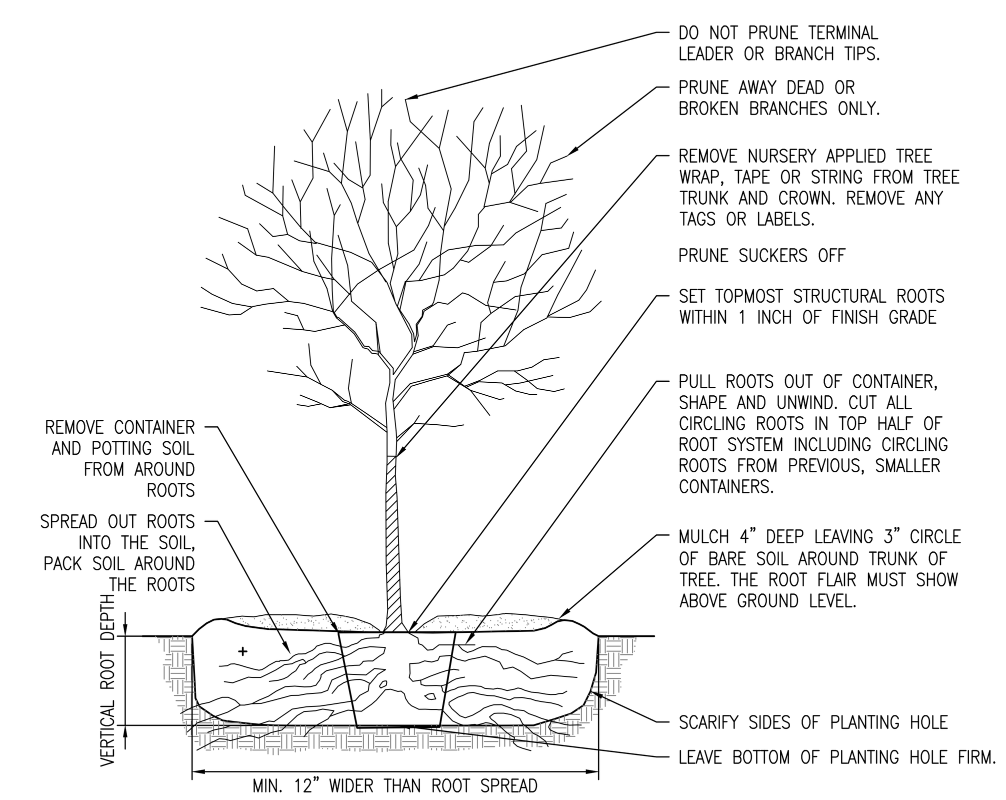
10 / L-500 SYNTHETIC TURF
NO SCALE



11 / L-500 MOVABLE BLEACHERS
NO SCALE



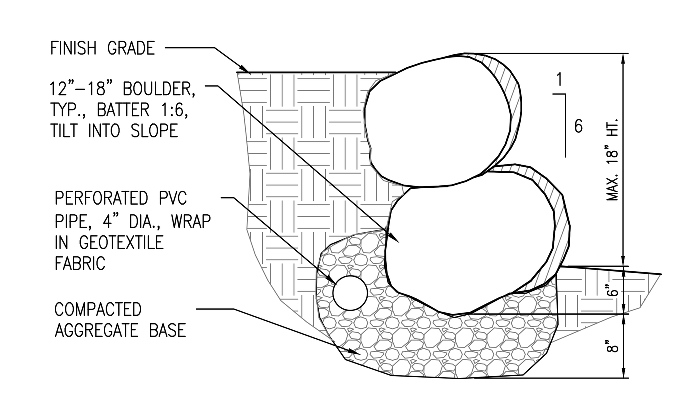
12 / L-500 PERENNIAL PLUG INSTALLATION
NO SCALE



NOTES:

1. DIG THE PLANT POCKET AT LEAST 12" WIDER THAN ROOT SPREAD AND DEEP ENOUGH TO ACCOMMODATE VERTICAL ROOTS.
2. LOOSEN SUBSOIL TO A DEPTH OF 4". LOOSEN EARTH ON SIDES OF PLANT POCKET TO BREAK ANY GLAZING CAUSED BY DIGGING.
3. PLACE TREE IN CENTER OF PLANTING HOLE, PLUMB WITH BOTTOM OF THE HOLE, WITH TREE TRUNK UPRIGHT AND STRAIGHT.
4. BACKFILL PLANTING HOLE WITH ORIGINAL SOIL, MYCORRHIZAL FUNGI AND SOIL MOIST ACCORDING TO MANUFACTURER INSTRUCTIONS, BREAKING UP LARGE CLODS, AND WORKING IT WITH HANDS OR SHOVEL. WATER THE ROOT BALL AND ENTIRE BACKFILLED AREA.
5. STAKE TREE ONLY IF NECESSARY. STAKE WHEN THE ROOTS ARE UNSTABLE, THE TRUNK IS BENDING, SITES WITH HEAVY PEDESTRIAN TRAFFIC, OR ON WINDY AND EXPOSED SITES. USE WIDE NYLON, CANVAS STRAPS, OR NYLON STOCKINGS. PLACE MINIMUM OF TWO STAKES, OUTSIDE OF THE ROOT BALL, ON OPPOSITE SIDES OF THE TREE. REMOVE AFTER 1 YEAR.

13 / L-500 CONTAINER TREE INSTALLATION
NO SCALE



14 / L-500 BOULDER RETAINING WALL
NO SCALE

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Stantec

LANSING SCHOOL DISTRICT
MT. HOPE
LANSING, MI

LANDSCAPE NOTES AND DETAILS

REVISIONS

REV	DESCRIPTION	DATE
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PROJ. #: 220116

DATE: 23-JUN-2023

SHEET

L-500

100% CONSTRUCTION DOCUMENTS

WE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
BLACK
WHITE

PLOTTED BY: WEAVER, GABRIEL 6/23/2023 5:54 PM
M:\2022\220116_LSD_MTHOPE\DRAWINGS\DS-LSD MT HOPE\SHEETS\220116_LSD MTHOPE_LANDSCAPE_DETAILS.DWG - LANDSCAPE NOTES AND DETAILS
C2AE.STANDARD.STB

DESIGNED BY: -
CHECKED BY: -
APPROVED BY: -

ABBREVIATIONS

TYPE	DESCRIPTION	TYPE	DESCRIPTION
ALT.	ALTERNATE	LG.	LONG.
ARCH.	ARCHITECTURAL	LLH.	LONG LEG HORIZONTAL
AVG.	AVERAGE	LLV.	LONG LEG VERTICAL
AFF	ABOVE FINISH FLOOR	LONG.	LONGITUDINAL
		L.P.	LOW POINT
BFF	BELOW FINISH FLOOR	MAX.	MAXIMUM
BLDG.	BUILDING	MECH.	MECHANICAL
BOTT.	BOTTOM	MEZZ.	MEZZANINE
B.O.	BOTTOM OF	MANUF.	MANUFACTURER
BRG.	BEARING	MIN.	MINIMUM
		MISC.	MISCELLANEOUS
CANT.	CANTILEVER	M.O.	MASONRY OPENING
C.J.	CONTROL JOINT	N.S.	NEAR SIDE
CLR.	CLEAR		
CMU	CONCRETE MASONRY UNIT	O.C.	ON CENTER
CONC.	CONCRETE	OPNG.	OPENING
CONST. JT.	CONSTRUCTION JOINT	O.D.	OUTSIDE DIAMETER
CONT.	CONTINUOUS	O.F	OUTSIDE FACE
		O.H.	OVERHANG
DIA.	DIAMETER	OHD	OVERHEAD DOOR
		O/O	OUT TO OUT
EA.	EACH		
ELEC.	ELECTRICAL	PSF	POUNDS PER SQUARE FT.
ELEV./EL.	ELEVATION	PSI	POUNDS PER SQUARE IN.
EQ.	EQUAL		
E.W.	EACH WAY	REINF.	REINFORCING
EXIST.	EXISTING	REQ'D.	REQUIRED
EXST.	EXISTING		
E.F.	EACH FACE	SIM.	SIMILAR
F.F.	FINISH FLOOR	T&B	TOP AND BOTTOM
FLR.	FLOOR	T.O.	TOP OF
FND.	FOUNDATION	T.O.F	TOP OF FOOTING
FTG.	FOOTING	T.O.W.	TOP OF WALL
F.S.	FAR SIDE	T.O.P.	TOP OF PIER
		T.O.S.	TOP OF STEEL
GA.	GAUGE	TRANS.	TRANSVERSE
GALV.	GALVANIZED	TYP.	TYPICAL
HDG	HOT DIPPED GALVANIZED	U.N.O.	UNLESS NOTED OTHERWISE
HORIZ.	HORIZONTAL		
H.P.	HIGH POINT	VERT.	VERTICAL
		V.S.C	VERTICAL SLOTTED CONN.
INSUL.	INSULATION	V.B.F.	VERTICAL BRACED FRAME
I.F.	INSIDE FACE		
ISO.	ISOLATION	WWF	WELDED WIRE FABRIC
		W/	WITH

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

WHITE

WE RECYCLE

LAP CHART

4000 PSI CONCRETE

BAR SIZE	VERT. BARS	HORZ. BARS
#3	19"	25"
#4	25"	33"
#5	31"	41"
#6	38"	49"
#7	54"	71"
#8	62"	81"
#9	70"	91"
#10	79"	102"

REQUIRED SPECIAL INSPECTIONS (2015 MBC SECTION 1705)

REQUIRED REPORTS AND CERTIFICATES ARE TO BE SENT TO THE BUILDING OFFICIAL FROM EITHER THE OWNER OR OWNER'S AUTHORIZED AGENT IN ACCORDANCE WITH SECTION 1704.2.4	SPECIAL INSPECTIONS TO BE PROVIDED BY APPROVED AGENCIES IN ADDITION TO INSPECTIONS BY BUILDING OFFICIAL
SPECIAL INSPECTIONS AND NONDESTRUCTIVE TESTING OF STRUCTURAL STEEL ELEMENTS IN ACCORDANCE WITH AISC 360. REFERENCED STANDARDS: MBC 1705.2.1	PERIODIC
SPECIAL INSPECTIONS AND WELDING QUALIFICATIONS OF SPECIAL INSPECTORS FOR COLD-FORMED STEEL FLOOR AND ROOF DECK IN ACCORDANCE WITH SDI. REFERENCED STANDARDS: MBC 1705.2.2	PERIODIC
SPECIAL INSPECTIONS OF OPEN WEB STEEL JOISTS AND STEEL GIRDERS :	
WELDED OR BOLTED END CONNECTIONS IN ACCORDANCE WITH SJI. REFERENCED STANDARDS: MBC 1705.2.3, 2207.1	PERIODIC
HORIZONTAL OR DIAGONAL BRIDGING IN ACCORDANCE WITH SJI. REFERENCED STANDARDS: MBC 1705.2.3, 2207.1	PERIODIC
SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION :	
INSPECT REINFORCING AND PLACEMENT IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3, 1908.4	PERIODIC
INSPECT REINFORCING BAR WELDABILITY IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3, AWS D1.4	PERIODIC
INSPECT ANCHORS CAST IN CONCRETE IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3	PERIODIC
INSPECT POST INSTALLED ANCHORS IN HARDENED CONCRETE, INCLUDING ADHESIVE ANCHORS AND MECHANICAL ANCHORS, IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3	PERIODIC
VERIFY USE OF CORRECT MIX DESIGN. REFERENCED STANDARDS: MBC 1705.3, 1904.1, 1904.2, 1908.2, 1908.3	PERIODIC
PRIOR TO CONCRETE PLACEMENT, PERFORM AIR CONTENT, SLUMP, AND TEMPERATURE TESTS AND FABRICATE SPECIMENS FOR STRENGTH TESTING IN ACCORDANCE WITH ASTM C172 AND ASTM C31. REFERENCED STANDARDS: MBC 1705.3, 1908.10	CONTINUOUS
INSPECT CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3, 1908.6, 1908.7, 1908.8	CONTINUOUS
INSPECT CONCRETE FOR APPLICATION OF PRESTRESSING FORCES AND GROUTING OF BONDED TENDONS IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3	N/A
INSPECT ERECTION OF PRECAST CONCRETE IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3	PERIODIC
VERIFY IN-SITU CONCRETE STRENGTH PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3	N/A
INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF MEMBER BEING FORMED IN ACCORDANCE WITH ACI 318. REFERENCED STANDARDS: MBC 1705.3	PERIODIC
SPECIAL INSPECTIONS FOR HIGH LOAD WOOD DIAPHRAGMS INCLUDING GRADE AND THICKNESS OF STRUCTURAL PANELS. VERIFY NOMINAL SIZE OF FRAMING MEMBERS AT ADJOINING PANELS AND FASTENERS PER CONSTRUCTION DOCUMENTS. REFERENCED STANDARDS: MBC 1704.2, 1705.1, 2306.2	N/A
SPECIAL INSPECTIONS AND TESTS OF SITE AND SOIL CONDITIONS :	
VERIFY ADEQUATE BEARING CAPACITY FOR SHALLOW FOUNDATIONS AND EXCAVATIONS HAVE REACHED PROPER DEPTH AND MATERIAL. REFERENCED STANDARDS: MBC 1705.6	PERIODIC
PERFORM CLASSIFICATION AND COMPACTION TESTING OF FILL MATERIALS. REFERENCED STANDARDS: MBC 1705.6	PERIODIC
VERIFY CONTINUOUS USE OF PROPER MATERIALS, LIFT THICKNESSES, AND COMPACTION FOR FILL PLACEMENT. REFERENCED STANDARDS: MBC 1705.6	CONTINUOUS
INSPECT SUBGRADE HAS BEEN PREPARED PRIOR TO PLACEMENT. REFERENCED STANDARDS: MBC 1705.6	PERIODIC

GENERAL STRUCTURAL NOTES

1. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL DIMENSIONS AND CONDITIONS AT THE JOB SITE AND TO CROSS-CHECK DETAILS AND DIMENSIONS ON THE STRUCTURAL DRAWINGS WITH THE RELATED REQUIREMENTS ON THE ARCHITECTURAL, MECHANICAL, ELECTRICAL, AND PLUMBING PLANS. FLOOR AND WALL OPENINGS, SLEEVES AND OTHER ARCH., MECH., ELEC., REQUIREMENTS MUST BE COORDINATED BEFORE THE CONTRACTOR PROCEEDS WITH CONSTRUCTION.
2. ALL ENGINEERING DESIGN, CONSTRUCTION, AND TESTING SHALL CONFORM TO THE REQUIREMENTS OF THE MOST RECENT EDITION OF THE MICHIGAN BUILDING CODE.
3. ALL STRUCTURAL WORK MUST BE TEMPORARILY BRACED AND SUPPORTED UNTIL THE STRUCTURE IS SUFFICIENTLY COMPLETED AND CAN SAFELY CARRY THE DESIGN AND CONSTRUCTION LOADS.
4. REFER TO THE ARCHITECTURAL DRAWINGS FOR DIMENSIONS NOT SHOWN ON THE STRUCTURAL DRAWINGS.
5. ALL OMISSIONS OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND/OR SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH ANY WORK THAT IS INVOLVED IN THE CONFLICT.

FOUNDATION:

1. ALL FOOTINGS SHALL BE ESTABLISHED ON PROPERLY UNDISTURBED SOIL OR PROPERLY COMPACTED ENGINEERED FILL.
2. ALL FOUNDATION BEARING AND FILL MATERIALS SHALL BE INSPECTED PRIOR TO PLACING CONCRETE. SOIL FILL, AND SOIL BEARING MATERIAL SHALL BE APPROVED BY THE BUILDING INSPECTOR, OR THE GEOTECHNICAL FIRM RETAINED FOR THIS PROJECT.
3. ALL FILL AND BACKFILL MATERIAL SHALL BE NON-COHESIVE SOILS, COMPACTED TO 95% MAXIMUM DENSITY PER ASTM D1557-70 MODIFIED PROCTOR METHOD. THE UPPER 8" OF SUB GRADE SHALL BE SCARIFIED, MOISTURE CONDITIONED, AND COMPACTED PER TESTS ABOVE.
4. REFER TO SOILS REPORTS BY DRIESENGA & ASSOCIATES, INC., PROJECT NO.2240647.3A, DATED 09-16-202022. SHOULD ANY CONDITIONS BE ENCOUNTERED THAT ARE UNUSUAL OR DO NOT GIVE THE MINIMUM ALLOWABLE BEARING CAPACITIES (INDICATED BELOW), OR COMPACTION LEVELS, THE OWNER SHALL BE NOTIFIED, AND WORK SHALL CEASE. WORK SHALL NOT RESUME UNTIL THE OWNER'S ENGINEER EVALUATES THE EXCAVATION, AND GIVES WRITTEN INSTRUCTIONS TO RESUME FOUNDATION WORK.
5. MINIMUM ALLOWABLE SOIL BEARING PRESSURE: Qal = 2000 PSF
6. ALL EXCAVATION FOR STRUCTURES SHALL BE KEPT DEWATERED UNTIL BACKFILL IS IN PLACE. EXCAVATION FOR STRUCTURES SHALL INCLUDE ALL NECESSARY SHEETING AND SHORING.
7. WHERE THE FOUNDATION IS OVER EXCAVATED, REMOVE ALL DISTURBED FOUNDATION SOIL AND REPLACE WITH GRANULAR MATERIAL PROPERLY COMPACTED AS DIRECTED ABOVE.
8. ALL SLABS ON GRADE SHALL BEAR ON A MINIMUM 6" OF CLEAN GRANULAR FILL CONSISTING OF SAND AND GRAVEL OR CRUSHED STONE. BASE COURSE TO BE COMPACTED TO A MINIMUM 95% OF MODIFIED STANDARD PROCTOR ON VAPOR BARRIER.

CONCRETE:

1. ALL CONCRETE WORK TO BE PERFORMED IN CONFORMANCE WITH THE MOST RECENT EDITION OF ACI 301 & ACI 318 CODE REQUIREMENTS AND DETAILING STANDARDS.
2. ALL CONCRETE SHALL DEVELOP THE COMPRESSIVE STRENGTHS AT 28 DAYS (F'c) AS LISTED IN THE CONCRETE SPECIFICATIONS.
3. USE AIR ENTRAINED CONCRETE FOR ALL AREAS EXPOSED TO WEATHER, FROST IN SOIL, OR FREEZE THAW CYCLES. REFER TO CONCRETE SPECIFICATIONS FOR AIR CONTENT CRITERIA.
4. ALL REINFORCING BARS, DOWELS, ANCHOR BOLTS AND OTHER INSERTS SHALL BE SECURED IN POSITION PRIOR TO PLACING OF THE CONCRETE.
5. ALL HORIZONTAL BARS IN CONCRETE WALLS AND GRADE BEAMS SHALL BE CONTINUOUS AND BENT AT ALL CORNERS AND INTERSECTIONS. PRE-BENT "CORNER" BARS SUBSTITUTED FOR CONTINUOUS BENT BARS SHALL BE OF SAME SPACING AS HORIZONTAL BARS AND SHALL BE OF SUFFICIENT LENGTH TO PROVIDE REQUIRED LAP SPLICE LENGTHS.
6. DETAILING BENDING AND PLACING OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH THE MOST RECENT EDITION OF THE ACI CODE.
7. ALL CONCRETE FORMWORK SHALL BE ADEQUATELY TIED TOGETHER AND BRACED TO FORM TRUE LINES, SQUARE CORNERS, AND PLUMB WALLS.
8. NO CONCRETE SHALL BE POURED SUBJECT TO FREEZING CONDITIONS, OR ON FROZEN GROUND.
9. REFER TO ARCHITECTURAL DRAWINGS FOR MOLDS, GROOVES, ORNAMENTS, OR ACCESSORIES REQUIRED TO BE CAST INTO CONCRETE, AND FOR LOCATIONS OF FLOOR FINISHES AND SLAB DEPRESSIONS.
10. FOOTINGS SHALL BE LOCATED ON THE CENTERLINE OF WALLS, PIERS, OR COLUMNS, UNLESS NOTED OTHERWISE.
11. LOCATE ALL SLEEVES, OPENINGS, EMBEDDED ITEMS, ETC. WHICH ARE INDICATED ON DESIGN DRAWINGS. CHECK WITH OTHER TRADES TO VERIFY THAT ALL SLEEVES, OPENINGS, AND EMBEDDED ITEMS ARE IN PLACE AND LOCATED CORRECTLY PRIOR TO PLACEMENT OF CONCRETE.
12. PIPE MAY PASS THROUGH STRUCTURAL CONCRETE IN SLEEVES, BUT SHALL NOT BE EMBEDDED THEREIN. SLEEVES SHALL BE WRAPPED WITH EXPANSION JOINT FILLER MATERIAL TO ALLOW CONCRETE TO CURE WITHOUT RESTRAINT. PIPES OR CONDUITS WITH DIAMETER EXCEEDING ONE THIRD THE SLAB OR WALL THICKNESS SHALL NOT BE IN STRUCTURAL CONCRETE UNLESS SPECIFICALLY DETAILED AS SUCH. SEE MECHANICAL AND/OR ELECTRICAL DRAWINGS FOR LOCATIONS OF SLEEVES, ACCESSORIES, ETC.
13. THE SURFACE OF ALL CONSTRUCTION JOINTS SHALL BE CLEANED TO REMOVE ALL DUST, CHIPS, OR OTHER FOREIGN MATTER PRIOR TO THE PLACEMENT OF ADJACENT CONCRETE.
14. SLAB CONTROL JOINTS SHALL BE INSTALLED WITH JOINT FORMERS WHEN THE SLAB IS POURED, OR SAWCUT AS SOON AS THE CONCRETE WILL ALLOW WITHOUT DAMAGE.
15. ALL EMBEDDED ITEMS SHALL BE PLACED IN THE FORMWORK PRIOR TO PLACING CONCRETE. DRILLING AND GROUTING IS ACCEPTABLE SUBJECT TO ENGINEER APPROVAL.
16. CONCRETE WALLS MAY BE BACKFILLED TO TWO-THIRDS THE WALL HEIGHT ONCE 75% OF THE 28 DAY COMPRESSIVE DESIGN STRENGTH HAS BEEN ACHIEVED. WALLS WITH TOP SLABS MAY BE BACKFILLED TO ONE-HALF OF THE WALL HEIGHT PRIOR TO CASTING THE TOP SLAB.

REINFORCING STEEL:

1. ALL REINFORCING STEEL SHALL BE HIGH STRENGTH DEFORMED BARS, GRADE 60 ASTM A615, WITH 60,000 PSI MINIMUM YIELD STRENGTH, UNLESS NOTED OTHERWISE.
2. REINFORCEMENT PROTECTION: (U.N.O.)
   A. CONCRETE POURED AGAINST EARTH TO WEATHER, EARTH OR LIQUID = 3"
   B. CONCRETE POURED IN FORMS BUT EXPOSED = 2"
   C. SLABS AND WALLS NOT EXPOSED TO WEATHER OR EARTH = 1 1/2"
   D. BEAMS, GIRDERS, AND COLUMNS NOT EXPOSED TO WEATHER, OR IN CONTACT WITH EARTH = 1 1/2"
3. WELDING OF REINFORCING BARS IS NOT PERMITTED, UNLESS NOTED OTHERWISE.

MASONRY:

1. CONCRETE MASONRY UNITS (CMU) ARE TO CONFORM TO ASTM C-90.
2. SEE SPECIFICATIONS FOR UNIT WEIGHT AND STRENGTH.
3. ALL MASONRY REINFORCING SHALL BE PLACED AND SUPPORTED IN CONFORMANCE WITH THE PROVISIONS OF THE LATEST EDITION OF TMS 602/ACI 530.1/ASCE 6.
4. ALL VERTICAL REINFORCING STEEL IN CMU WALLS SHALL BE CONTINUOUS FROM THE FOOTING TO THE BOND BEAM, AND TERMINATED IN END HOOKS. WHERE BOND BEAMS ARE NOT AT THE TOP OF A WALL, REINFORCING SHALL BE CONTINUOUS THROUGH THE BOND BEAM TO TOP WALL.
5. ALL REINFORCING BARS MARKED "CONTINUOUS" SHALL BE SPLICED A MINIMUM OF 50 BAR DIAMETERS, BUT NOT LESS THAN 24 INCHES.
6. ALL MASONRY WORK BELOW GRADE SHALL HAVE CORES GROUTED SOLID WITH GROUT CONFORMING TO ASTM C476. BELOW GRADE MASONRY SHALL USE TYPE M OR S MORTAR.
7. SEE LINTEL SCHEDULE FOR LINTEL SIZES. ALL STEEL LINTELS IN EXTERIOR WALLS SHALL BE HOT-DIP GALVANIZED, UNLESS NOTED OTHERWISE.
8. MASONRY CONSTRUCTION AND MATERIALS SHALL CONFORM TO ALL REQUIREMENTS OF "SPECIFICATIONS FOR MASONRY STRUCTURES (ACI 530.1/ASCE-6/TMS-602)," EXCEPT AS MODIFIED BY THE REQUIREMENTS OF THESE CONTRACT DRAWINGS.
9. CONTROL JOINTS SHALL BE INSTALLED AT LOCATIONS SHOWN ON THESE DRAWINGS. IN AREAS NOT NOTED ON DRAWINGS, A MINIMUM PLACEMENT OF ONE SIDE ABOVE ALL OPENINGS 6'-0" WIDE OR LESS, AND AT BOTH SIDES OF ALL OTHER OPENINGS, OR AT 20'-0" O.C.MAX.

STRUCTURAL STEEL:

1. STRUCTURAL AND MISC. STEEL SHALL BE DETAILED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE MOST RECENT EDITION OF AISC STEEL CONSTRUCTION MANUAL AND CODE OF STANDARD PRACTICE. STEEL JOISTS SHALL CONFORM TO THE MOST RECENT EDITION OF STANDARD SPECIFICATIONS OF THE STEEL JOIST INSTITUTE. METAL DECK SHALL CONFORM TO THE MOST RECENT EDITION OF THE STANDARD SPECIFICATION OF THE STEEL DECK INSTITUTE.
2. USE BOLTED CONNECTIONS AS SPECIFIED IN FRAMING DETAIL FOR SIZE AND NUMBER OF BOLTS AND WELDS FOR ALL STRUCTURAL STEEL CONNECTIONS. ALL BOLTED CONNECTIONS SHALL BE STANDARD ROUND HOLES (UNLESS NOTED OTHERWISE).
3. IF DETAIL IS NOT PROVIDED:
   ALL BOLTED CONNECTIONS SHALL BE BEARING TYPE "N", 3/4" DIA. BOLTS (BRG. TYPE) OR WELDED EQUIVALENT, UNLESS OTHERWISE NOTED. SELECT CONNECTIONS TO SUPPORT ONE HALF THE TOTAL LOAD CAPACITY FOR EACH GIVEN BEAM AND SPAN. THE EFFECT OF CONCENTRATED LOADS SHALL ALSO BE CONSIDERED.
4. CONNECTIONS MADE WITH HIGH STRENGTH STEEL BOLTS SHALL CONFORM IN ALL RESPECTS TO THE CURRENT SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 BOLTS AS ENDORSED BY THE AISC. NO PAINT ON FAYING SURFACES.
5. WELDING SHALL BE DONE IN ACCORDANCE WITH THE "AMERICAN WELDING SOCIETY" (AWS) D1.1, USING E70 ELECTRODES. WELDING SHALL BE PERFORMED BY AN APPROVED CERTIFIED WELDER.
6. NO CHANGES SHALL BE MADE IN THE STEEL STRUCTURE NOR ANY MATERIAL CUT IN THE FIELD (UNLESS NOTED AS "FIELD CUT OR TRIM" ON DRAWINGS), WITHOUT THE WRITTEN PERMISSION OF THE ENGINEER.
7. NO CUTTING, BURNING, OR HOLES OTHER THAN THOSE SPECIFICALLY DETAILED SHALL BE ALLOWED THROUGH STRUCTURAL STEEL MEMBERS WITHOUT THE PRIOR CONSENT OF THE ENGINEER. BOLT HOLES SHALL CONFORM WITH THE GOVERNING AISC SPECIFICATION, AND SHALL BE STANDARD HOLES UNLESS NOTED OTHERWISE.
8. THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES BETWEEN THE DESIGN AND ACTUAL CONDITIONS NOTED IN THE FIELD.
9. CONTRACTOR SHALL PROVIDE NECESSARY LABOR, MATERIAL, AND EQUIPMENT TO ERECT ALL MISCELLANEOUS IRON AND STEEL AS DETAILED ON THESE DRAWINGS.
10. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS PRIOR TO FABRICATION.
11. UNLESS OTHERWISE INDICATED, ROOF OPENINGS MADE IN EXISTING ROOF STRUCTURE SHALL BE SUPPORTED ON ALL EDGES BY L4x4x1/4" FOR SPANS OF 5'-0" OR LESS, AND BY C8X11.5 FOR SPANS BETWEEN 5'-0" AND 10'-0". SPANS EXCEEDING 10'-0" SHALL REQUIRE SECTIONS APPROVED BY THE ENGINEER. CONNECTIONS SHALL BE WELDED IN ACCORDANCE WITH AWS D1.1 AND AISC, OR MINIMUM 2-BOLT CONNECTIONS ACCORDING TO AISC.

STRUCTURAL WOOD:

1. STRUCTURAL WOOD AND TIMBER FRAMING SHALL CONFORM TO THE "TIMBER CONSTRUCTION MANUAL" AS PUBLISHED BY THE AMERICAN INSTITUTE OF TIMBER CONSTRUCTION.
2. ALL WOOD IN CONTACT WITH CONCRETE, STEEL OR EXPOSED TO WEATHER SHALL BE PRESSURE TREATED.
3. CONTRACTOR SHALL PROVIDE CONNECTION HARDWARE THAT WILL PROPERLY JOIN ALL WOOD MEMBERS TO EACH OTHER AND THEIR SUPPORTS. WOOD FRAMING SHALL FOLLOW A CONTINUOUS LOAD PATH TO FOUNDATION.
4. CONNECTION SHALL BE CAPABLE OF TRANSFERRING THE APPLIED LOADS TO THE SUPPORTING MEMBERS.
5. WOOD DESIGN DATA:
   ALL STRUCTURAL WOOD SHALL BE SOUTHERN YELLOW PINE (Fb MIN. = 1500 PSI) No. 1 MIN. WITH A MAXIMUM MOISTURE CONTENT OF 19% (UNLESS NOTED OTHERWISE).

STRUCTURAL DESIGN INFORMATION:

DESIGN DATA BASED ON ASCE 7-16

RISK CATEGORY: III

1. SNOW LOAD:
   SNOW EXPOSURE FACTOR (Ce) 1.00
   THERMAL FACTOR (Ct) 1.00
   SNOW IMPORTANCE FACTOR (Is) 1.10
   GROUND SNOW LOAD (Pg) 30 PSF
   FLAT ROOF SNOW LOAD (Pf) 23.1 PSF
   SLOPED ROOF FACTOR (Cs) 1.0

   SNOW DRIFT DIAGRAMS INCLUDED WITH ROOF FRAMING PLAN SHEETS
2. LIVE LOAD:
   CONSTRUCTION 25 PSF
3. ROOF DEAD LOADS:
   SEE FRAMING PLAN NOTES
4. WIND LOADS:
   ULTIMATE DESIGN WIND SPEED (Vult) 114 MPH
   NOMINAL DESIGN WIND SPEED (Vasd) 88.3 MPH
   WIND IMPORTANCE FACTOR (Iw) 1.0
   WIND EXPOSURE CATEGORY B
   COMPONENTS & CLADDING WIND PRESSURE: SEE TABLE - THIS SHEET

   MAIN WIND FORCE RESISTING SYSTEM WIND PRESSURE – LOW ROOF:
   MAIN WALL = 14.1 PSF
   END WALL = -12.7 PSF
   MAIN ROOF = -7.1 PSF
   END ROOF = -15.5 PSF

   MAIN WIND FORCE RESISTING SYSTEM WIND PRESSURE – HIGH ROOF:
   MAIN WALL = 17.3 PSF
   END WALL = -15.6 PSF
   MAIN ROOF = -8.76 PSF
   END ROOF = -19.0 PSF
5. SEISMIC LOADS:
   SEISMIC IMPORTANCE FACTOR (Ie): 1.25
   SITE CLASS D
   SPECTRAL RESPONSE COEFFICIENTS:
   Ss = 0.092 Sds = 0.099
   S1 = 0.046 Sd1 = 0.074
   SEISMIC DESIGN CATEGORY B
   BASIC SEISMIC FORCE RESISTING SYSTEM:
   ORDINARY REINFORCED MASONRY SHEAR WALLS.
   RESPONSE MODIFICATION COEFFICIENT: R = 2.0
   SEISMIC RESPONSE COEFFICIENT: Cs = 0.06
   DESIGN BASE SHEAR: 300 KIPS
   ANALYSIS PROCEDURE: EQUIVALENT LATERAL FORCE PROCEDURE

COMPONENTS & CLADDING WIND PRESSURE SCHEDULE

ROOF COMPONENTS			
EFFECTIVE WIND AREA (SFT)	INTERIOR ZONE (PSF)	EDGE ZONE (PSF)	CORNER ZONE (PSF)
<=10	9.7 / -37.9	9.7 / -49.9	9.7 / -68.1
25	8.9 / -34.6	8.9 / -45.7	8.9 / -59.6
50	8.3 / -32.1	8.3 / -42.5	8.3 / -53.1
>100	7.7 / -29.6	7.7 / -39.3	7.7 / -46.7
WALL COMPONENTS			
EFFECTIVE WIND AREA (SFT)	INTERIOR ZONE (PSF)	EDGE ZONE (PSF)	
<=10	21.7 / -23.6	21.7 / -29.0	
50	19.5 / -21.3	19.5 / -24.5	
200	17.6 / -19.4	17.6 / -20.7	
>500	16.3 / -18.1	16.3 / -18.1	

NOTES:

1. WIND PRESSURES SHOWN ARE FACTORED (LRFD) DESIGN. LOAD FACTOR FOR UNFACTORED (ASD) DESIGN IS 0.6.
2. POSITIVE PRESSURES ACT TOWARDS THE SURFACE. NEGATIVE PRESSURES ACT AWAY FROM THE SURFACE.
3. WIDTH OF ROOF CORNER ZONE IN EACH DIRECTION AND EDGE ZONE IS 19'-2"; REFER TO ASCE FIGURE 30.3-2A.
4. WIDTH OF WALL EDGE ZONE IS 7'-5"; REFER TO ASCE TABLE 30.3-1 AND FIGURE 30.3-2A.
5. LINEAR INTERPOLATE PRESSURES FOR EFFECTIVE WIND AREAS BETWEEN THOSE SCHEDULED OR USE PRESSURES FOR THE SMALLER EFFECTIVE WIND AREA.

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GENERAL NOTES AND LEGENDS

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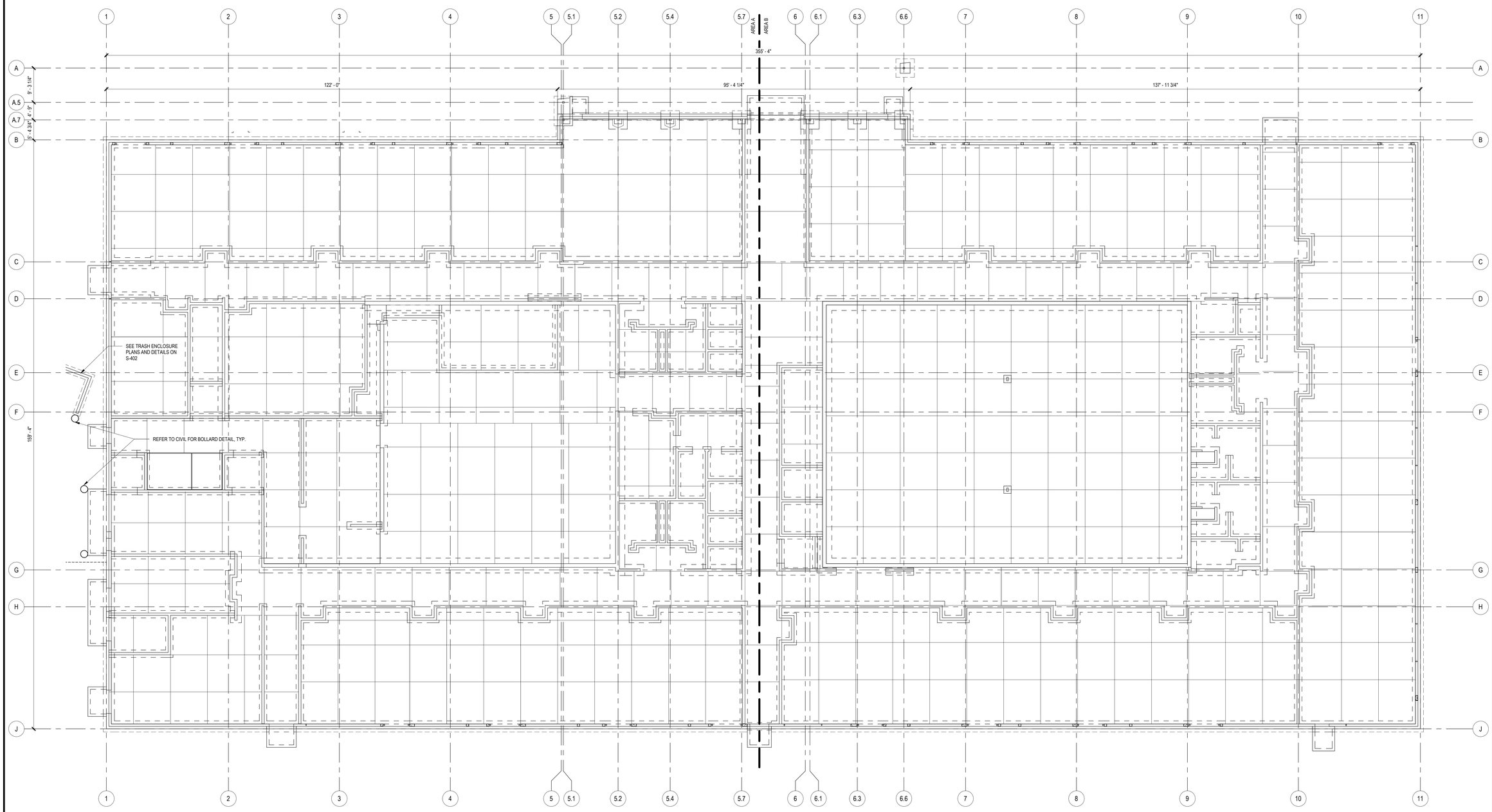
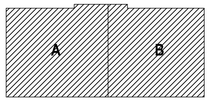
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK.
WHITE
WE RECYCLE



01.0 - FOUNDATION PLAN - OVERALL
3/32" = 1'-0"



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FOUNDATION PLAN - OVERALL

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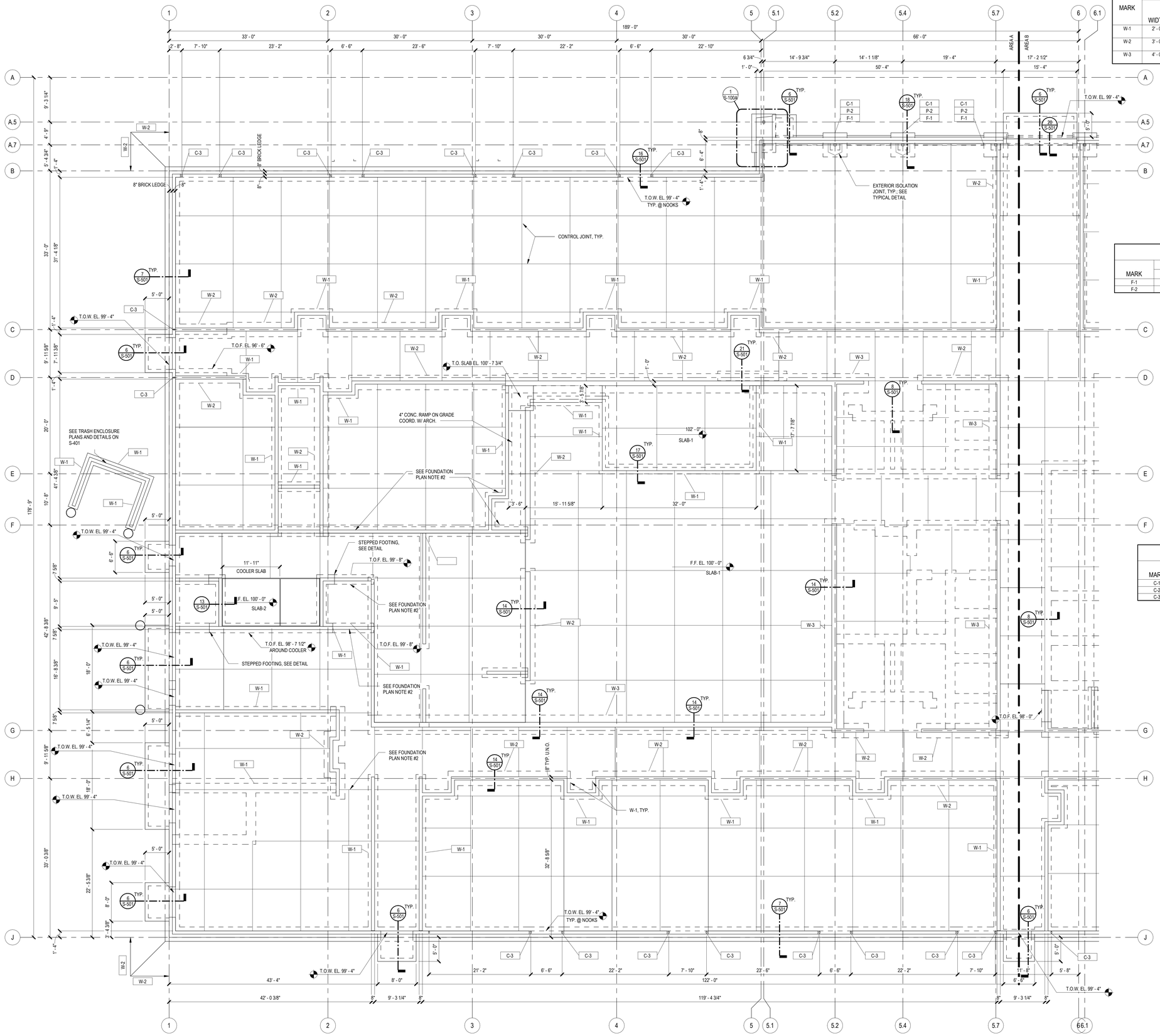


01.0 - FOUNDATION PLAN - AREA A
1/8" = 1'-0"

WALL FOOTING SCHEDULE

MARK	DIMENSIONS		REINFORCING				COMMENTS
	WIDTH	THICKNESS	W (SHORT BARS)	L (LONG BARS)	WALL VERTICAL BARS	WALL HORIZONTAL BARS	
W-1	2' - 0"	1' - 0"	#5 BARS @ 16" O.C.	(3) #5 CONT. BARS	#5 BARS @ 16" O.C.	#4 BARS @ 16" O.C.	WALLS > 10" BARS EA. FACE
W-2	3' - 0"	1' - 0"	#5 BARS @ 16" O.C.	(4) #5 CONT. BARS	#5 BARS @ 16" O.C.	#4 BARS @ 16" O.C.	WALLS > 10" BARS EA. FACE
W-3	4' - 0"	1' - 6"	#5 BARS @ 16" O.C., T&B	(4) #5 CONT. BARS, T&B	#5 BARS @ 16" O.C.	#4 BARS @ 16" O.C.	WALLS > 10" BARS EA. FACE

REINF. CONC. FLOOR SLAB

MARK	DESCRIPTION
SLAB-1	4" CONC. SLAB ON GRADE W/ 6x6 - W2.9x W2.9 WWF, OVER MINIMUM 6" OF COMPACTED GRANULAR FILL OVER VAPOR RETARDER PER SPECIFICATIONS, TYP. U.N.O.
SLAB-2	5.25" CONC. SLAB W/ 6x6 - W2.9x W2.9 WWF, OVER 6" RIGID INSULATION, OVER 5.25" CONC. SLAB ON GRADE W/ 6x6 - W2.9x W2.9 WWF OVER MINIMUM 6" OF COMPACTED GRANULAR FILL OVER VAPOR RETARDER PER SPECIFICATIONS, TYP. U.N.O.

PIER SCHEDULE

MARK	DIMENSIONS		REINFORCING		COMMENTS
	WIDTH	LENGTH	VERTICAL BARS	TIES	
P-1	2' - 8"	2' - 8"	(8) #6 BARS	#3 @ 12" O.C.	
P-2	2' - 0"	2' - 8"	(8) #6 BARS	#3 @ 12" O.C.	
P-3	3' - 4"	2' - 8"	(12) #6 BARS	#3 @ 12" O.C.	

COLUMN FOOTING SCHEDULE

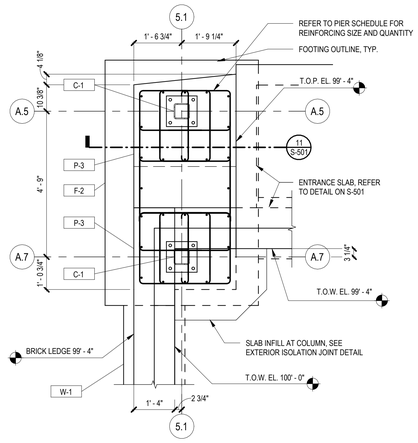
MARK	DIMENSIONS			REINFORCING		COMMENTS
	WIDTH	LENGTH	THICKNESS	W (SHORT BARS)	L (LONG BARS)	
F-1	5' - 0"	5' - 0"	1' - 6"	(6) #5 BARS TOP & BOTT.	(6) #5 BARS TOP & BOTT.	
F-2	5' - 0"	8' - 0"	1' - 6"	(7) #5 BARS TOP & BOTT.	(5) #5 BARS TOP & BOTT.	

FOUNDATION PLAN NOTES

1. C.J. AND CONST. JOINT LOCATIONS ARE SHOWN FOR VISUAL REPRESENTATION ONLY. FIELD LOCATE AT SPACING NOT TO EXCEED 30 *SLAB THICKNESS.
2. PIPE PENETRATIONS THRU FOUNDATION, PER DETAIL.
3. REFER TO DETAIL FOR PIPE BOLLARD FOOTING DETAIL.
4. ALL FOOTINGS SHALL BEAR ON UNDISTURBED SOIL OR PROPERLY COMPACTED FILL AS REQUIRED.
5. CONTRACTOR SHALL VERIFY DIMENSIONS WITH ARCHITECTURAL PLANS. NOTIFY ENGINEER OF DISCREPANCIES.
6. FINISH FLOOR ELEVATION = 100'-0"
7. REFER TO DETAIL FOR ANCHOR ROD INFORMATION.
8. TOP OF EXTERIOR FOOTING ELEVATION (T.O.F.) = 96'-6" UNLESS NOTED OTHERWISE.
9. ALL INTERIOR BEARING WALL FOOTINGS TO BE CONSTRUCTED AT FROST DEPTH (T.O.F.) = 96'-6" UNLESS NOTED OTHERWISE. CMU PARTITION WALLS SUPPORTED ON THICKENED SLAB, REFER TO DETAIL ON S-501.
10. TOP OF PIER ELEVATION (T.O.P.) = 99'-4" UNLESS NOTED OTHERWISE.
11. BRICK LEDGE ELEVATION = 99'-4" UNLESS NOTED OTHERWISE.
12. TOP OF WALL ELEVATION (T.O.W.) = 100'-0" UNLESS NOTED OTHERWISE.
13. ALL REINFORCED CONCRETE SLABS ON GRADE TO BE SLAB-1 (U.N.O.)
14. SEE ARCHITECTURAL PLANS FOR FOUNDATION INSULATION.

COLUMN SCHEDULE

MARK	MEMBER	BASE PLATE	ANCHOR BOLTS			COMMENTS
			QTY.	SIZE	MIN. EMBED.	
C-1	HSS6X6X3/8	12" X 12" X 3/4"	4	3/4"Ø	12"	BP-1
C-2	HSS4X4X5/16	11" X 5" X 1/2"	4	3/4"Ø	N/A	BP-2
C-3	HSS5X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3



1 FOUNDATION PLAN VIEW - CANOPY CORNER
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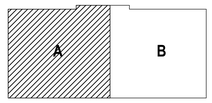

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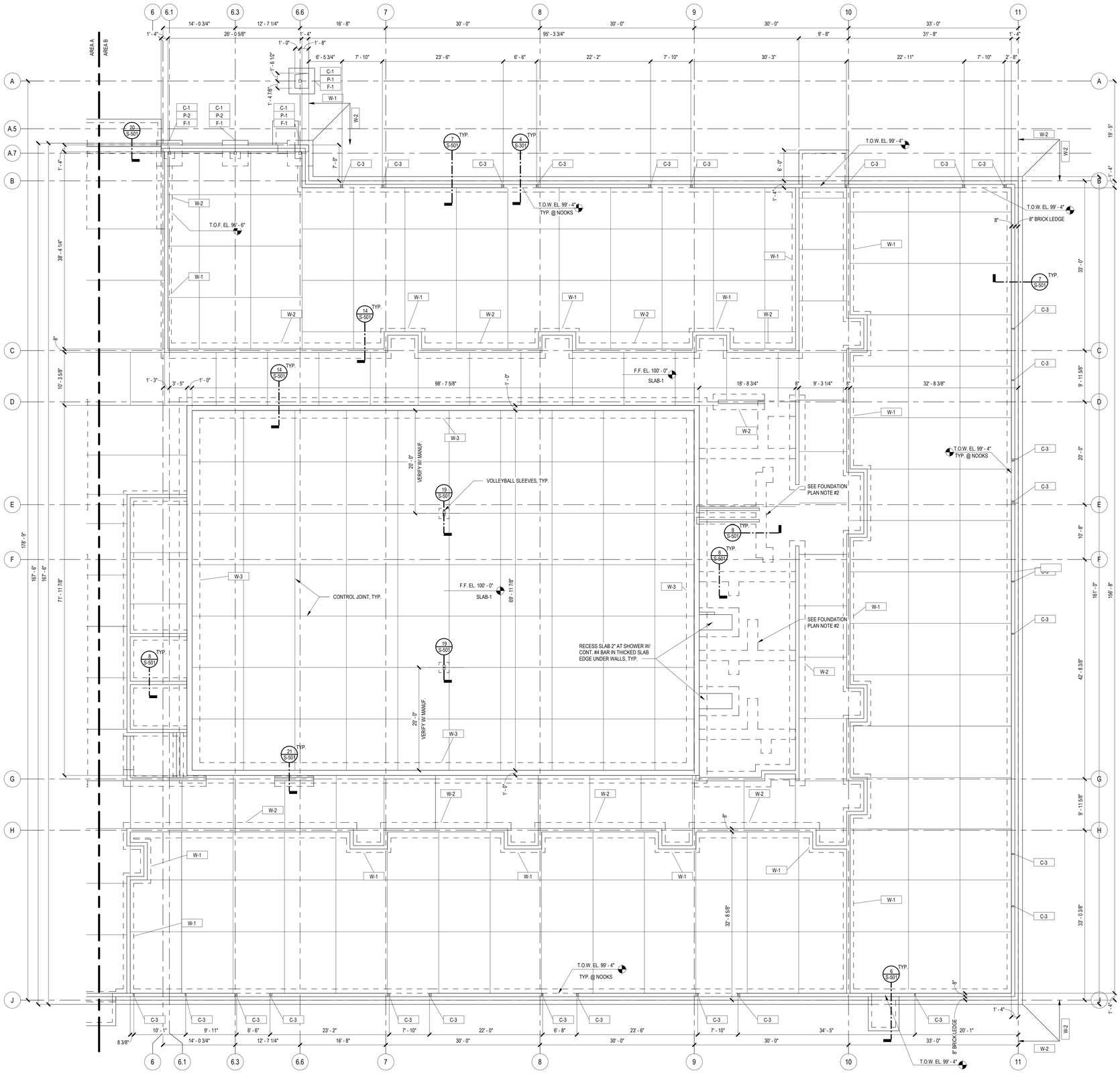


01.0 - FOUNDATION PLAN - AREA B
1/8" = 1'-0"

WALL FOOTING SCHEDULE

MARK	DIMENSIONS		REINFORCING				COMMENTS
	WIDTH	THICKNESS	W (SHORT BARS)	L (LONG BARS)	WALL VERTICAL BARS	WALL HORIZONTAL BARS	
W-1	2' - 0"	1' - 0"	#5 BARS @ 16" O.C.	(3) #5 CONT. BARS	#5 BARS @ 16" O.C.	#4 BARS @ 16" O.C.	WALLS > 10" BARS EA. FACE
W-2	3' - 0"	1' - 0"	#5 BARS @ 16" O.C.	(4) #5 CONT. BARS	#5 BARS @ 16" O.C.	#4 BARS @ 16" O.C.	WALLS > 10" BARS EA. FACE
W-3	4' - 0"	1' - 6"	#5 BARS @ 16" O.C., T&B	(4) #6 CONT. BARS, T&B	#5 BARS @ 16" O.C.	#4 BARS @ 16" O.C.	WALLS > 10" BARS EA. FACE

COLUMN FOOTING SCHEDULE

MARK	DIMENSIONS			REINFORCING		COMMENTS
	WIDTH	LENGTH	THICKNESS	W (SHORT BARS)	L (LONG BARS)	
F-1	5' - 0"	5' - 0"	1' - 6"	(6) #5 BARS TOP & BOTT.	(6) #5 BARS TOP & BOTT.	
F-2	5' - 0"	8' - 0"	1' - 6"	(7) #5 BARS TOP & BOTT.	(5) #5 BARS TOP & BOTT.	

PIER SCHEDULE

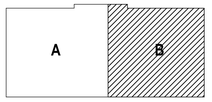
MARK	DIMENSIONS		REINFORCING		COMMENTS
	WIDTH	LENGTH	VERTICAL BARS	TIES	
P-1	2' - 8"	2' - 8"	(8) #6 BARS	#3 @ 12" O.C.	
P-2	2' - 0"	2' - 8"	(8) #6 BARS	#3 @ 12" O.C.	
P-3	3' - 4"	2' - 8"	(12) #6 BARS	#3 @ 12" O.C.	

REINF. CONC. FLOOR SLAB

MARK	DESCRIPTION
SLAB-1	4" CONC. SLAB ON GRADE W/ 6x6 - W2.9x W2.9 WWF, OVER MINIMUM 6" OF COMPACTED GRANULAR FILL OVER VAPOR RETARDER PER SPECIFICATIONS, TYP. U.N.O.
SLAB-2	5.25" CONC. SLAB W/ 6x6 - W2.9x W2.9 WWF, OVER 6" RIGID INSULATION. OVER 5.25" CONC. SLAB ON GRADE W/ 6x6 - W2.9x W2.9 WWF OVER MINIMUM 6" OF COMPACTED GRANULAR FILL OVER VAPOR RETARDER PER SPECIFICATIONS, TYP. U.N.O.

FOUNDATION PLAN NOTES

1. C.J. AND CONST. JOINT LOCATIONS ARE SHOWN FOR VISUAL REPRESENTATION ONLY. FIELD LOCATE AT SPACING NOT TO EXCEED 30 *SLAB THICKNESS.
2. PIPE PENETRATIONS THRU FOUNDATION, PER DETAIL.
3. REFER TO DETAIL FOR PIPE BOLLARD FOOTING DETAIL.
4. ALL FOOTINGS SHALL BEAR ON UNDISTURBED SOIL OR PROPERLY COMPACTED FILL AS REQUIRED.
5. CONTRACTOR SHALL VERIFY DIMENSIONS WITH ARCHITECTURAL PLANS. NOTIFY ENGINEER OF DISCREPANCIES.
6. FINISH FLOOR ELEVATION = 100'-0"
7. REFER TO DETAIL FOR ANCHOR ROD INFORMATION.
8. TOP OF EXTERIOR FOOTING ELEVATION (T.O.F.) = 96'-6" UNLESS NOTED OTHERWISE.
9. ALL INTERIOR BEARING WALL FOOTINGS TO BE CONSTRUCTED AT FROST DEPTH (T.O.F.) = 96'-6" UNLESS NOTED OTHERWISE. CMU PARTITION WALLS SUPPORTED ON THICKENED SLAB, REFER TO DETAIL ON S-501.
10. TOP OF PIER ELEVATION (T.O.P.) = 99'-4" UNLESS NOTED OTHERWISE.
11. BRICK LEDGE ELEVATION = 99'-4" UNLESS NOTED OTHERWISE.
12. TOP OF WALL ELEVATION (T.O.W.) = 100'-0" UNLESS NOTED OTHERWISE.
13. ALL REINFORCED CONCRETE SLABS ON GRADE TO BE SLAB-1 (U.N.O.)
14. SEE ARCHITECTURAL PLANS FOR FOUNDATION INSULATION.



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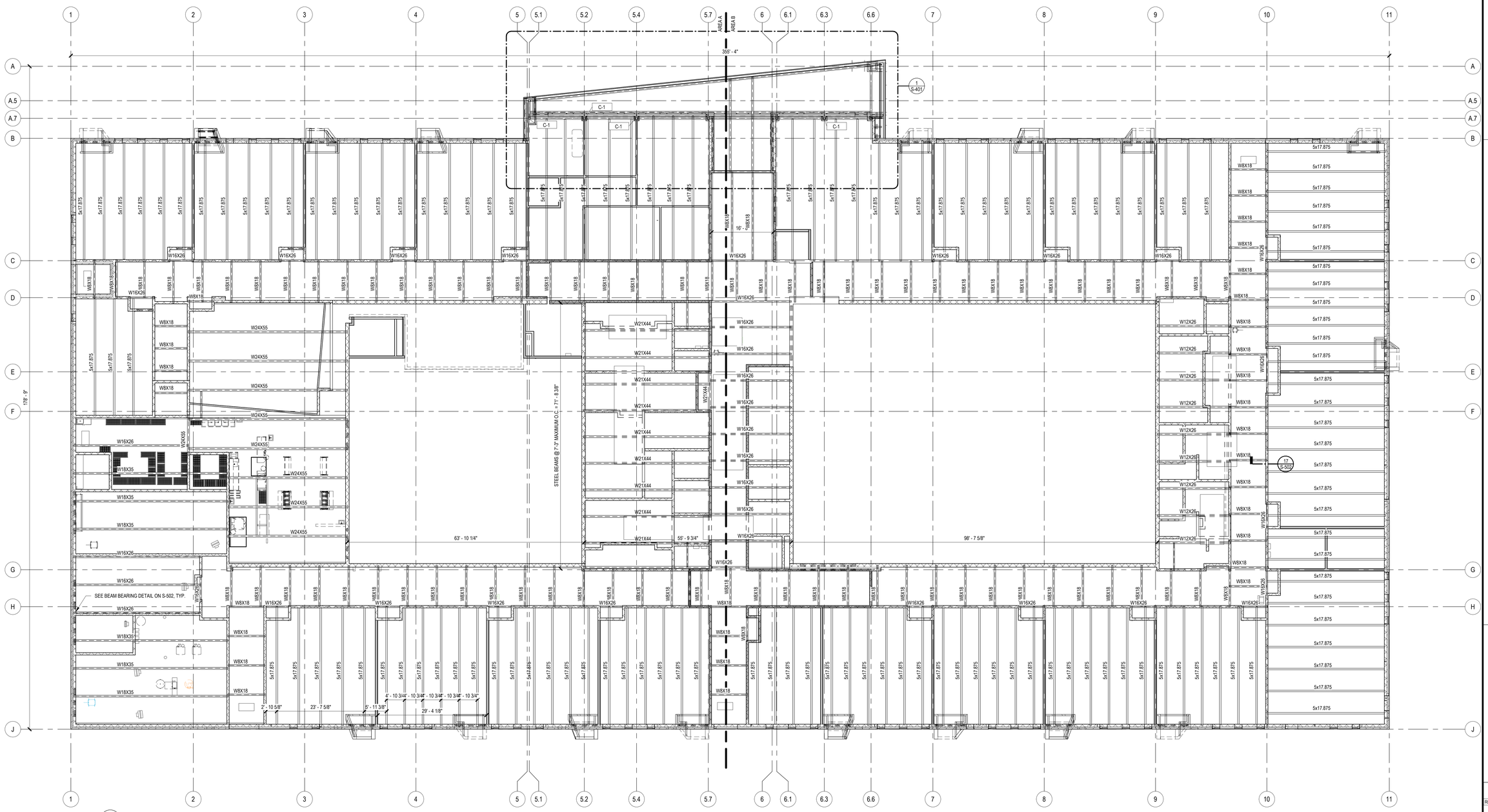
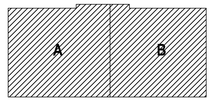
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE



FRAMING PLAN - OVERALL LOW ROOF LEVEL
3/32" = 1'-0"



KEY PLAN
NOT TO SCALE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK.
WHITE
WE RECYCLE

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FRAMING PLAN - OVERALL LOW ROOF

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-101

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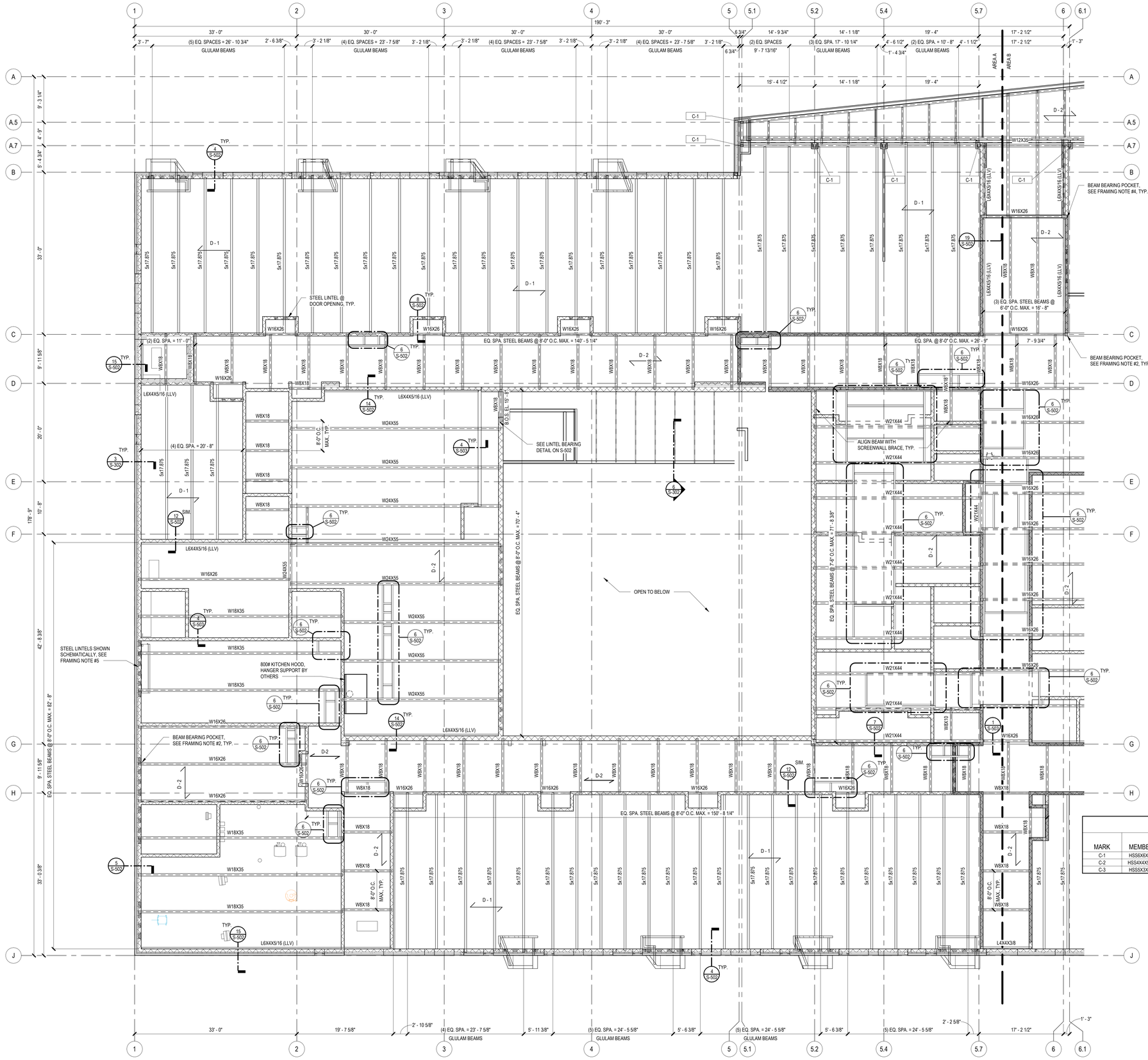


FRAMING PLAN - AREA A LOW ROOF LEVEL
1/8" = 1'-0"

LOW ROOF FRAMING NOTES

1. DESIGN LOADS

   LIVE LOAD
   CONSTRUCTION 25 PSF

   DEAD LOAD (WOOD GLULAM FRAMING):
   TECTUM DECK 6 PSF
   ROOFING & INSULATION 7 PSF
   MISCELLANEOUS DL 7 PSF
   TOTAL DEAD LOAD 20 PSF

   DEAD LOAD (STEEL BEAM FRAMING):
   STEEL DECK 3 PSF
   ROOFING & INSULATION 7 PSF
   MISCELLANEOUS DL 10 PSF
   TOTAL DEAD LOAD 20 PSF

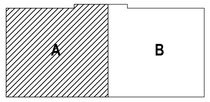
2. PROVIDE LOOSE BEARING PLATES FOR STEEL BEAMS BEARING ON CMU WALLS. STEEL PLATES TO BE MINIMUM 7"x 7" x 3/8" W/ (2) 1/2"Ø x 6" HEADED STUDS (U.N.O.) IN SOLID GROUTED CORES.
3. TYPICAL TOP OF BOND BEAM ELEVATION = 112' - 8"
   TOP OF 12" TALL BOND BEAM AT EXTERIOR WALL = 115'-0"
4. BEAM ELEVATIONS ARE TOP OF STEEL AND WOOD ELEVATIONS (U.N.O.).
   LOW ROOF (TOP OF BEAM ELEVATION) FOR WOOD & STEEL = 115' - 0"
   CANOPY (T.O.S. EL.) = 115' - 5 1/2"
5. NOT ALL STEEL LINTELS ARE SHOWN FOR CLARITY. COORDINATE STEEL LINTEL ELEVATIONS AND LOCATIONS WITH ARCHITECTURAL PLANS. REFER TO MISCELLANEOUS STEEL LINTEL SCHEDULE FOR SIZE AND DETAILS.
6. STAGGER STEEL BEAM BEARING LOCATIONS WHERE NECESSARY. PROVIDE 8" MINIMUM SPACING BETWEEN BEAM CENTERS.
7. CMU WALL CORES MUST BE SOLID GROUTED A MINIMUM 12" IN EITHER HORIZONTAL DIRECTION FROM CENTER OF GLULAM BEAM HANGERS. STAGGER STEEL BEAMS AS NECESSARY.
8. SEE GENERAL NOTES ON SHEET S-001 FOR MORE INFORMATION.

ROOF DECK

MARK	DESCRIPTION
D-1	TECTUM E ROOF DECK PANEL PER SPECIFICATION. FASTEN TO END SUPPORTS W/ SIPTP SCREWS, #10 DIAMETER SIPTP SCREWS MINIMUM 3 PER WOOD BEAM PER PANEL AND 12" O.C. SIDES AND ENDS. 1-1/2" MIN. PENETRATION INTO WOOD FRAMING AND CMU. LAP TECTUM PANELS 3.5" MIN. OVER TOP OF CMU WALL.
D-2	3NL-32, GRADE 50 STEEL ROOF DECK (3", 20 GA.). FASTEN TO END SUPPORTS W/ X-ENP-19 L15 HILTI POWDER ACTUATED FASTENERS, IN A 36/3 PATTERN, AND WITH (2) HILTI SLC 01 SIDELAP CONNECTORS IN EACH SIDELAP PER SPAN. (3) SPAN MINIMUM.
D-3	2.0DA, GRADE 40 ACOUSTICAL DOVETAIL STEEL ROOF DECK (2", 20 GA.). FASTEN TO END SUPPORTS W/ X-ENP-19 L15 HILTI POWDER ACTUATED FASTENERS, IN A 24.5/4 PATTERN, AND WITH (2) HILTI SLC 01 SIDELAP CONNECTORS IN EACH SIDELAP PER SPAN. (3) SPAN MINIMUM.

COLUMN SCHEDULE

MARK	MEMBER	BASE PLATE	ANCHOR BOLTS QTY.	ANCHOR BOLTS SIZE	ANCHOR BOLTS MIN. EMBED.	COMMENTS
C-1	HSS6X6X3/8	12" X 12" X 3/4"	4	3/4"Ø	12"	BP-1
C-2	HSS4X4X5/16	11" X 5" X 1/2"	4	3/4"Ø	N/A	BP-2
C-3	HSS3X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3



KEY PLAN
NOT TO SCALE

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FRAMING PLAN - AREA A LOW ROOF

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-101A

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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Autodesk Docs://220116_LSD - Mt HOPE/220116_S.rvt
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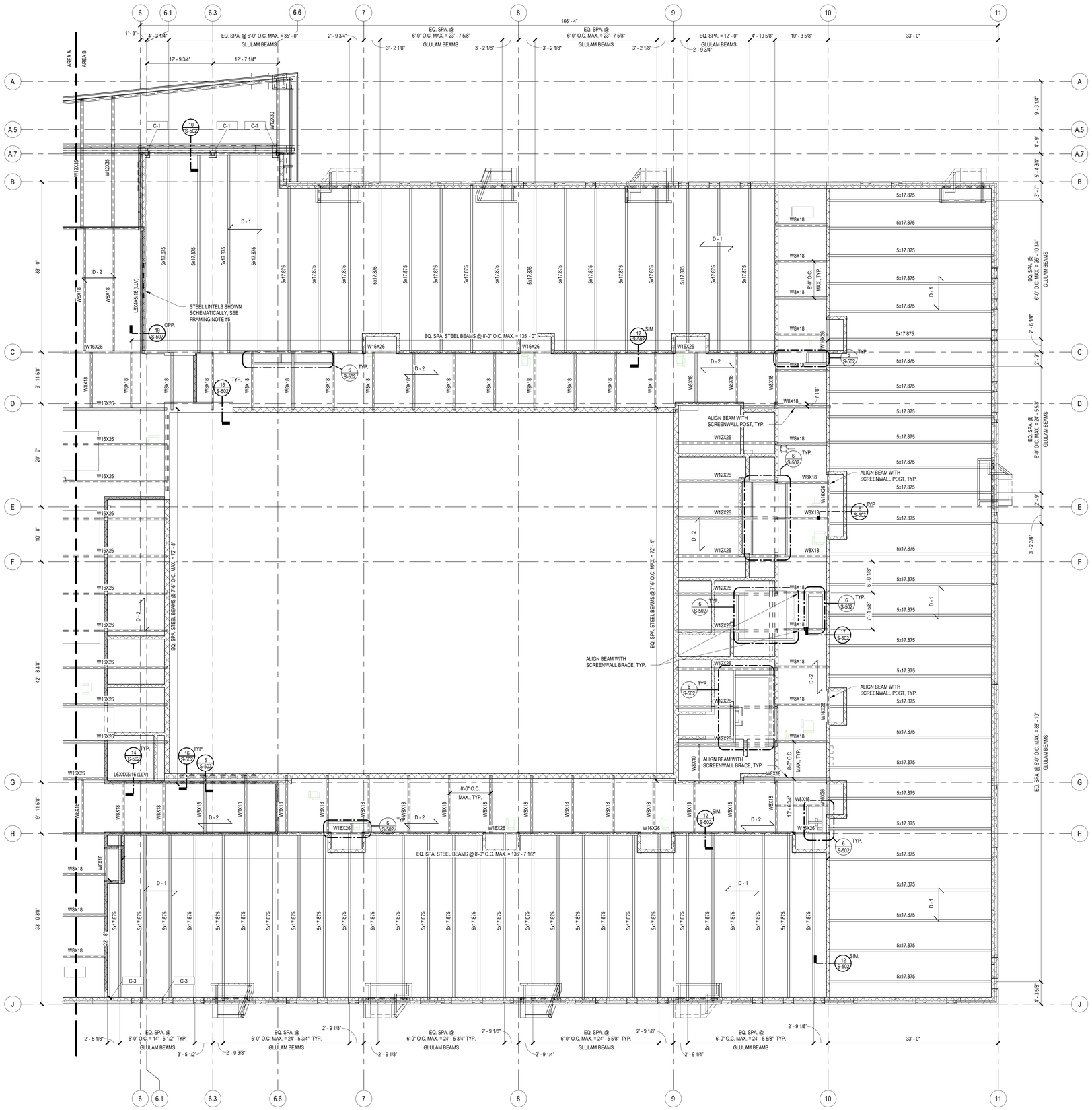

FRAMING PLAN - AREA B LOW ROOF LEVEL
1/8" = 1'-0"

LOW ROOF FRAMING NOTES

1. DESIGN LOADS

   LIVE LOAD:
   CONSTRUCTION 25 PSF

   DEAD LOAD (WOOD GLULAM FRAMING):
   TECTUM DECK 6 PSF
   ROOFING & INSULATION 7 PSF
   MISCELLANEOUS DL 7 PSF
   TOTAL DEAD LOAD 20 PSF

   DEAD LOAD (STEEL BEAM FRAMING):
   STEEL DECK 3 PSF
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   MISCELLANEOUS DL 10 PSF
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2. PROVIDE LOOSE BEARING PLATES FOR STEEL BEAMS BEARING ON CMU WALLS. STEEL PLATES TO BE MINIMUM 7" x 7" x 3/8" W/ (2) 1/2"Ø x 6" HEADED STUDS (U.N.O.) IN SOLID GROUTED CORES.
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ROOF DECK

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COLUMN SCHEDULE

MARK	MEMBER	BASE PLATE	ANCHOR BOLTS QTY.	ANCHOR BOLTS SIZE	ANCHOR BOLTS MIN. EMBED.	COMMENTS
C-1	HSS6X6X3/8	12" X 12" X 3/4"	4	3/4"Ø	12"	BP-1
C-2	HSS4X4X5/16	11" X 5" X 1/2"	4	3/4"Ø	N/A	BP-2
C-3	HSS5X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3

KEY PLAN
NOT TO SCALE

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FRAMING PLAN - AREA B LOW ROOF

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
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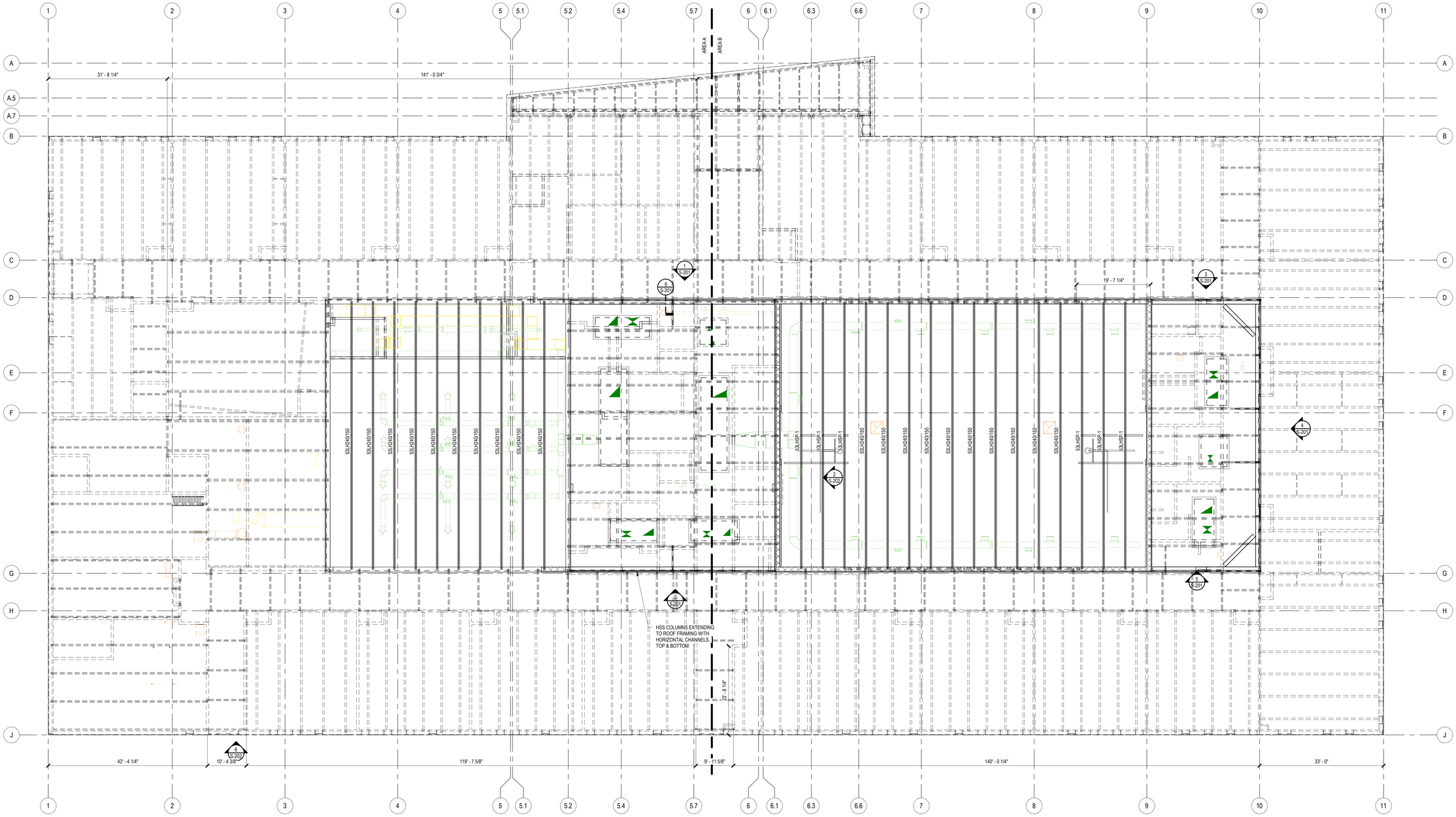
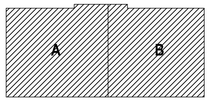


FRAMING PLAN - OVERALL HIGH ROOF LEVEL
3/32" = 1'-0"



KEY PLAN
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FRAMING PLAN - OVERALL HIGH ROOF

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-102

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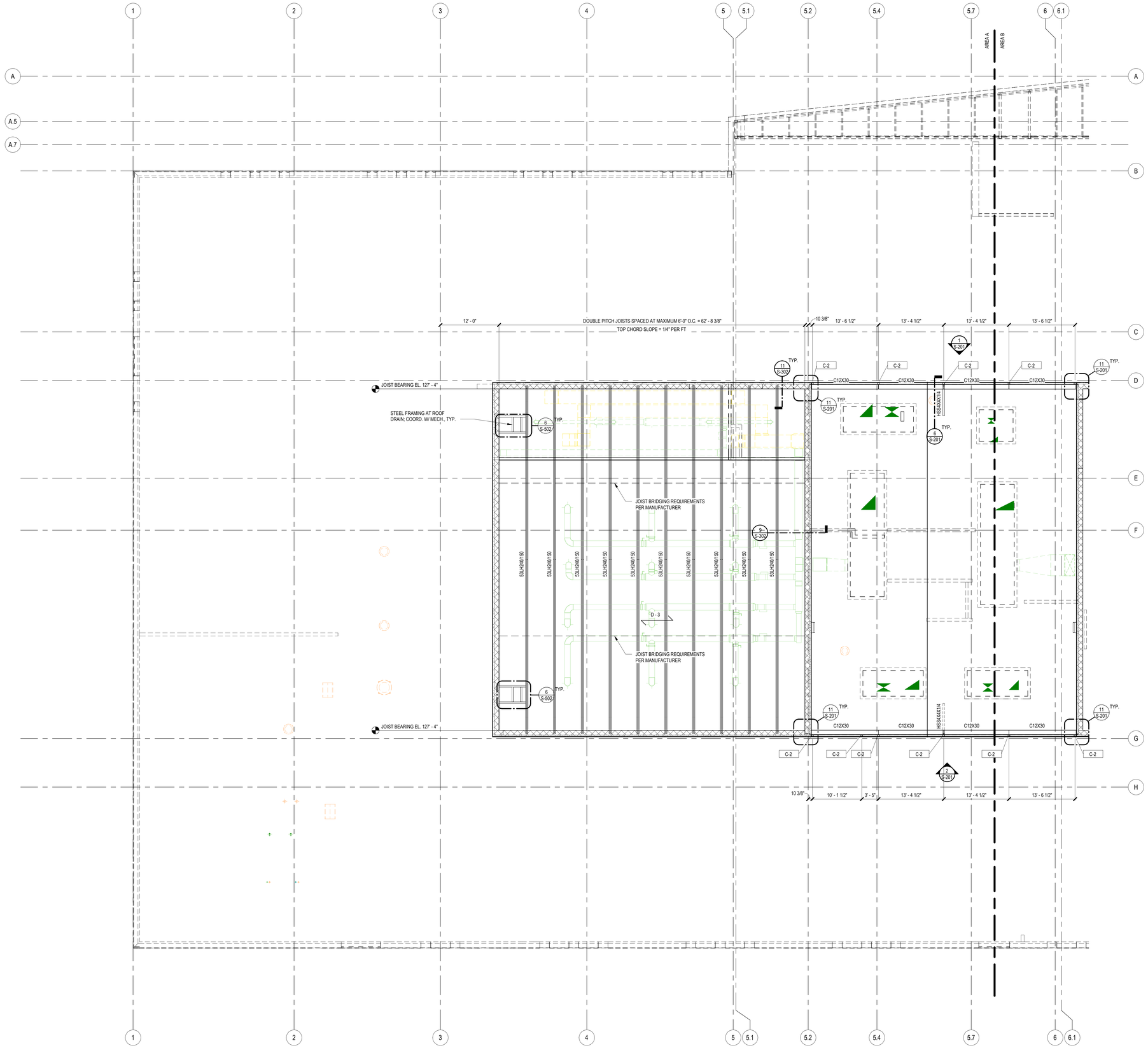

FRAMING PLAN - AREA A HIGH ROOF LEVEL
1/8" = 1'-0"

HIGH ROOF FRAMING NOTES

1. DESIGN LOADS
2. LIVE LOAD:
   CONSTRUCTION 25 PSF
3. DEAD LOAD (STEEL JOIST FRAMING):
   STEEL DECK 3 PSF
   ROOFING & INSULATION 7 PSF
   MISCELLANEOUS DL 10 PSF
   TOTAL DEAD LOAD 20 PSF
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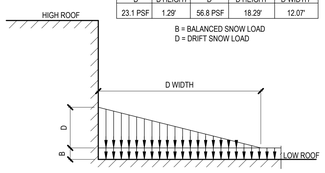
SNOW DRIFT LOADS				
B	B HEIGHT	D	D HEIGHT	D WIDTH
23.1 PSF	1.29'	56.8 PSF	18.29'	12.07'

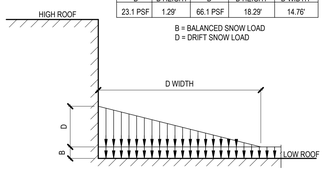
B = BALANCED SNOW LOAD
D = DRIFT SNOW LOAD



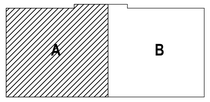
SNOW DRIFT (EAST/WEST)
NOT TO SCALE

SNOW DRIFT LOADS				
B	B HEIGHT	D	D HEIGHT	D WIDTH
23.1 PSF	1.29'	66.1 PSF	18.29'	14.76'

B = BALANCED SNOW LOAD
D = DRIFT SNOW LOAD



SNOW DRIFT (NORTH/SOUTH)
NOT TO SCALE



KEY PLAN
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FRAMING PLAN - AREA A
HIGH ROOF

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-102A

100% CONSTRUCTION DOCUMENTS

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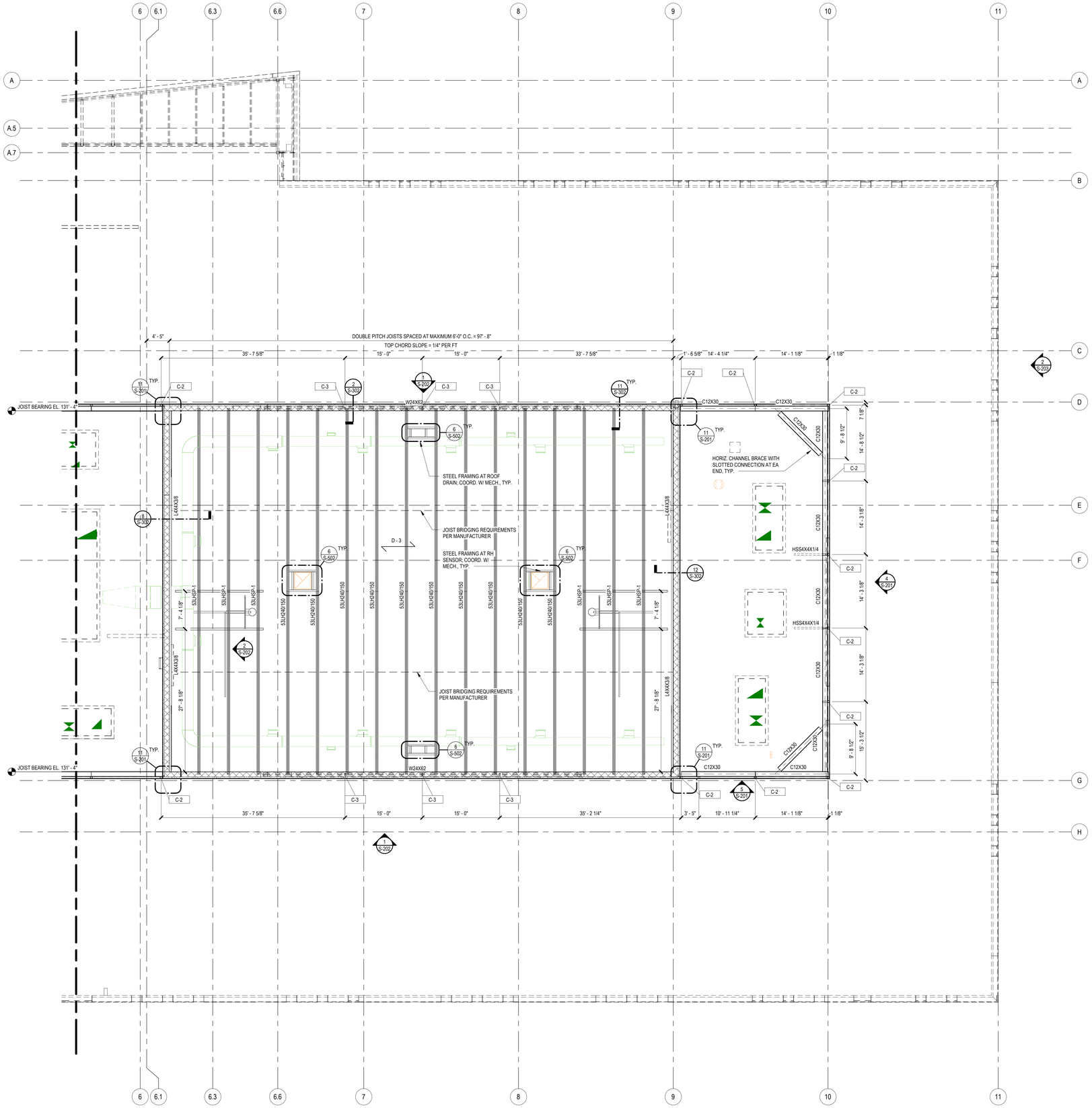

FRAMING PLAN - AREA B HIGH ROOF LEVEL
1/8" = 1'-0"

HIGH ROOF FRAMING NOTES

1. DESIGN LOADS
2. LIVE LOAD:
   CONSTRUCTION 25 PSF
3. DEAD LOAD (STEEL JOIST FRAMING):
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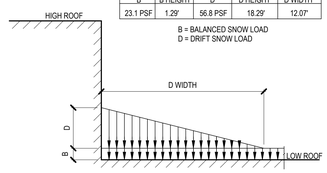

SNOW DRIFT LOADS				
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SNOW DRIFT (EAST/WEST)
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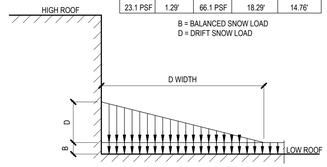

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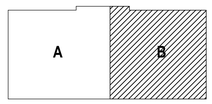

KEY PLAN
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Mt. Hope
1210 E Mt Hope Ave, Lansing, MI 48910

FRAMING PLAN - AREA B
HIGH ROOF

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
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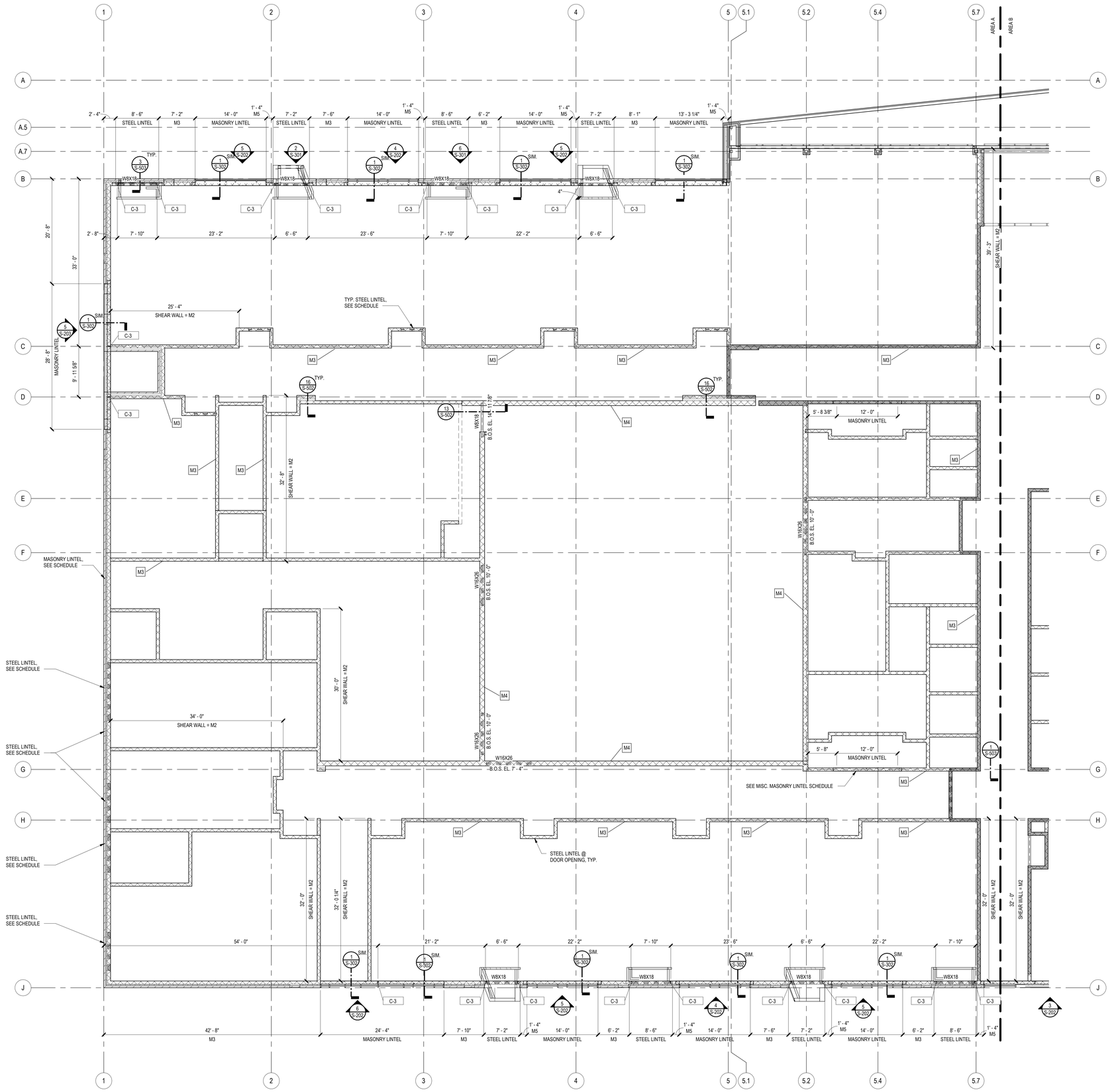


MASONRY FRAMING PLAN - AREA A
1/8" = 1'-0"

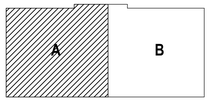
COLUMN SCHEDULE

MARK	MEMBER	BASE PLATE	ANCHOR BOLTS QTY.	ANCHOR BOLTS SIZE	ANCHOR BOLTS MIN. EMBED.	COMMENTS
C-1	HSS6X6X3/8	12" X 12" X 3/4"	4	3/4"Ø	12"	BP-1
C-2	HSS4X4X5/16	11" X 5" X 1/2"	4	3/4"Ø	N/A	BP-2
C-3	HSS8X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3

MASONRY WALL REINFORCEMENT SCHEDULE

MARK	WALL SIZE	WALL VERTICAL REINF.	COMMENTS
M1	8" CMU	---	PARTITION WALL
M2	8" CMU	(1) #4 @ 60" O.C.	INTERIOR SHEAR WALL
M3	8" CMU	(1) #4 @ 48" O.C.	INTERIOR BEARING WALL AND EXTERIOR BEARING WALL W/ VENEER CLADDING
M4	12" CMU	(1) #5 @ 72" O.C.	EXTERIOR / INTERIOR BEARING WALL W/ VENEER CLADDING
M5	8" CMU	(1) #4 @ 8" O.C.	EXTERIOR BEARING WALL
M6	12" CMU	(1) #5 @ 48" O.C.	EXTERIOR SHEAR WALL

NOTES:
1. VERTICAL WALL REINFORCEMENT SHALL BE LAPPED WITH FOOTING DOWEL BARS AND SOLID GROUTED, FULL WALL HEIGHT.
2. PROVIDE HORIZONTAL LADDER REINFORCING AT 16" O.C. TYP. SEE SPECIFICATIONS FOR WIRE SIZE.
3. PROVIDE (2) VERTICAL BARS IN SOLID GROUTED CORES ADJACENT TO WALL OPENINGS (TYP.). RUN BARS FULL WALL HEIGHT AND DOWEL INTO FOUNDATION WALL. TO AVOID LINTEL INTERFERENCE DO NOT INSTALL IN FIRST CORE ADJACENT TO OPENING. GROUT REINFORCED CORE AND JAMB CORE SOLID TO FOUNDATION.
4. PROVIDE HORIZONTAL BOND BEAMS AT LOCATIONS SHOWN ON DETAILS, AND AT INTERMEDIATE LOCATIONS AS REQUIRED FOR A MAXIMUM BOND BEAM SPACING OF 12'-8" IN 8" CMU WALLS AND A MAXIMUM BOND BEAM SPACING OF 18'-0" IN 12" CMU WALLS. UNLESS OTHERWISE NOTED, BOND BEAM REINFORCING SHALL BE (2) #5 BARS CONTINUOUS.
5. ALL MASONRY SUPPORTING BEAMS SHALL INCLUDE BOTTOM PLATE AND BRICK ANGLES PER LINTEL SCHEDULE. GALVANIZE LINTELS SUPPORTING EXTERIOR MASONRY.
6. ALL MASONRY WORK SHALL BE DONE IN ACCORDANCE WITH LATEST ACI 530 SPECIFICATIONS. MASONRY UNITS SHALL CONFORM TO ASTM C91/C91M GRADE SW AS APPLICABLE. USE TYPE M OR S MORTAR. f'm USED IN DESIGN = 2150 PSI.
7. BEAM AND LINTEL BEARING ON MASONRY WALLS SHALL BE A MINIMUM OF 7". SEE PLAN FOR LINTEL AND BEARING PLATE SIZES.
8. AT CONTROL JOINTS CONTINUE HORIZONTAL REINFORCEMENT THROUGH THE JOINT AT THE TOP OF THE WALL. VERTICAL REINFORCING TO BE WITHIN 8" OF CONTROL JOINT EACH SIDE.
9. AT CORNERS AND END OF WALLS VERTICAL REINFORCEMENT TO BE WITHIN 8" AND LAPPED WITH FOUNDATION WALL STEEL.
10. MASONRY WALLS NOT TAGGED ON PLAN TO BE UNREINFORCED, TYPE M1.



KEY PLAN
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MASONRY FRAMING PLAN - AREA A

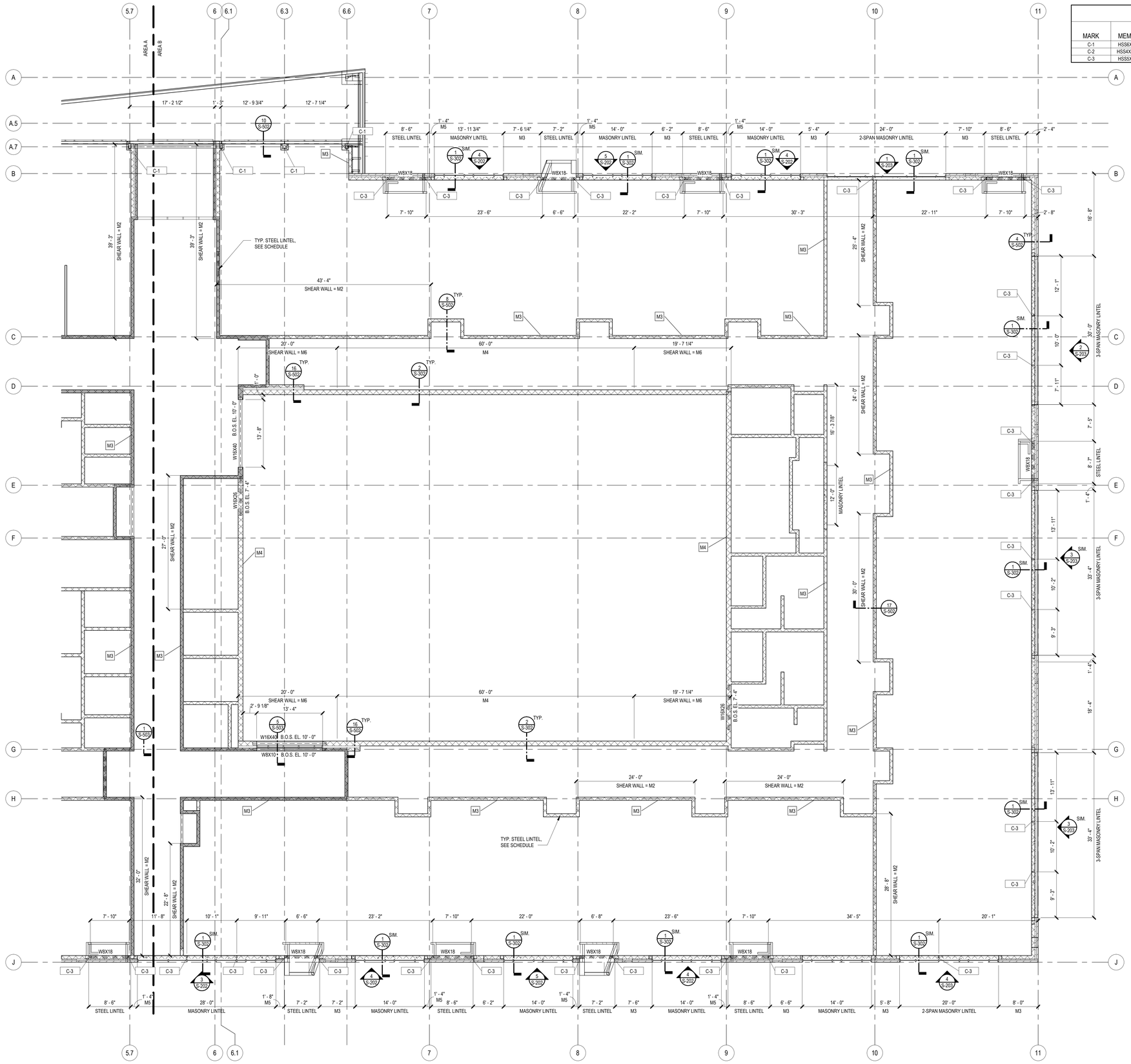
REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-103A

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE



MASONRY FRAMING PLAN - AREA B
1/8" = 1'-0"

COLUMN SCHEDULE

MARK	MEMBER	BASE PLATE	ANCHOR BOLTS QTY.	ANCHOR BOLTS SIZE	ANCHOR BOLTS MIN. EMBED.	COMMENTS
C-1	HSS6X6X3/8	12" X 12" X 3/4"	4	3/4"Ø	12"	BP-1
C-2	HSS4X4X5/16	11" X 5" X 1/2"	4	3/4"Ø	N/A	BP-2
C-3	HSS5X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3

MASONRY WALL REINFORCEMENT SCHEDULE

MARK	WALL WALL SIZE	WALL VERTICAL REINF.	COMMENTS
M1	8" CMU	---	PARTITION WALL
M2	8" CMU	(1) #4 @ 60" O.C.	INTERIOR SHEAR WALL
M3	8" CMU	(1) #4 @ 48" O.C.	INTERIOR BEARING WALL AND EXTERIOR BEARING WALL W/ VENEER CLADDING
M4	12" CMU	(1) #5 @ 72" O.C.	EXTERIOR / INTERIOR BEARING WALL W/ VENEER CLADDING
M5	8" CMU	(1) #4 @ 8" O.C.	EXTERIOR BEARING WALL
M6	12" CMU	(1) #5 @ 48" O.C.	EXTERIOR SHEAR WALL

NOTES:
1. VERTICAL WALL REINFORCEMENT SHALL BE LAPPED WITH FOOTING DOWEL BARS AND SOLID GROUTED, FULL WALL HEIGHT.
2. PROVIDE HORIZONTAL LADDER REINFORCING AT 16" O.C. TYP. SEE SPECIFICATIONS FOR WIRE SIZE.
3. PROVIDE (2) VERTICAL BARS IN SOLID GROUTED CORES ADJACENT TO WALL OPENINGS (TYP.). RUN BARS FULL WALL HEIGHT AND DOWEL INTO FOUNDATION WALL. TO AVOID LINTEL INTERFERENCE DO NOT INSTALL IN FIRST CORE ADJACENT TO OPENING. GROUT REINFORCED CORE AND JAMB CORE SOLID TO FOUNDATION.
4. PROVIDE HORIZONTAL BOND BEAMS AT LOCATIONS SHOWN ON DETAILS, AND AT INTERMEDIATE LOCATIONS AS REQUIRED FOR A MAXIMUM BOND BEAM SPACING OF 12'-8" IN 8" CMU WALLS AND A MAXIMUM BOND BEAM SPACING OF 18'-0" IN 12" CMU WALLS. UNLESS OTHERWISE NOTED, BOND BEAM REINFORCING SHALL BE (2) #5 BARS CONTINUOUS.
5. ALL MASONRY SUPPORTING BEAMS SHALL INCLUDE BOTTOM PLATE AND BRICK ANGLES PER LINTEL SCHEDULE. GALVANIZE LINTELS SUPPORTING EXTERIOR MASONRY.
6. ALL MASONRY WORK SHALL BE DONE IN ACCORDANCE WITH LATEST ACI 530 SPECIFICATIONS. MASONRY UNITS SHALL CONFORM TO ASTM C91/C91M GRADE SW AS APPLICABLE. USE TYPE M OR S MORTAR. f'm USED IN DESIGN = 2150 PSI.
7. BEAM AND LINTEL BEARING ON MASONRY WALLS SHALL BE A MINIMUM OF 7". SEE PLAN FOR LINTEL AND BEARING PLATE SIZES.
8. AT CONTROL JOINTS CONTINUE HORIZONTAL REINFORCEMENT THROUGH THE JOINT AT THE TOP OF THE WALL. VERTICAL REINFORCING TO BE WITHIN 8" OF CONTROL JOINT EACH SIDE.
9. AT CORNERS AND END OF WALLS VERTICAL REINFORCEMENT TO BE WITHIN 8" AND LAPPED WITH FOUNDATION WALL STEEL.
10. MASONRY WALLS NOT TAGGED ON PLAN TO BE UNREINFORCED, TYPE M1.

KEY PLAN
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MASONRY FRAMING PLAN - AREA B

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-103B

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
WHITE BLACK
WE RECYCLE

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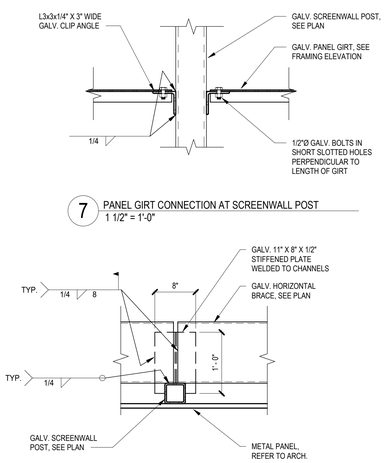
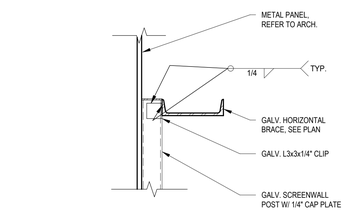
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

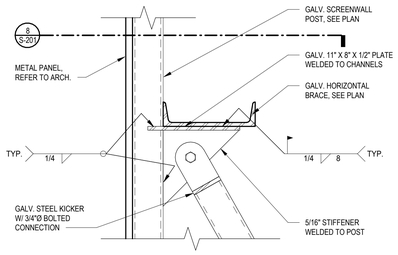


7 PANEL GIRT CONNECTION AT SCREENWALL POST
1 1/2" = 1'-0"

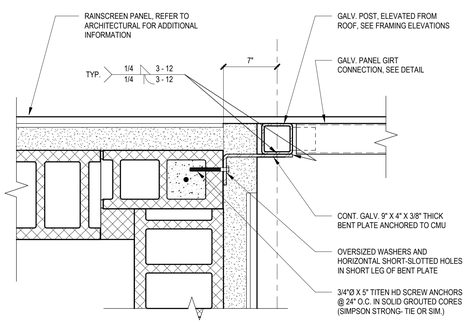
8 BRACE CONNECTION TO SCREENWALL POST
1" = 1'-0"



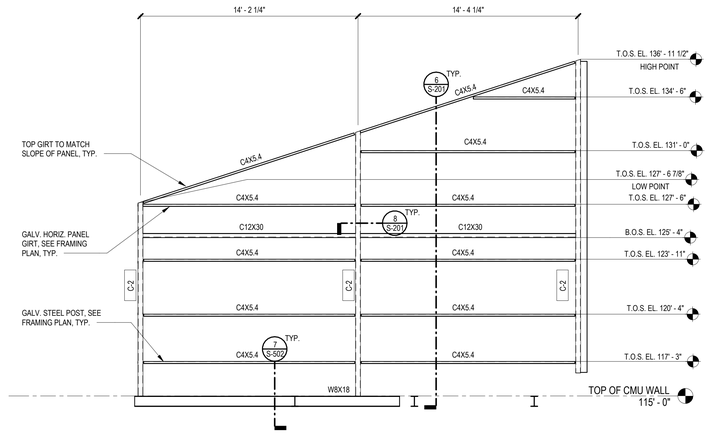
9 OPENING FRAME CLIP
1" = 1'-0"



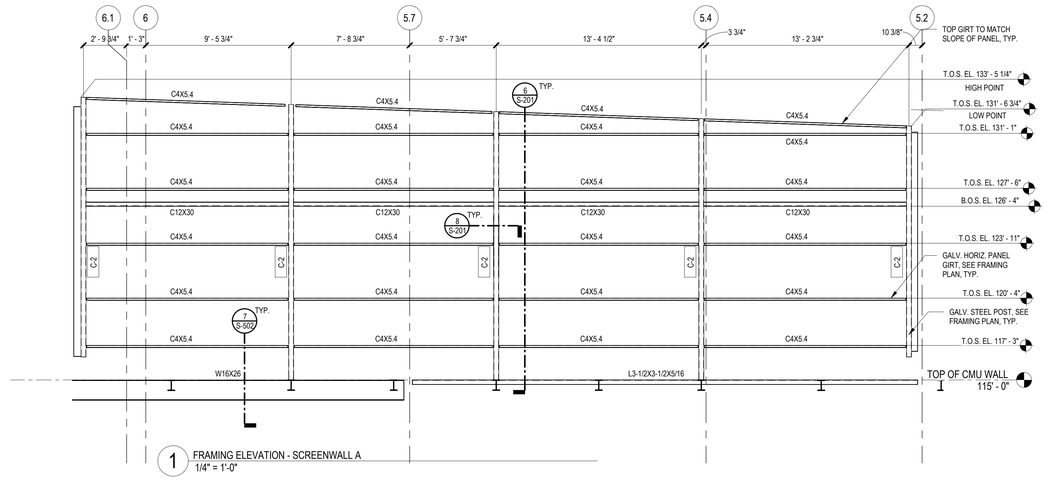
10 BRACE CONNECTION TO SCREENWALL POST
1 1/2" = 1'-0"



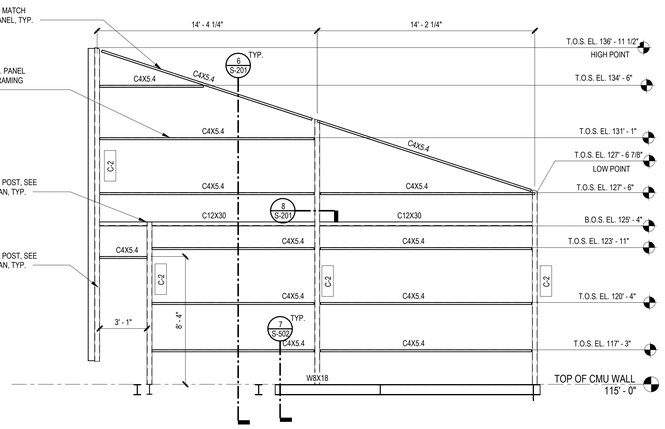
11 TYP. SCREENWALL CLIP ATTACHMENT
1 1/2" = 1'-0"



3 FRAMING ELEVATION - SCREENWALL D
1/4" = 1'-0"



1 FRAMING ELEVATION - SCREENWALL A
1/4" = 1'-0"



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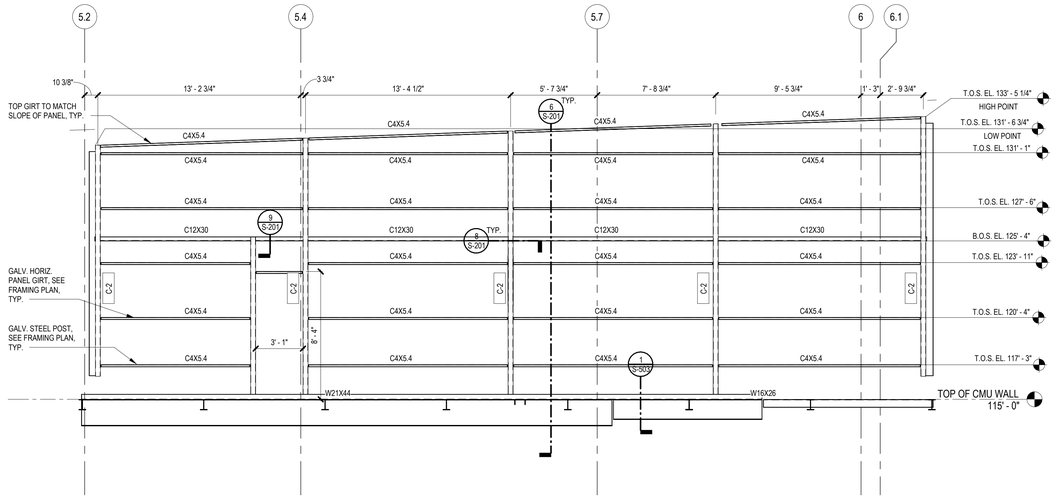
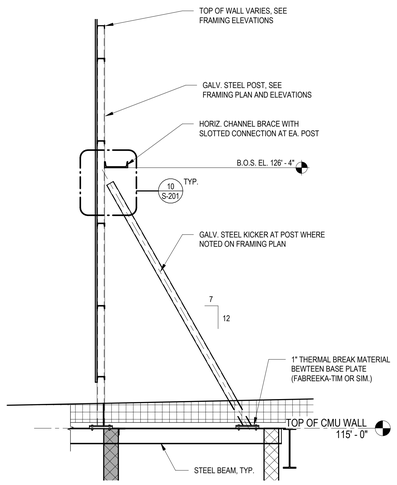
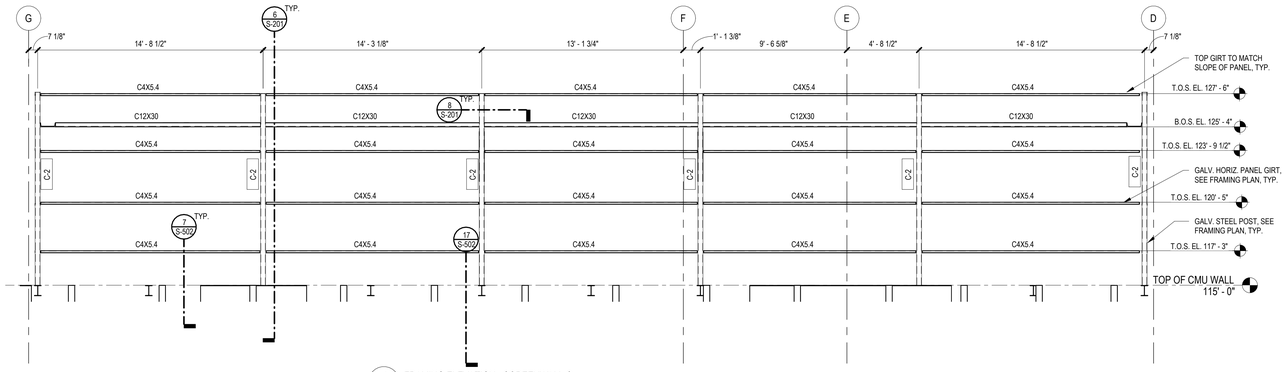
1/4" = 1'-0"



2 FRAMING ELEVATION - SCREENWALL B
1/4" = 1'-0"



6 TYP. SCREENWALL POST - CENTER & END WALL
3/8" = 1'-0"



4 FRAMING ELEVATION - SCREENWALL C
1/4" = 1'-0"

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FRAMING ELEVATIONS

REVISIONS

REV	DESCRIPTION	DATE

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THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
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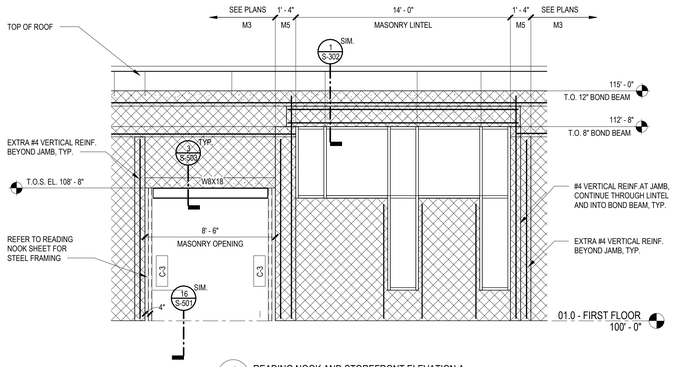
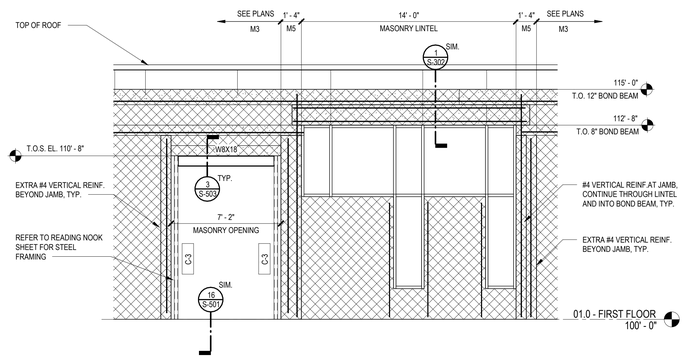
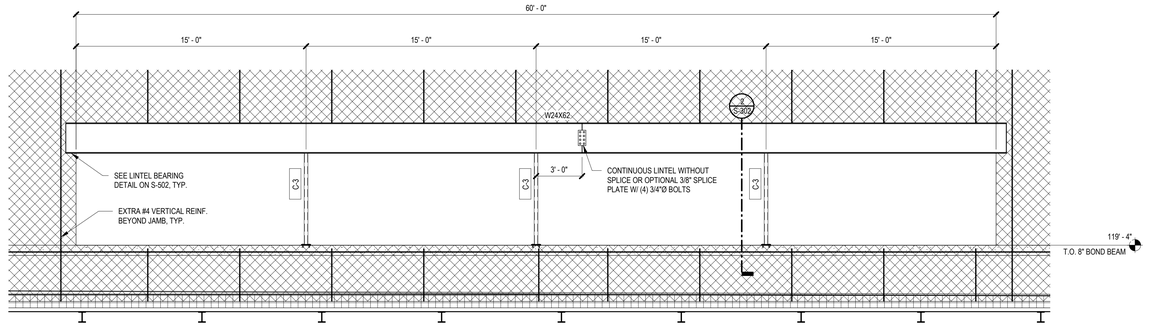
CHECKED BY: Checker APPROVED BY: Approver



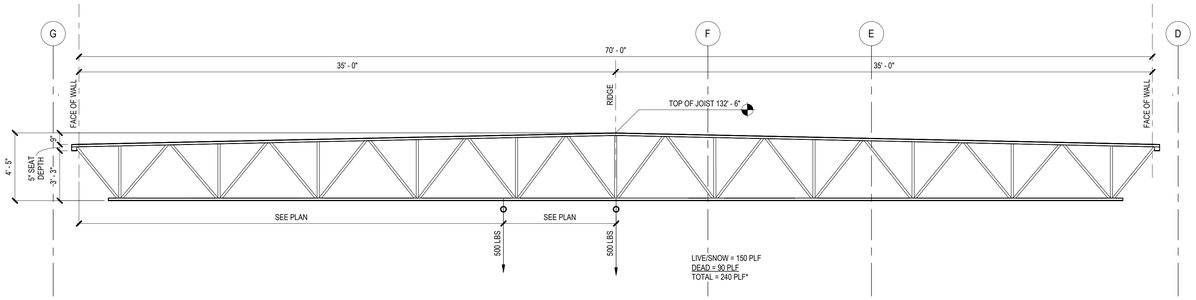
4 READING NOOK AND STOREFRONT ELEVATION A
1/4" = 1'-0"



5 READING NOOK AND STOREFRONT ELEVATION B
1/4" = 1'-0"



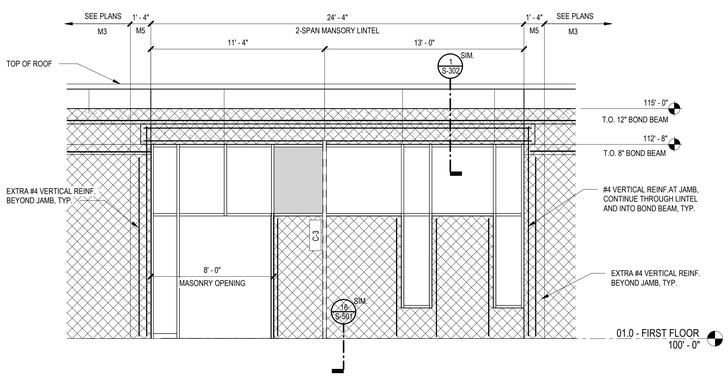
1 GYM WINDOW FRAMING ELEVATION
1/4" = 1'-0"



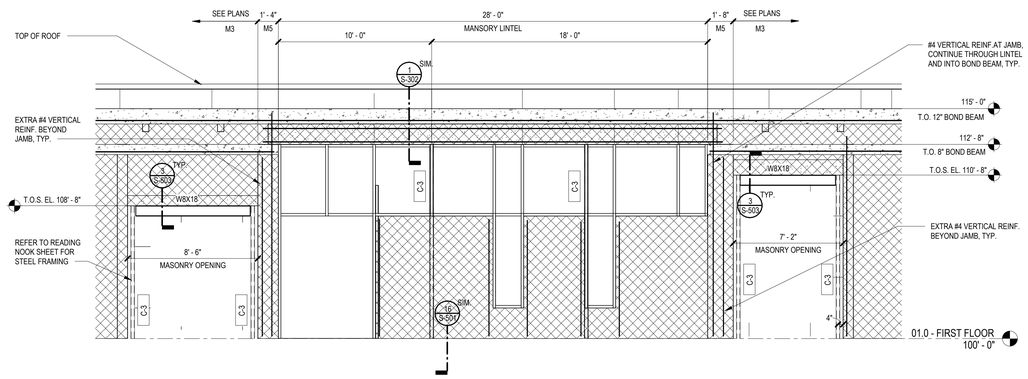
2 DOUBLE PITCHED TOP CHORD - 53LHSP-1
1/4" = 1'-0"

SPECIAL JOIST NOTES

1. ALL SPECIAL JOISTS IN FRAMING DIAGRAMS TO BE DESIGNED FOR LRFD. LISTED REACTIONS ARE UNFACTORED. DISTRIBUTED LOADS LISTED DO NOT INCLUDE JOIST SELF WEIGHT.*
2. POINT LOAD MAGNITUDES AND LOCATIONS DUE TO GYM OR ROOF EQUIPMENT ARE SCHEDMATIC. SEE MANUFACTURER FOR DETAILS.
3. INSTALL SUPPLEMENTAL JOIST REINFORCEMENT PER DETAIL ON S-502 AT EQUIPMENT MOUNTING LOCATIONS.



6 STOREFRONT ELEVATION - AREA A- WEST
1/4" = 1'-0"



3 READING NOOK AND STOREFRONT ELEVATION - SOUTHWEST ENTRY
1/4" = 1'-0"

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FRAMING ELEVATIONS

REVISIONS

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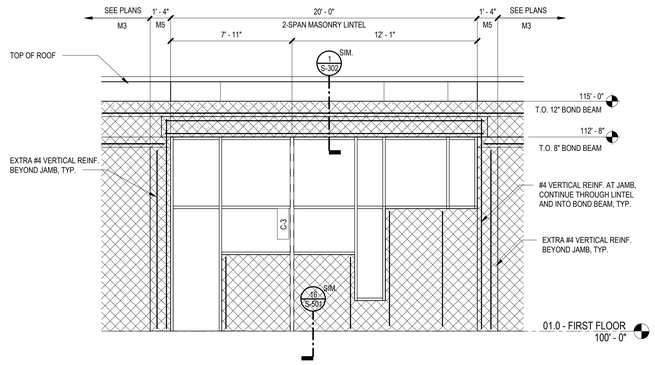
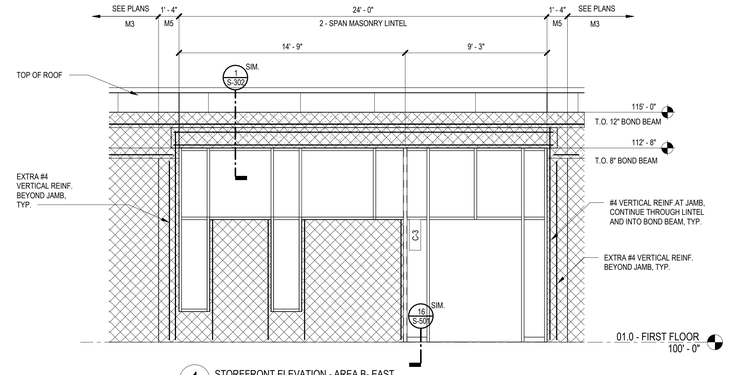
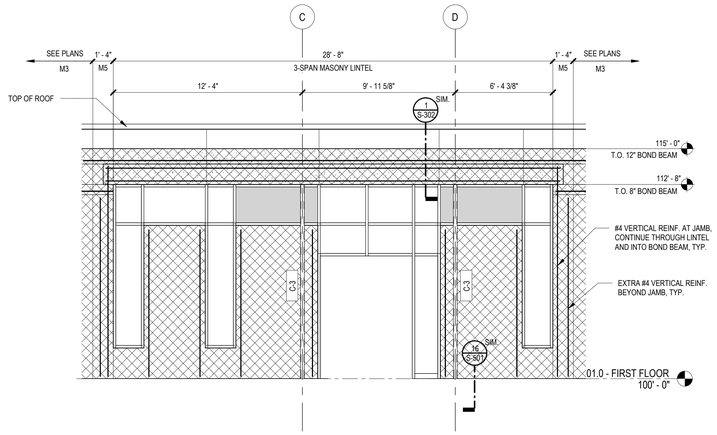


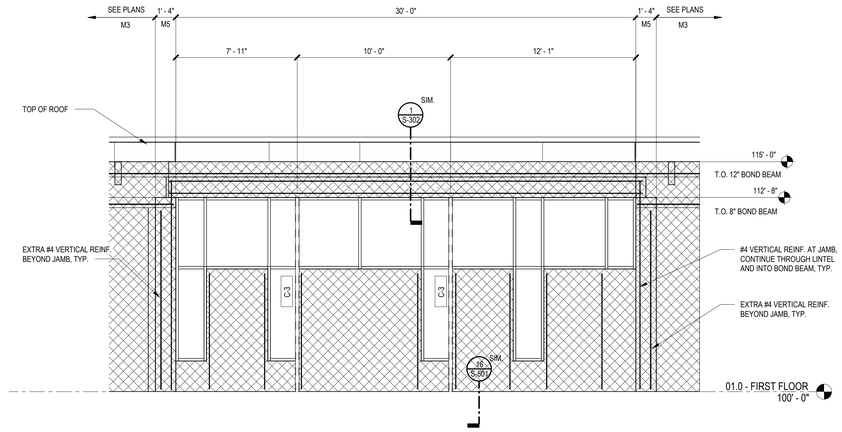
4 WINDOWS - AREA B - WEST- A
1/4" = 1'-0"



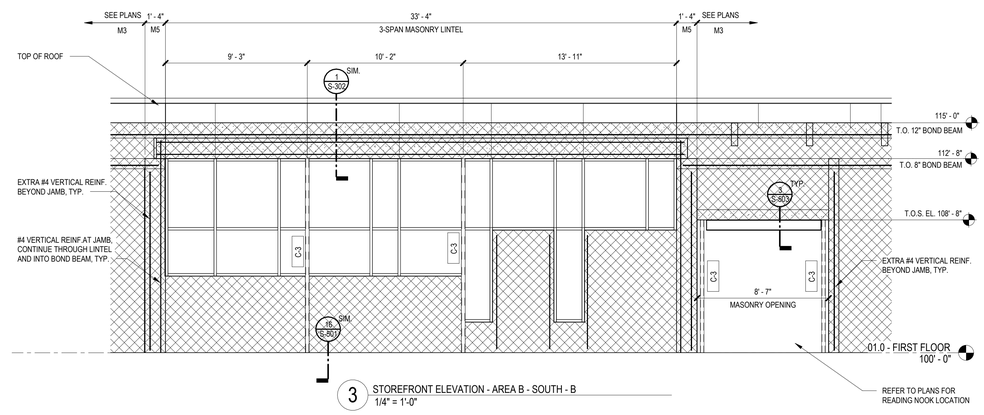
1 STOREFRONT ELEVATION - AREA B- EAST
1/4" = 1'-0"



5 STOREFRONT ELEVATION - AREA A - NORTH
1/4" = 1'-0"



2 STOREFRONT ELEVATION - AREA B - SOUTH - A
1/4" = 1'-0"



3 STOREFRONT ELEVATION - AREA B - SOUTH - B
1/4" = 1'-0"

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FRAMING ELEVATIONS

REVISIONS

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PROJ. #: 220116
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SHEET
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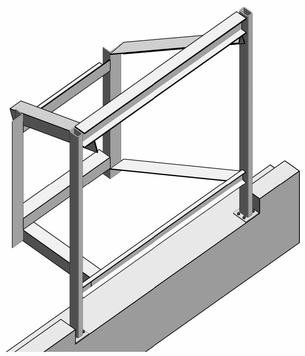
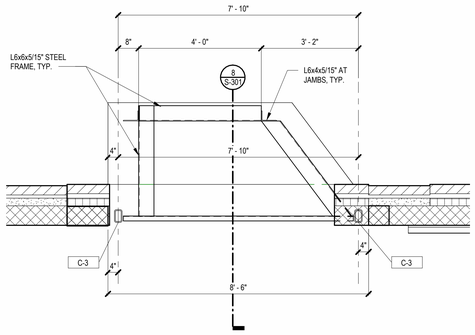
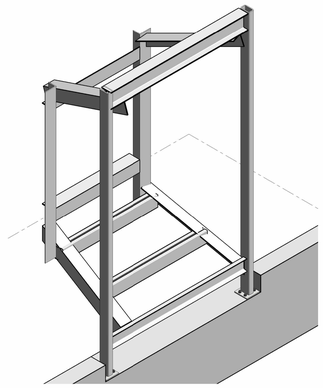


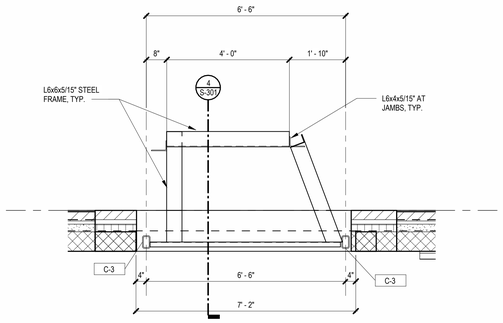
7 ISOMETRIC VIEW - READING NOOK A



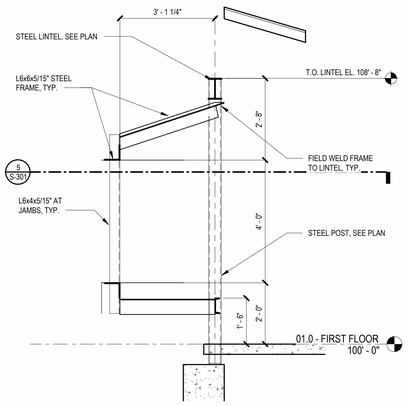
5 ENLARGED FRAMING PLAN - READING NOOK A
1/2" = 1'-0"



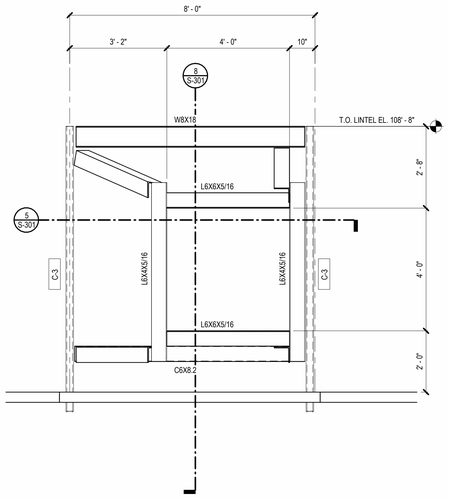
3 ISOMETRIC VIEW - READING NOOK B



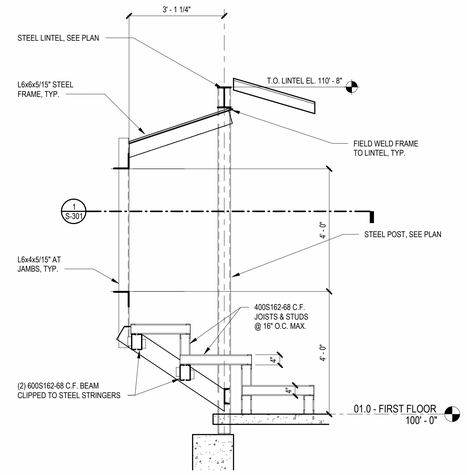
1 ENLARGED FRAMING PLAN - READING NOOK B
1/2" = 1'-0"



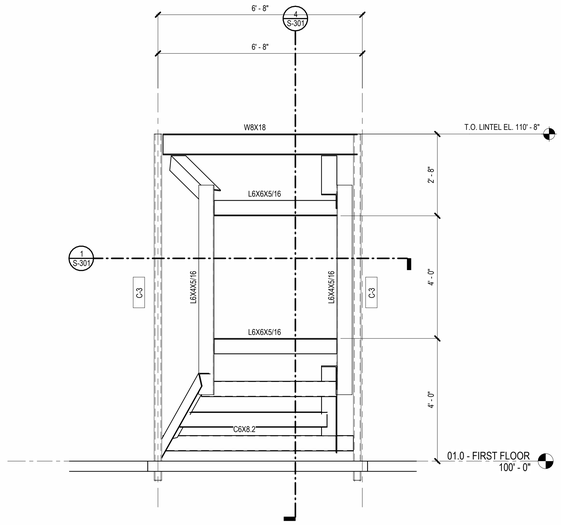
8 WALL SECTION - READING NOOK A
1/2" = 1'-0"



6 FRAMING ELEVATION - READING NOOK A
1/2" = 1'-0"



4 WALL SECTION - READING NOOK B
1/2" = 1'-0"



2 FRAMING ELEVATION - READING NOOK B
1/2" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK.
WHITE
WE RECYCLE

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Autodesk Docs://220116_LSD - Mt HOPE/220116_S.rvt

DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

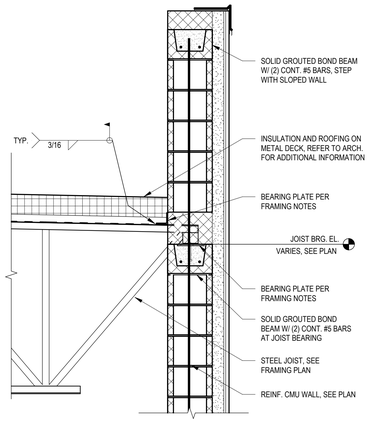
READING NOOK DETAILS

REVISIONS

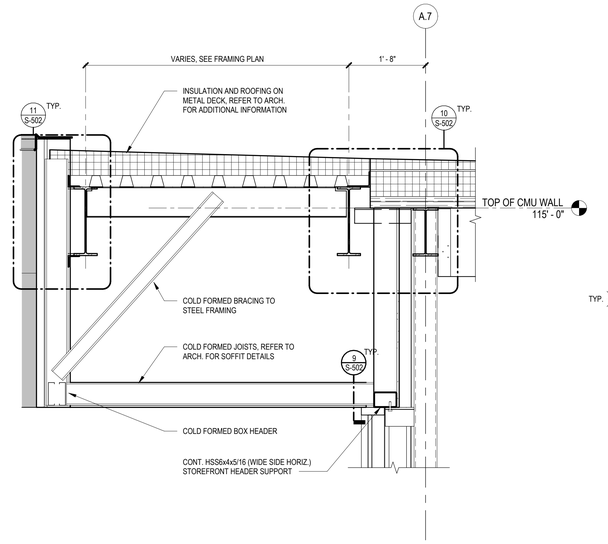
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-301

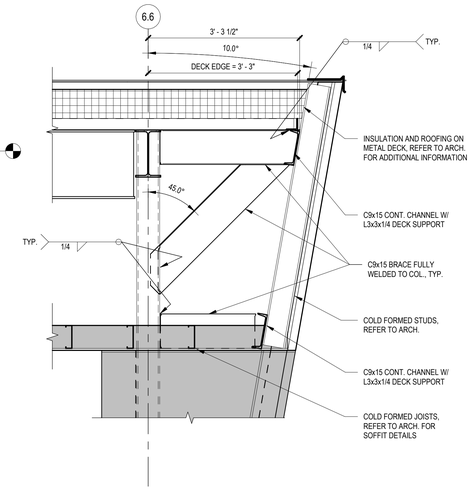
100% CONSTRUCTION DOCUMENTS



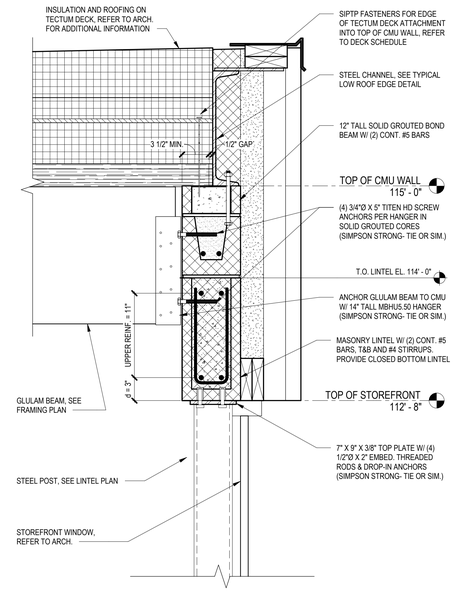
11 TYPICAL JOIST BEARING SECTION
3/4" = 1'-0"



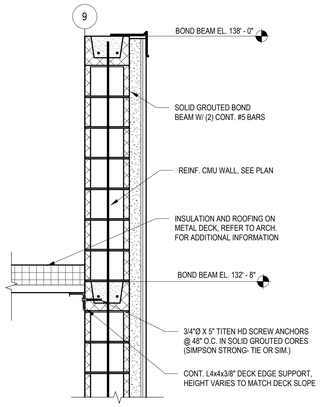
7 ENTRY CANOPY SECTION
3/4" = 1'-0"



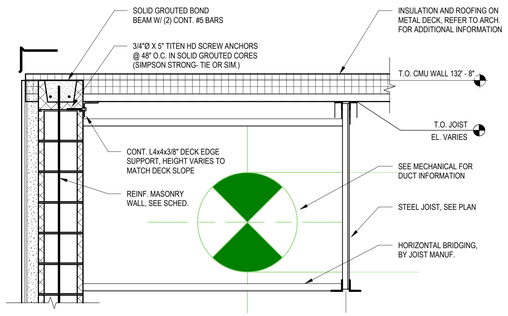
4 CANOPY ROOF EDGE FRAME
3/4" = 1'-0"



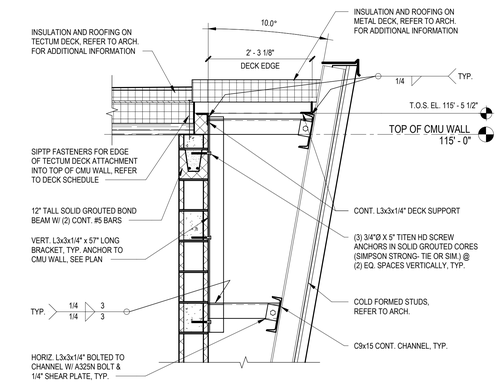
1 MASONRY LINTEL AT STOREFRONT - POST SUPPORTED
1 1/2" = 1'-0"



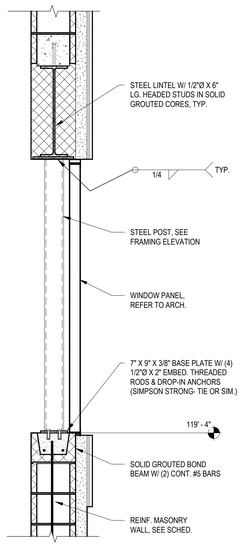
12 HIGH ROOF PARAPET SECTION
3/4" = 1'-0"



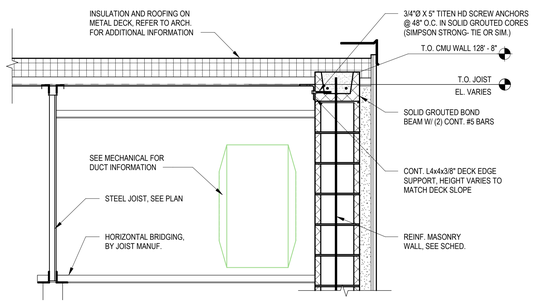
8 ROOF EDGE - NORTH GYM WALL
3/4" = 1'-0"



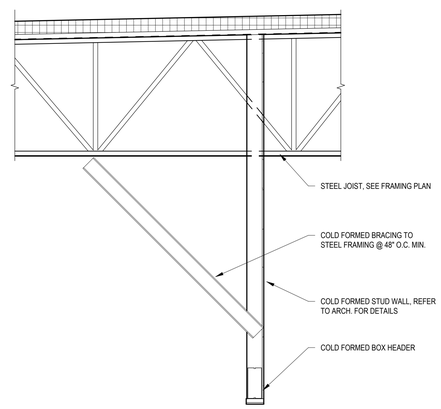
5 CANOPY ROOF OVERHANG
3/4" = 1'-0"



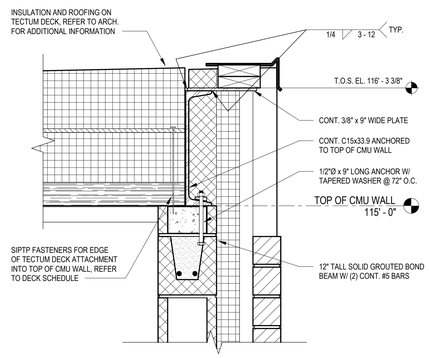
2 GYM LINTEL POST SECTION
3/4" = 1'-0"



9 ROOF EDGE - SOUTH CAFETERIA WALL
3/4" = 1'-0"



6 STAGE BULKHEAD SECTION
1/2" = 1'-0"



3 TYPICAL LOW ROOF EDGE SECTION
1 1/2" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

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1215 E Mt Hope Ave, Lansing, MI 48910

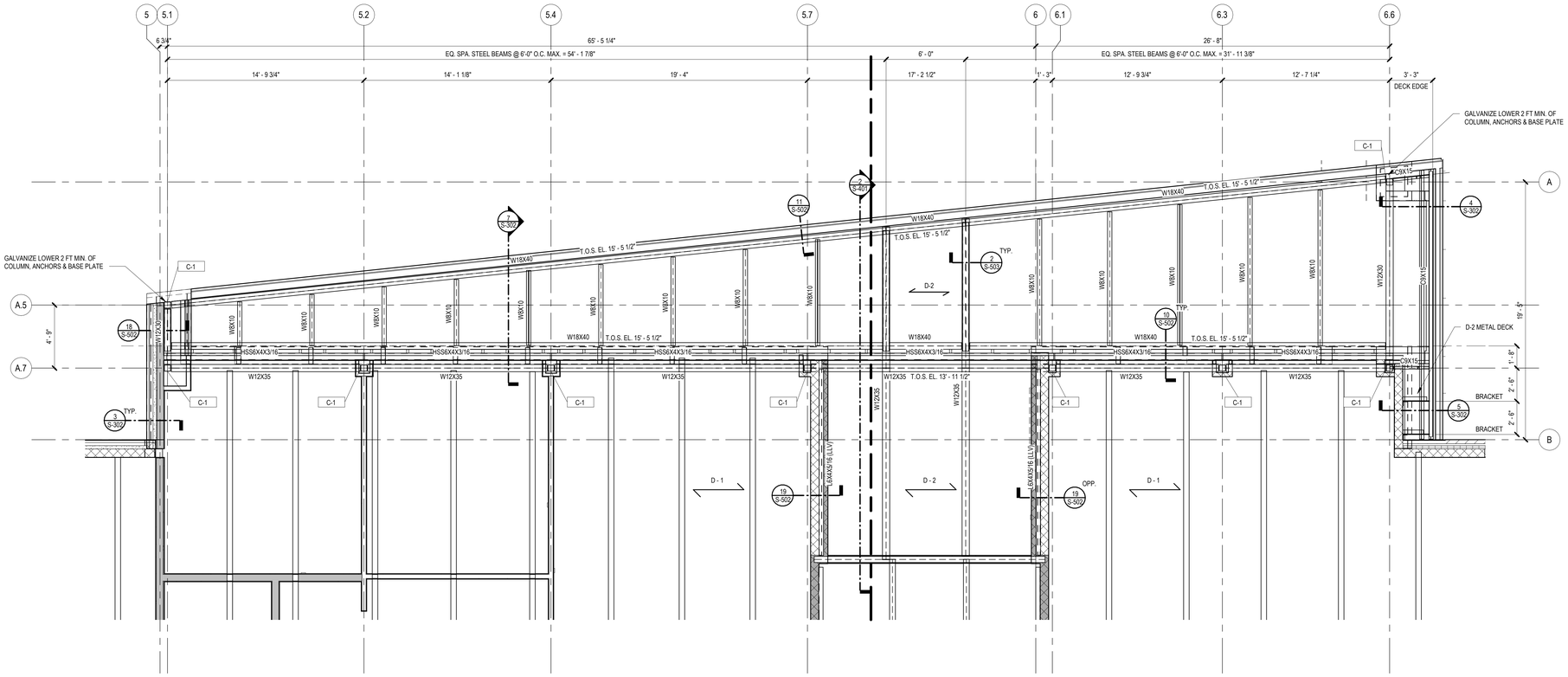
SECTIONS

REVISIONS

REV	DESCRIPTION	DATE

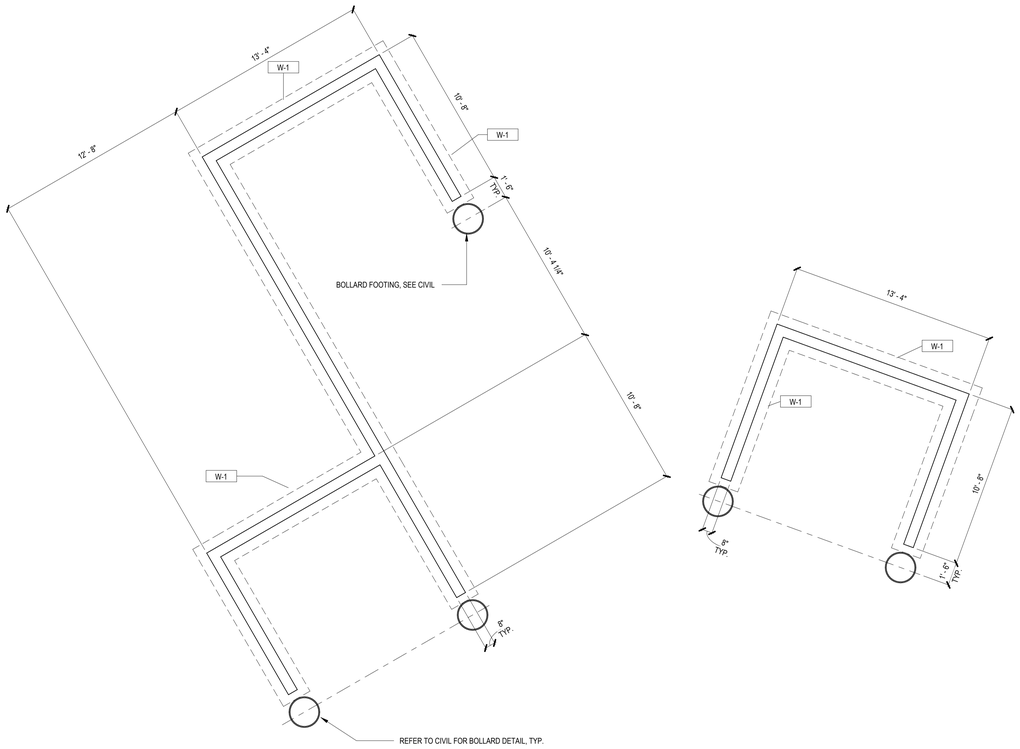
PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-302

100% CONSTRUCTION DOCUMENTS

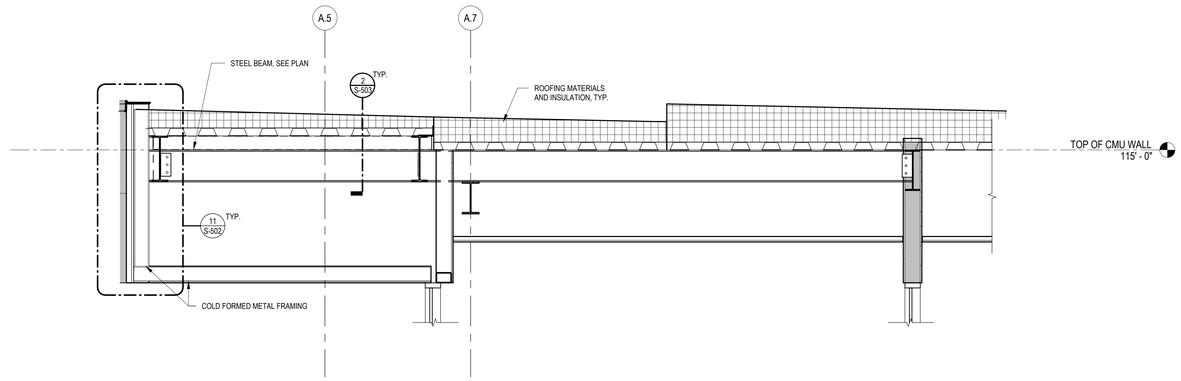


1 02.0 - FRAMING - ENLARGED CANOPY FRAMING PLAN
1/4" = 1'-0"

ROOF DECK	
MARK	DESCRIPTION
D-1	TECTUM E ROOF DECK PANEL PER SPECIFICATION. FASTEN TO END SUPPORTS W/ SIPTP SCREWS, #10 DIAMETER SIPTP SCREWS MINIMUM 3 PER WOOD BEAM PER PANEL AND 12" O.C. SIDES AND ENDS. 1-1/2" MIN. PENETRATION INTO WOOD FRAMING AND CMU. LAP TECTUM PANELS 3.5" MIN. OVER TOP OF CMU WALL.
D-2	3NL-32, GRADE 50 STEEL ROOF DECK (3", 20 GA.). FASTEN TO END SUPPORTS W/ X-ENP-19 L15 HILTI POWDER ACTUATED FASTENERS, IN A 36/3 PATTERN, AND WITH (2) HILTI SLC 01 SIDELAP CONNECTORS IN EACH SIDELAP PER SPAN. (3) SPAN MINIMUM.
D-3	2.0DA, GRADE 40 ACOUSTICAL DOVETAIL STEEL ROOF DECK (2", 20 GA.) . FASTEN TO END SUPPORTS W/ X-ENP-19 L15 HILTI POWDER ACTUATED FASTENERS, IN A 24 5/4 PATTERN, AND WITH (2) HILTI SLC 01 SIDELAP CONNECTORS IN EACH SIDELAP PER SPAN. (3) SPAN MINIMUM.



ENLARGED FOUNDATION PLAN - TRASH ENCLOSURE
1/4" = 1'-0"



2 CANOPY SECTION AT VESTIBULE
1/2" = 1'-0"

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ENLARGED PLANS

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SHEET
S-401

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THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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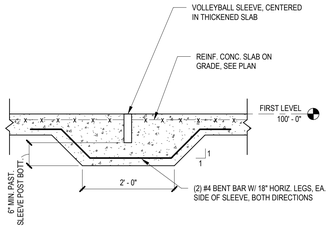
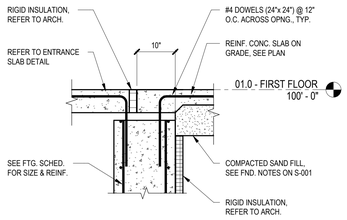
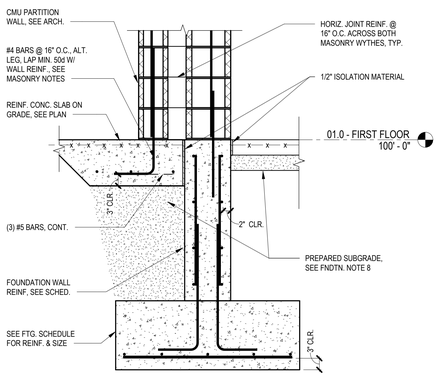


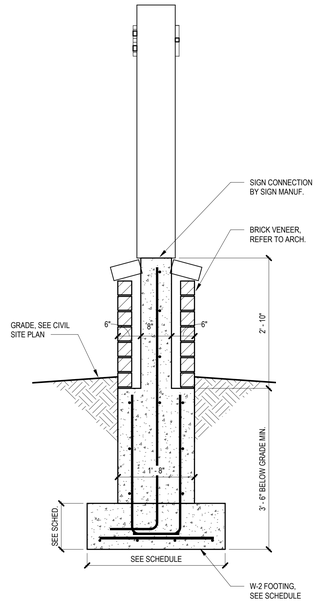
19 VOLLEYBALL SLEEVE DETAIL
3/4" = 1'-0"



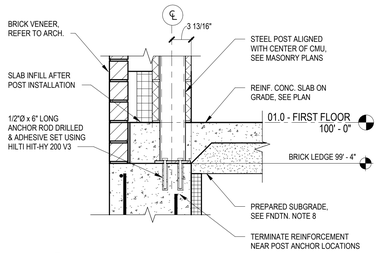
20 SLAB EDGE AT DOOR
3/4" = 1'-0"



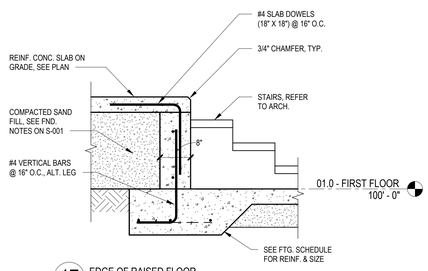
21 THICKENED SLAB AT DOUBLE CMU WALL
3/4" = 1'-0"



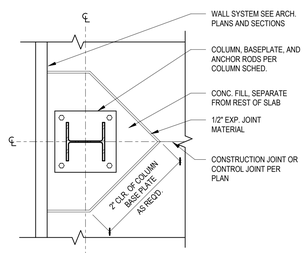
15 MONUMENT SIGN FOUNDATION
3/4" = 1'-0"



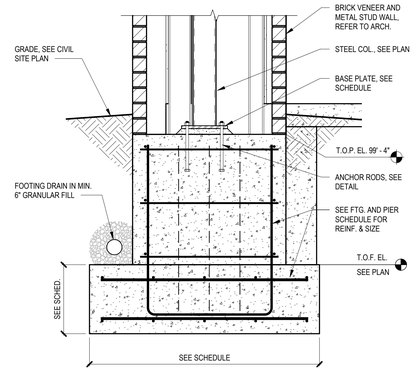
16 POST BASE AT FOUNDATION WALL
1" = 1'-0"



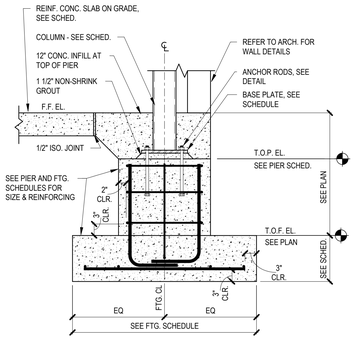
17 EDGE OF RAISED FLOOR
3/4" = 1'-0"



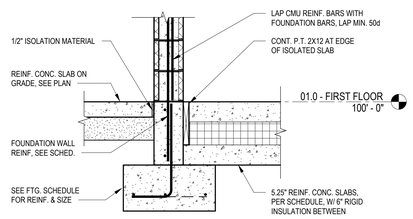
18 EXTERIOR ISOLATION JOINT DETAIL
NOT TO SCALE



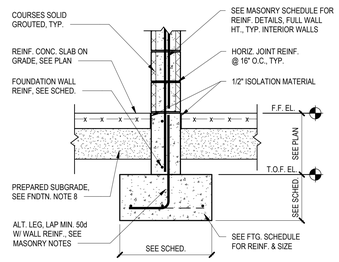
11 CANOPY FOUNDATION PIER - NORTH
3/4" = 1'-0"



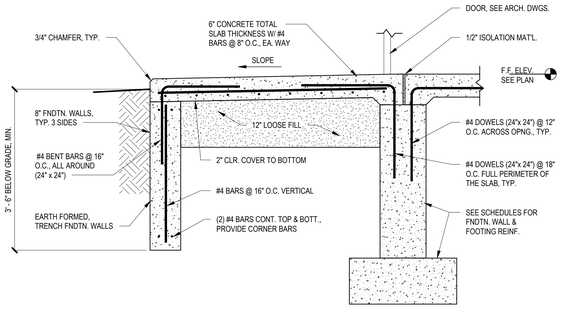
12 TYP. EXTERIOR CONCRETE FOOTING SECTION
3/4" = 1'-0"



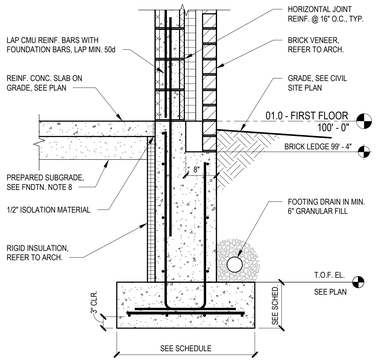
13 INSULATED SLAB EDGE
3/4" = 1'-0"



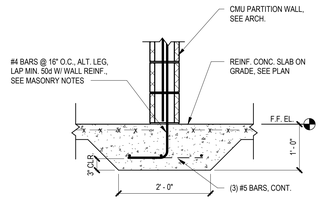
14 INTERIOR BEARING WALL FOOTING SECTION
3/4" = 1'-0"



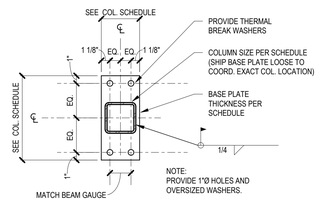
6 ENTRANCE SLAB SECTION
3/4" = 1'-0"



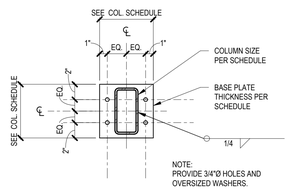
7 TYPICAL FOUNDATION WALL
3/4" = 1'-0"



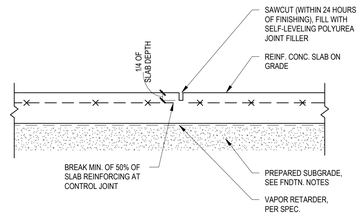
8 INTERIOR THICKENED SLAB SECTION
3/4" = 1'-0"



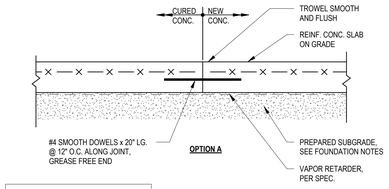
9 BASE PLATE BP-2
1 1/2" = 1'-0"



10 BASE PLATE BP-3
1 1/2" = 1'-0"



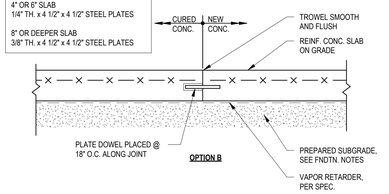
1 SLAB ON GRADE CONTROL JOINT DETAIL
3/4" = 1'-0"



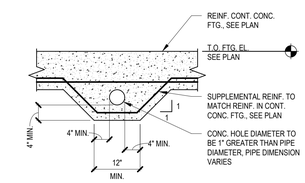
NOTE:
PLATE DOWELS OR OTHER ENGINEER APPROVED EQUAL SLAB JOINT TRANSFER REINFORCING TO BE:

4" OR 6" SLAB
1/4" TH. x 4 1/2" x 4 1/2" STEEL PLATES

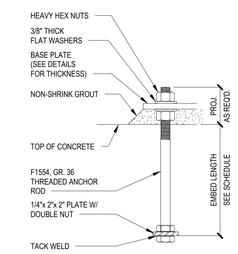
8" OR DEEPER SLAB
3/8" TH. x 4 1/2" x 4 1/2" STEEL PLATES



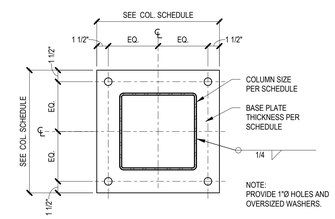
2 SLAB ON GRADE CONSTRUCTION JOINT DETAIL
3/4" = 1'-0"



3 PIPE PENETRATION DETAIL
3/4" = 1'-0"



4 ANCHOR ROD DETAIL
1 1/2" = 1'-0"



5 BASE PLATE BP-1
1 1/2" = 1'-0"

THE RECYCLE BLACK
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

6/25/2023 12:29:56 PM
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FOUNDATION DETAILS

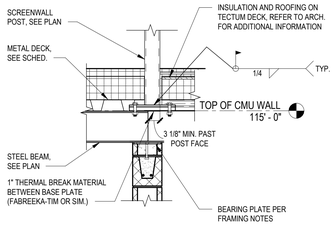
REVISIONS

REV	DESCRIPTION	DATE

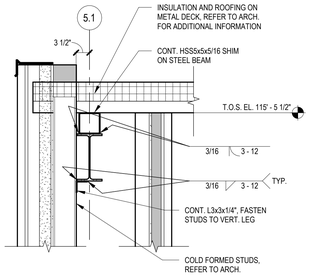
PROJ. #: 220116
DATE: 23-JUN-2023

SHEET
S-501

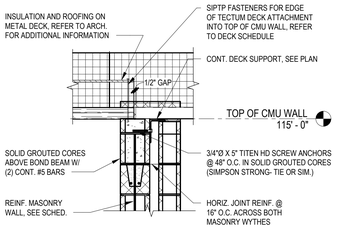
100% CONSTRUCTION DOCUMENTS



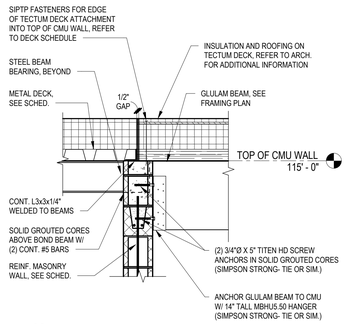
17 TYPICAL SCREENWALL POST SUPPORT
3/4" = 1'-0"



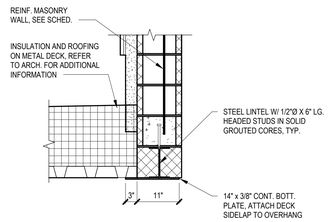
18 CANOPY ROOF EDGE - NORTH
3/4" = 1'-0"



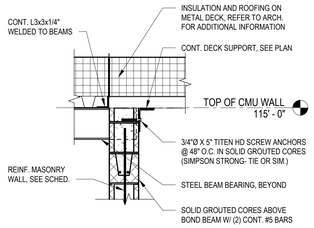
19 TOP OF VESTIBULE WALL
3/4" = 1'-0"



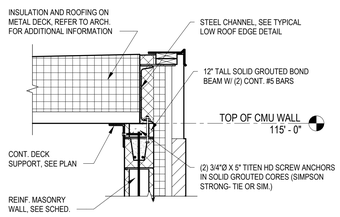
12 INTERIOR GLULAM FRAMING DETAIL
3/4" = 1'-0"



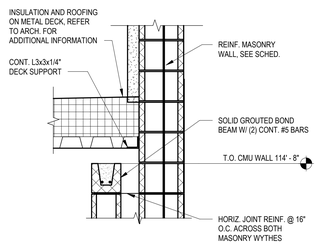
13 LINTEL DETAIL AT CAFETERIA
3/4" = 1'-0"



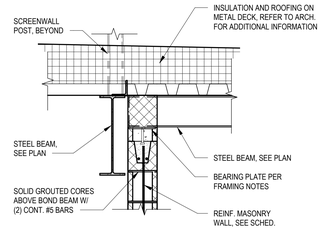
14 INTERIOR DECK BEARING ANGLE
3/4" = 1'-0"



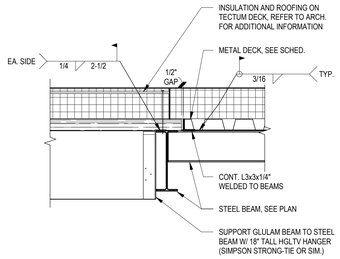
15 EXTERIOR EDGE OF METAL ROOF DECK
3/4" = 1'-0"



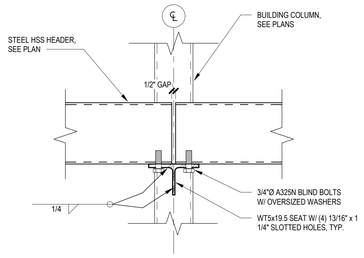
16 WALL BRACING AT LOW ROOF
3/4" = 1'-0"



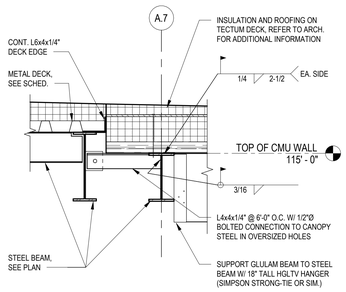
7 ROOF FRAMING DETAIL
3/4" = 1'-0"



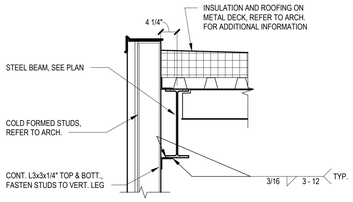
8 GLULAM HANGER AT STEEL BEAM
3/4" = 1'-0"



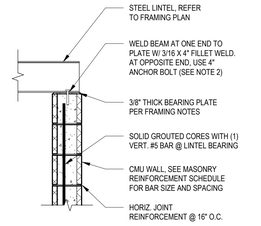
9 TYPICAL HEADER CLIP DETAIL
NOT TO SCALE



10 ROOF TRANSITION AT CANOPY
3/4" = 1'-0"



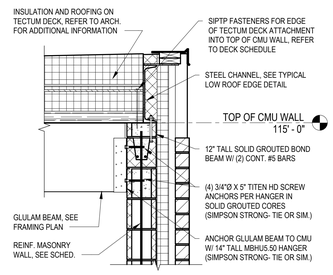
11 CANOPY ROOF EDGE - EAST
3/4" = 1'-0"



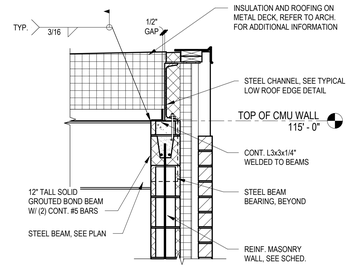
NOTES:

1. BEARING DETAIL APPLIES TO WIDE FLANGE STEEL SECTIONS BEARING AT A WALL END (PARALLEL TO LINTEL) AND FOR STEEL ROOF FRAMING BEARING PERPENDICULAR TO MASONRY WALLS.
2. PROVIDE SHORT SLOTTED HOLES IN BEARING PLATE. BOLT BEAM FLANGE SNUG TIGHT TO PLATE TO ALLOW FOR IN-PLANE MOVEMENT.
3. END OF BEAM TO BEAR ACROSS FULL DEPTH OF BEARING PLATE, CENTERED ON GROUTED WALL CORE.
4. BEARING PLATE DIMENSIONS:
   WIDTH = BEAM FLANGE + 1"
   DEPTH = NOMINAL CMU WIDTH - 1"

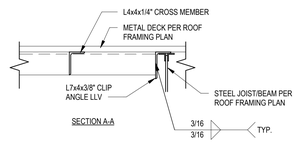
3 TYP. STEEL LINTEL BEARING DETAIL
3/4" = 1'-0"

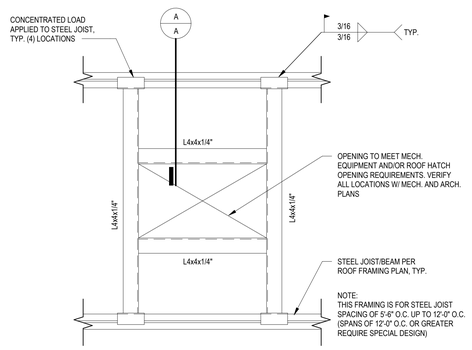


4 GLULAM HANGER AT EXTERIOR WALL
3/4" = 1'-0"



5 ROOF BEAM END BEARING
3/4" = 1'-0"





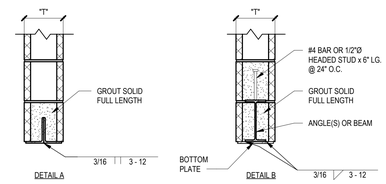
6 FRAMING @ ROOF OPENING
NOT TO SCALE

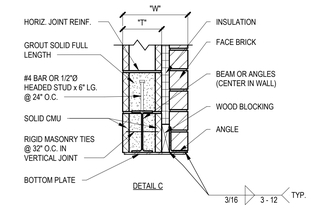
MISCELLANEOUS STEEL LINTEL SCHEDULE

SPAN	WITHOUT FACE BRICK			WITH FACE BRICK		
	T	DESCRIPTION	DETAIL	T	DESCRIPTION	DETAIL
0 TO 6'-0"	6"	(2) L3 1/2 x 2 1/2 x 5/16" (LLV)	A	6"	(1) WT7x13 & L4 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
	8"	(2) L3 1/2 x 3 1/2 x 5/16"	A	8"	(3) L3 1/2 x 3 1/2 x 5/16" WITH 3/8" x (W-1") PLATE	C
	10"	L4 x 3 x 5/16 & L5 x 3 x 5/16" (SLV)	A	10"	(3) L4 x 4 x 5/16" WITH 3/8" x (W-1") PLATE	C
	12"	(2) L4 x 4 x 5/16" WITH 3/8" x 11" PLATE	B	12"	(3) L4 x 4 x 5/16" WITH 3/8" x (W-1") PLATE	C
6'-1" TO 8'-0"	6"	(1) WT7x13 (CENTERED)	A	6"	(1) WT7x13 & L4 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
	8"	(2) L5 x 3 1/2 x 5/16"	A	8"	(3) L5 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
	10"	L4 x 4 x 5/16" & L5 x 5 x 5/16"	A	10"	W8x10 & L4 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
	12"	W8x10 WITH 3/8" x 11" PLATE	B	12"	W8x10 & L4 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
8'-1" TO 10'-0"	6"	WT8x15.5 (CENTERED)	A			
	8"	W8x15 WITH 3/8" x 7" PLATE	B	8"	W8x15 & L5 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
	10"	W8x15 WITH 3/8" x 9" PLATE	B	10"	W8x15 & L5 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C
	12"	W8x15 WITH 3/8" x 11" PLATE	B	12"	W8x15 & L5 x 3 1/2 x 5/16" (LLV) WITH 3/8" x (W-1") PLATE	C

NOTES:

1. DETAIL A & B LINTELS TO BEAR A MINIMUM OF 8" ON FULLY GROUTED COURSES OF SOLID MASONRY. LINTELS SPANNING 8'-0" OR MORE TO BEAR ON FULLY GROUTED CORES FULL HEIGHT OF JAMB.
2. ALL LINTELS AT EXTERIOR LOCATIONS OR OTHERWISE SUBJECT TO WEATHER OR CORROSIVE ATMOSPHERE TO BE GALVANIZED. LINTELS CONSISTING OF A PLATE AND ROLLED BEAM W8 AND SMALLER TO HAVE BOTH PLATE AND BEAM GALVANIZED AFTER WELDING. LINTELS CONSISTING OF A PLATE AND ROLLED BEAM LARGER THAN W8 TO HAVE PLATE GALVANIZED AND BEAM PAINTED WITH SHOP PRIMER. ALL ANGLES TO BE GALVANIZED.
3. LINTELS UTILIZING BOTTOM PLATES TO HAVE PLATE EXTEND FULL LENGTH OF MASONRY OPENING ONLY. BOTTOM PLATES ARE NOT TO EXTEND INTO JAMBS OF WALL OPENINGS.
4. FOR OPENINGS 16 INCHES AND SMALLER, PROVIDE SOLID GROUTED BOND BEAM WITH (2) #5 BARS WITH 8" MIN. BEARING EACH SIDE OF OPENING.

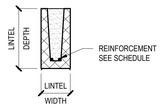




1 MISC STEEL LINTEL SCHEDULE
1/4" = 1'-0"

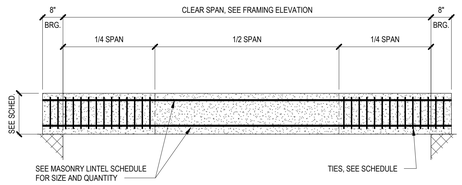
MISCELLANEOUS MASONRY LINTEL SCHEDULE

SPAN	CMU WIDTH	SIZE	REINFORCING
0 TO 4'-0"	8"	(1) BEAM 8" WIDE x 8" DEEP	(2) #5 BARS CONT.
	12"	(1) BEAM 12" WIDE x 8" DEEP	(3) #5 BARS CONT.
4'-1" TO 10'-0"	8"	(1) BEAM 8" WIDE x 16" DEEP	(2) #5 BARS CONT.
	12"	(1) BEAM 12" WIDE x 16" DEEP	(3) #5 BARS CONT.
10'-1" TO 14'-0"	8"	(1) BEAM 8" WIDE x 24" DEEP	(2) #5 BARS BOTTOM, CONT. (2) #5 BARS TOP, CONT. #4 TIES @ 6" O.C.
	12"	(1) BEAM 12" WIDE x 24" DEEP	(3) #5 BARS CONT.



NOTES:

1. BOND BEAMS TO EXTEND A MINIMUM OF 8" PAST MASONRY OPENINGS EXCEPT WHERE BEAM TERMINATES INTO PERPENDICULAR WALL. AT THESE LOCATIONS BOND BEAM (AND GROUTED COURSE IF APPLICABLE) TO EXTEND FULL DEPTH OF PERPENDICULAR WALL.
2. DISTANCE FROM REINFORCING BARS TO BOTTOM OF BOND BEAM = 2 INCHES CLEAR.
3. ON ALL BOND BEAMS THAT HAVE SOLID GROUTED COURSE ABOVE, PROVIDE #4 BENT VERTICAL BARS AT EACH END AND AT 16" O.C. MAXIMUM.
4. ALL BOND BEAMS TO BE SHORED FOR A MINIMUM OF 7 DAYS.
5. FOR OPENINGS 16 INCHES AND SMALLER, PROVIDE SOLID GROUTED BOND BEAM WITH (2) #5 BARS WITH 8" MIN. BEARING EACH SIDE OF OPENING.
6. MAXIMUM UNIFORM LOAD NOT TO EXCEED 520LB/FT FOR 8" WIDE WALLS & 780LB/FT FOR 12" WALLS



2 MASONRY LINTEL SCHEDULE
NOT TO SCALE

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FRAMING DETAILS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-502

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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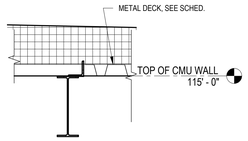
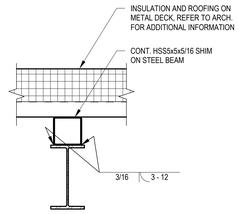
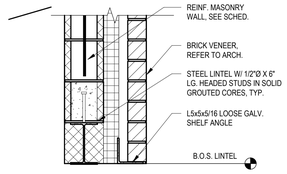
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



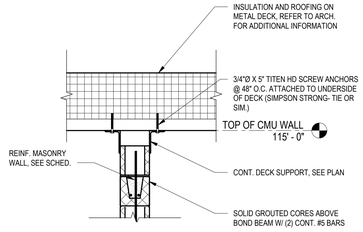
1 ROOF FRAMING DETAIL
3/4" = 1'-0"



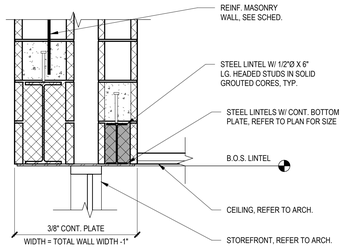
2 BUILT-UP CANOPY BEAM
1" = 1'-0"



3 LINTEL DETAIL - EXTERIOR WALL
1" = 1'-0"



4 CMU PARTITION WALL BRACING
3/4" = 1'-0"



5 STEEL LINTEL AT DOUBLE WALL
1" = 1'-0"

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FRAMING DETAILS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
S-503

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/25/2023 12:30:01 PM
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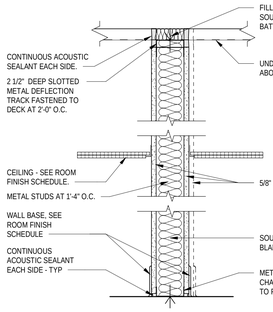
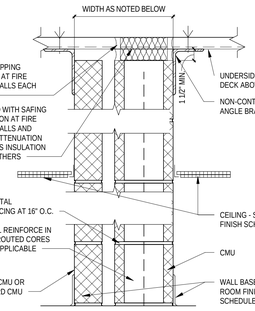
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



PARTITION TYPE 'S5A'
(NON-RATED / 3 5/8" METAL STUDS)

PARTITION TYPE 'S5B'
(NON-RATED / 6" METAL STUDS)

PARTITION TYPE 'S5C'
(NON-RATED / SOUND-RATED / 6" METAL STUDS)
(2-LAYERS OF GYP. ON ONE SIDE)



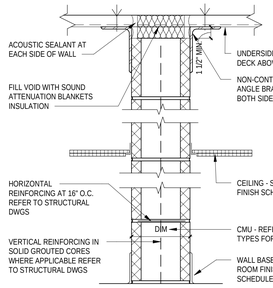
PARTITION TYPE 'M4A'
NON-RATED & SMOKE TIGHT / 8" CMU WITH 8" CMU

PARTITION TYPE 'M4B'
NON-RATED & SMOKE TIGHT / 12" CMU WITH 8" CMU
(2'-0" FULL WIDTH)

PARTITION TYPE 'M4C'
NON-RATED & SMOKE TIGHT / 12" CMU WITH 4" BURNISHED BLOCK (ONE SIDED FACING CORRIDOR, U.N.O.) (2'-0" FULL WIDTH)

PARTITION TYPE 'M4D'
NON-RATED & SMOKE TIGHT / 8" CMU WITH 6" BURNISHED BLOCK (ONE SIDED FACING CORRIDOR, U.N.O.)

PARTITION TYPE 'M4E'
NON-RATED & SMOKE TIGHT / 8" CMU WITH 4" BRICK A (RUNNING BOND)



PARTITION TYPE 'M2A'
NON-RATED 4" BURNISHED BLOCK
(ONE SIDED FACING CORRIDOR, U.N.O.)

PARTITION TYPE 'M2B'
NON-RATED & SMOKE TIGHT 8" CMU

PARTITION TYPE 'M2C'
NON-RATED & SMOKE TIGHT 12" CMU

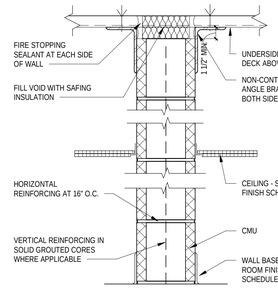
PARTITION TYPE 'M2D'
NON-RATED & SMOKE TIGHT 8" BURNISHED BLOCK (ONE SIDED FACING CORRIDOR, U.N.O.)

PARTITION TYPE 'M2E'
NON-RATED 6" CMU

PARTITION TYPE 'M2F'
NON-RATED & SMOKE TIGHT 12" BURNISHED BLOCK (ONE SIDED FACING CORRIDOR, U.N.O.)

PARTITION TYPE 'M2G'
NON-RATED 4" CMU

PARTITION TYPE 'M2H'
NON-RATED 6" BURNISHED BLOCK
(ONE-SIDED FACING CORRIDOR, U.N.O.)

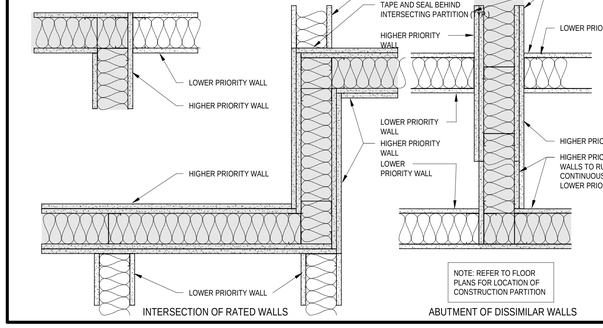


PARTITION TYPE 'M3A'
1 HOUR RATED U.L. #U905 / 8" CMU

PARTITION TYPE 'M3B'
2 HOUR RATED U.L. #U905 / 8" CMU

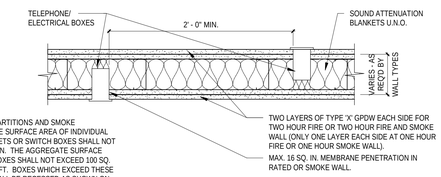
PARTITION TYPE 'M3C'
1 HOUR RATED U.L. #U905 / 12" CMU

WALL PRIORITY LEGEND	
TWO HOUR RATED FIRE AND SMOKE PARTITION	PRIORITY 1 HIGHEST
TWO HOUR RATED SHAFTWALL	PRIORITY 2
TWO HOUR RATED PARTITION	PRIORITY 2
ONE HOUR SMOKE PARTITION	PRIORITY 3
ONE HOUR RATED PARTITION	PRIORITY 4
PARTITION TO DECK (NON-RATED)	PRIORITY 5
PARTITION TO 3 5/8" MIN. ABOVE CEILING	PRIORITY 6



INTERSECTION OF RATED WALLS

ABUTMENT OF DISSIMILAR WALLS



NOTE:
IN ALL RATED PARTITIONS AND SMOKE PARTITIONS, THE SURFACE AREA OF INDIVIDUAL METALLIC OUTLETS OR SWITCH BOXES SHALL NOT EXCEED 16 SQ. IN. THE AGGREGATE SURFACE AREA OF THE BOXES SHALL NOT EXCEED 100 SQ. IN. PER 100 SQ. FT. BOXES WHICH EXCEED THESE STANDARDS SHALL BE RECESSED AS SHOWN ON RECESSED METAL WALL CABINETS DETAIL.

ELECTRICAL/TELEPHONE BOXES IN RATED AND/OR SMOKE WALLS
NOT TO SCALE

NOTE: REFER TO FLOOR PLANS FOR LOCATION OF CONSTRUCTION PARTITION

ABBREVIATIONS

ABBREV.	FULL TEXT
AB	ANCHOR BOLT
ABI	ADDITIVE BID ITEM
AC	ACOUSTICAL
ACB	ACOUSTICAL CEILING BAFFLE
ACP	ACOUSTICAL CEILING PANEL
ACS	ACOUSTICAL CEILING SPRAY
AD	AREA DRAIN
ADA	ADA
AFF	ABOVE FINISHED FLOOR
AL	ALUMINUM
ALUM	ALUMINUM
AP	ACCESS DOORS
APPROX	APPROXIMATE
ARCH	ARCHITECTURAL
ASPH	ASPHALT
AWP	ACOUSTICAL WALL PANEL
B/	BOTTOM OF
BD	BOARD
BF	BARRIER FREE
BIT	BITUMINOUS
BL	BUILDING LINE
BLDG	BUILDING
BLKHD	BULKHEAD
BOTT	BOTTOM
BP	BASE PLATE
BR	BUMP RAIL
BS	BOTH SIDES
BUR	BUILT UP ROOFING
CAB	CABINET
CB	CATCH BASIN
CEM	CEMENT
CG	CORNER GUARD
CH	CHANNEL
CHKDPL	CHECKERED PLATE
CJ	CONTROL JOINT
CL	CENTERLINE
CL TO CL	CENTERLINE TO CENTERLINE
CLG	CEILING
CLK	CAULKING
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
CO	CLEAN OUT
COL	COLUMN
COMP	COMPRESSIBLE
COMPO	COMPOSITION
CONC	CONCRETE
CONN	CONNECT, CONNECTION
CONST	CONSTRUCTION
CONST JT	CONSTRUCTION JOINT
CONT	CONTINUOUS
CONTR	CONTRACTOR
CPT	CARPET TILE
CS	CONCRETE SEALER
CTR	COUNTER
CTSK	COUNTERSINK
DEXS	DOUBLE EXTRA STRONG (STEEL PIPE)
DF	DRINKING FOUNTAIN
DIA	DIAMETER
DIFF	DIFFUSER
DN	DOWN
DO	DOOR OPENING
DP	DRAPERY
DR	DOOR
DS	DOWN SPOUT
DT	DRAIN TILE
DTL	DETAIL
DWG	DRAWING
DWR	DRAWER
E	EAST
EA	EACH
EIFS	EXTERIOR INSULATION AND FINISH SYSTEMS
EJ	EXPANSION JOINT
EL	ELEVATION
ELECT	ELECTRICAL
ELEV	ELEVATOR OR ELEVATION
ENCL	ENCLOSURE
EP	EPOXY PAINT
EPS	EXTERIOR PAINT SYSTEM
EQ	EQUAL
EQUIP	EQUIPMENT
ES	EXPOSED STRUCTURE
EW	EACH WAY
EWC	ELECTRICAL WATER COOLER

ABBREVIATIONS

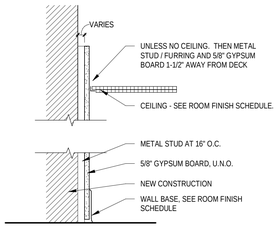
ABBREV.	FULL TEXT
EX	EXISTING
EXGR	EXISTING GRADE
EXP	EXPANSION
EXS	EXTRA STRONG (STEEL PIPE)
EXT	EXTERIOR
FA	FIRE ALARM
FAB	FABRIC/UPHOLSTERY
FD	FLOOR DRAIN
FDN	FOUNDATION
FE	FIRE EXTINGUISHER
FEC	FIRE EXTINGUISHER CABINET
FG	FROSTED GLASS
FHC	FIRE HOSE CABINET
FIN	FINISH
FL	FLOOR
FLL	FLOOR LINE
FLUOR	FLUORESCENT
FOC	FACE OF COLUMN
FOCONC	FACE OF CONCRETE
FRC	FIBER REINFORCED CONCRETE
FRP	FIELD REINFORCED PANEL
FRPFG	FIREPROOFING
FS	FULL SIZE
FT	FIRE TREATED
FTG	FOOTING
FUR	FURRING
FV	FIELD VERIFY
G.B.	GRAB BAR, GRADE BEAM
G.O.	GRILL OPENING
GA	GAUGE
GALV	GALVANIZED
GCT	GLAZED CERAMIC TILE
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GL	GLASS
GND.	GROUND
GR.	GRADE
GRTG.	GRATING
GSCFT	GLAZED STRUCTURAL CLAY FACING TILE
GT	GROUT
GYP. BD.	GYPSUM BOARD
HC	HOLLOW CORE
HCWD	HOLLOW CORE WOOD
HDPB	HIGH DENSITY PARTICLEBOARD
HM	HOLLOW METAL
HORIZ	HORIZONTAL
HP	HIGH POINT
HR	HOUR
HT	HEIGHT
HWD	HARDWARE
I.D. OR ID	INSIDE DIAMETER
I.E.	INVERT ELEVATION
IG	INSULATING GLASS
IN	INCHES
INCL	INCLUDING, INCLUSIVE
INSUL	INSULATION
INT	INTERIOR
IPS	INTERIOR PAINT SYSTEM
JAN	JANITOR
JT	JOINT
kW	KILOWATTS
kWh	KILOWATT HOURS
LAD	LADDER
LAM	LAMINATED
LAV	LAVATORY
LF	LINEAR FEET
LGTH	LENGTH
LH	LEFT HAND
LKR	LOCKER
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LO	LOUVER OPENING
LP	LIGHTING PANEL
LPG	LIQUID PETROLEUM GAS
LPS	LOW PRESSURE STEAM
LT	LIGHT
LWT	LEAVING WATER TEMPERATURE
MA	MEDICAL AIR
MANUF	MANUFACTURER
MAS	MASONRY
MATL	MATERIAL
MAX	MAXIMUM
MBH	THOUSAND BTU/HR
MC	MEDICINE CABINET
MCA	MINIMUM CIRCUIT AMPACITY

ABBREVIATIONS

ABBREV.	FULL TEXT
MCC	MULTI-COLOR COATING
MDO	MEDIUM DENSITY OVERLAY
MECH	MECHANICAL
MEMBWP	MEMBRANE WATERPROOFING
MET	METAL
MEZZ	MEZZANINE
MFR	MANUFACTURER
MFS	MAXIMUM FUSE SIZE
MG	MEDICAL GAS
MH	MANHOLE
MHP	MOTOR HORSEPOWER
MIN.	MINIMUM
MIRR	MIRROR
MISC	MISCELLANEOUS
MM	MISCELLANEOUS METALS
MO	MASONRY OPENING
MOCP	MAXIMUM OVERCRRENT PROTECTION
MP	METAL PANEL
MPC	MICHIGAN PLUMBING CODE
MR	MANUFACTURER'S RECOMMENDATIONS
MT	MARBLE TILE
MTD	MOUNTED
MUL	MULLION
N	NORTH
N.S.	NEAR SIDE
NF	NO FINISH
NIC	NOT IN CONTRACT
NO	NUMBER
NPSH	NET POSITIVE SUCTION HEAD
NSNS	NON SHRINK NON STAIN GROUT
NTS	NOT TO SCALE
NTS	NOT TO SCALE
O.C. OR OC	ON CENTER
OBSGL	OBSCURE GLASS
OD	OUTSIDE DIAMETER
OHDR	SECTIONAL OVERHEAD DOOR
OPNG	OPENING
OPP	OPPOSITE
P	PAINT
PART	PARTITION
PB	PARTICLE BOARD
PC	PRECAST
PCS	PIECES
PERM	PERMANENT
PL	PLATE
PL	PLASTIC LAMINATE
PLAS	PLASTER
PLBG	PLUMBING
PLY	PLYWOOD
PT	PRESSURE TREATED
PT	PORCELAIN TILE
PTB	PORCELAIN TILE BASE
POL	POLISHED CONCRETE
QT	QUARRY TILE
QTB	QUARTZ TILE BASE
QZ	QUARTZ
R	RISER
RA	RETURN AIR
RB	RUBBER BASE
RC	ROOF CONDUCTOR
RD	ROOF DRAIN
RD	ROUND
RECEIVG	RECEIVING
REF	REFRIGERATOR
REINF	REINFORCED
REQ'D	REQUIRED
RF	RESILIENT FLOORING
RH	RIGHT HAND
RL	ROOF LADDER
RM	ROOM
RO	ROUGH OPENING
RS	ROOF SUMP
RS	ROLLER SHADE
RSN	RESIN PANEL
RST	RUBBER STAIR TREAD
RWD	REDWOOD
RWM	RECESSED WALK OFF MAT
S	SOUTH
S	SPANDREL GLASS
SA	SUPPLY AIR
SAB	SOUND ATTENUATION BLANKETS
SC	SOLID CORE
SCH	SCHEDULE
SCONC	SEALED CONCRETE

ABBREVIATIONS

ABBREV.	FULL TEXT
SCWD	SOLID CORE WOOD
SECT	SECTION
SER.RECPT	SERVICE RECEPTOR
SH	SHELF
SHT	SHEET
SHWR	SHOWER
SIM	SIMILAR
SLR	SEALED CONCRETE
SLV	SHORT LEG VERTICAL
SPEC	SPECIFICATION
SQ	SQUARE
SQFT	SQUARE FOOT
SS	STAINLESS STEEL
SSK	SERVICE SINK
SSM	SOLID SURFACING MATERIAL
ST	SMOKE-TIGHT PER CODE TO RESIST THE PASSAGE OF SMOKE
ST	STONE
STD	STANDARD
STDW	STANDARD WEIGHT (STEEL PIPE)
STL	STEEL
STN	STAIN
STOR	STORAGE
STRL	STRUCTURAL
SUPP	SUPPORT
SUSP	SUSPENDED
SYM	SUSPENSION SYMMETRICAL
T	TREAD
T&G	TONGUE AND GROOVE
T.O.C. OR T/C	TOP OF CONCRETE
T.O.F. OR T/F	TOP OF FOOTING
T.O.M. OR T/M	TOP OF MASONRY
T.O.P. OR T/P	TOP OF PAVEMENT
T.O.S. OR T/S	TOP OF STEEL
T.O.W. OR T/W	TOP OF WALL
T/	TOP OF
TB	TRUSS BEARING
TG	TEMPERED GLASS
THK	THICK
THRESH	THRESHOLD
TLT	TOILET
TP	TOILET PARTITION
TR	TRANSITION TRIM
TYP	TYPICAL
TYP	TYPICAL
UNF	UNFINISHED
UNO	UNLESS NOTED OTHERWISE
UR	URINAL
VCT	VINYL COMPOSITION TILE
VERT	VERTICAL
VEST	VESTIBULE
VIF	VERIFY IN FIELD
W	WEST
W/	WITH
W/O	WITHOUT
WC	WATER CLOSET
WC	WALLCOVERING
WCO	WALL CLEAN OUT
WD	WOOD
WP	WATERPROOFING
WP	WORKPOINT
WP	WALL PROTECTION
WSCT	WAINSCOT
WT	WEIGHT
X-(MATERIAL)	DENOTES EXISTING MATERIAL REFRENCED



PARTITION TYPE 'F1A'
(NON-RATED/ 2 1/2" MTL STUD)
TYPICAL FURRED-OUT WALL

PARTITION TYPE 'F1B'
(NON-RATED/ 3 5/8" MTL STUD)
TYPICAL FURRED-OUT WALL

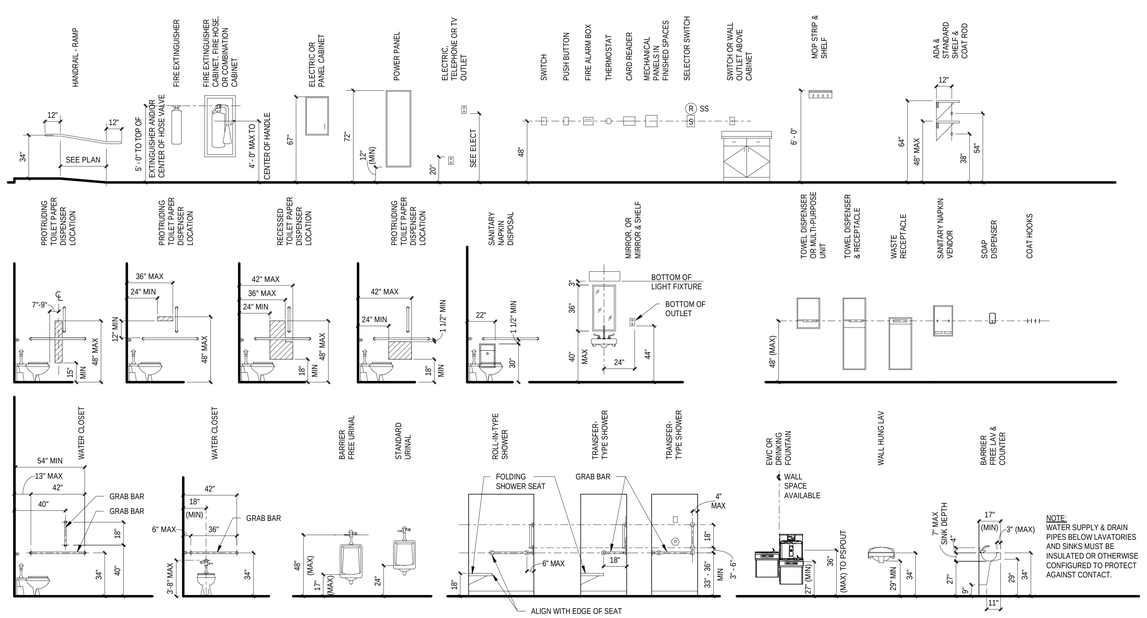
PARTITION TYPE 'F1C'
(NON-RATED/ 3 5/8" MTL STUD WITH 3/4" VENEER PLYWOOD)

PARTITION TYPE 'F1D'
(NON-RATED/ 6" MTL STUD)
TYPICAL FURRED-OUT WALL

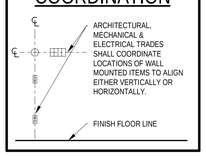
DRAWING REFERENCE SYMBOLS

# X-###	ENLARGED PLAN OR DETAIL	##	ARCHITECTURAL KEYNOTE
# X-###	WALL SECTION	X##	EQUIPMENT TAG
# X-### / # X-###	BUILDING SECTION	X#	WALL TAG
# X-###	EXTERIOR ELEVATIONS	###.#	DOOR TAG
X X-### X	INTERIOR ELEVATIONS	ROOM NAME ###	ROOM TAG
	REVISION CLOUD AND TAG	##	WINDOW TAG
# X-###	VIEW TITLE & REFERENCE	#' - #"	CEILING SPOT ELEVATION
# X-###	DETAIL	XX-#	FINISH TAG
#	EXISTING COLUMN LINE	XX- #	SPECIALITY EQUIPMENT TAG
#	NEW COLUMN LINE	XX#	FURNITURE TAG
##	DEMO KEYNOTE		
	LEVEL OR ELEVATION		
X X	DEMARCATION LINE		

RECOMMENDED MOUNTING HEIGHTS (UNLESS OTHERWISE NOTED)

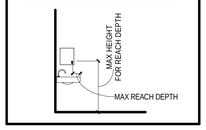


MOUNTING HEIGHT COORDINATION



GENERAL MAXIMUM REACH DEPTH AND HEIGHT FOR HAND DRYERS / TOWEL DISPENSERS

MAX REACH DEPTH	0.5"	2"	5"	6"	9"	11"
MAX REACH HEIGHT	48"	46"	42"	40"	35"	34"



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ARCHITECTURAL LEGENDS, SYMBOLS, AND ABBREVIATIONS

REVISIONS

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GENERAL NOTES:

1. SUB-CONTRACTORS ARE TO COORDINATE WORK WITH ALL OTHER TRADES.
2. CONFLICTS BETWEEN NOTES, DETAILS, SPECIFICATIONS, ETC., SHALL BE VERIFIED WITH THE OWNER'S REPRESENTATIVE OR THE MOST STRINGENT PROVISIONS SHALL GOVERN.
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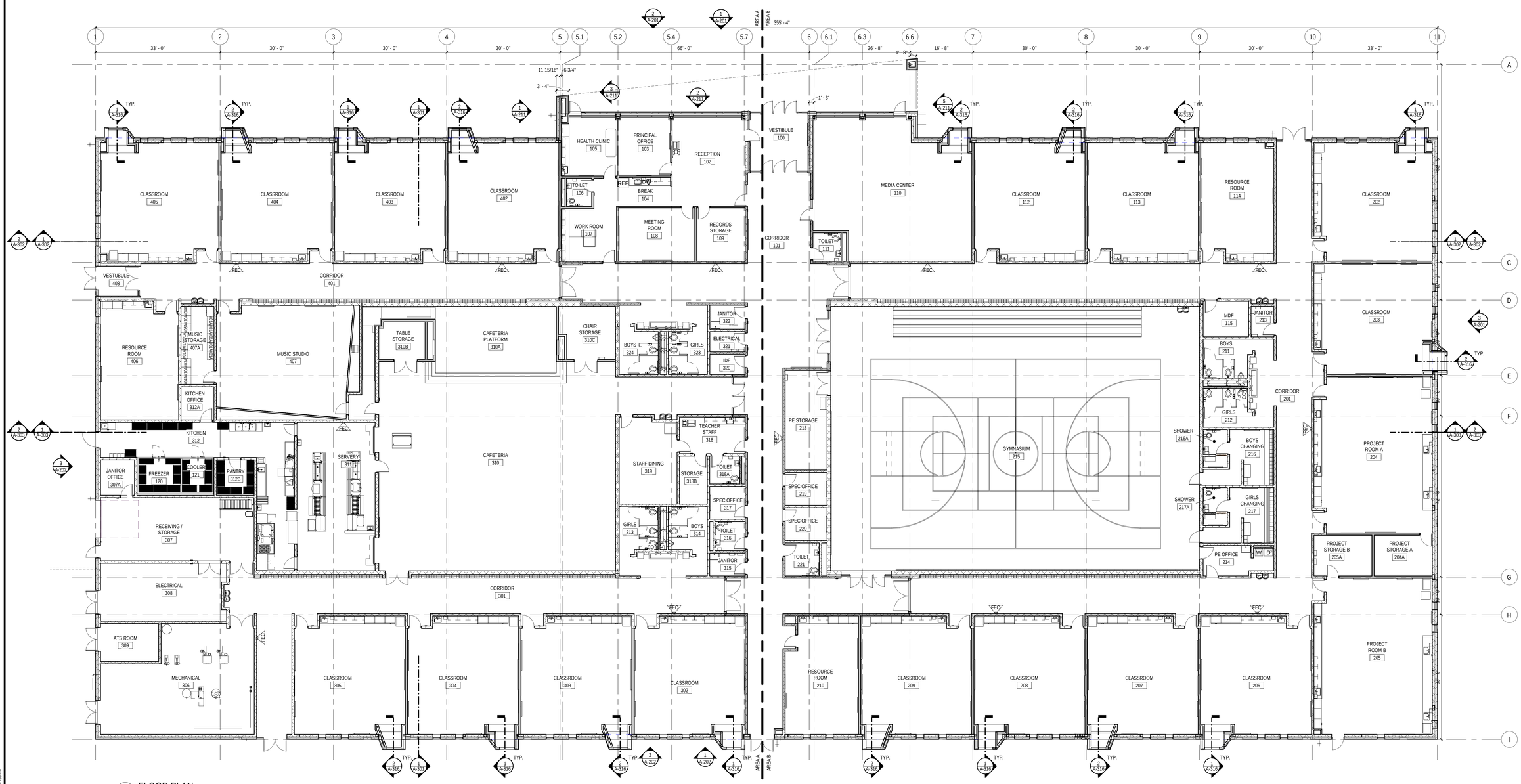
9. ALL DIMENSIONS ARE FROM FACE OF STUD, C.M.U., OR CONCRETE , U.N.O.
10. PROVIDE ISOLATION MATERIAL BETWEEN DISSIMILAR MATERIALS THAT ARE IN CONTACT WITH ONE ANOTHER
11. PROVIDE SOLID, CONTINUOUS, NON COMBUSTIBLE BLOCKING AT LOCATIONS WHERE MILLWORK, PLUMBING FIXTURES, EQUIP., ETC. ATTACH TO WALL OR CEILING.



FLOOR PLAN
3/32" = 1'-0"

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FLOOR PLAN - OVERALL

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A-101

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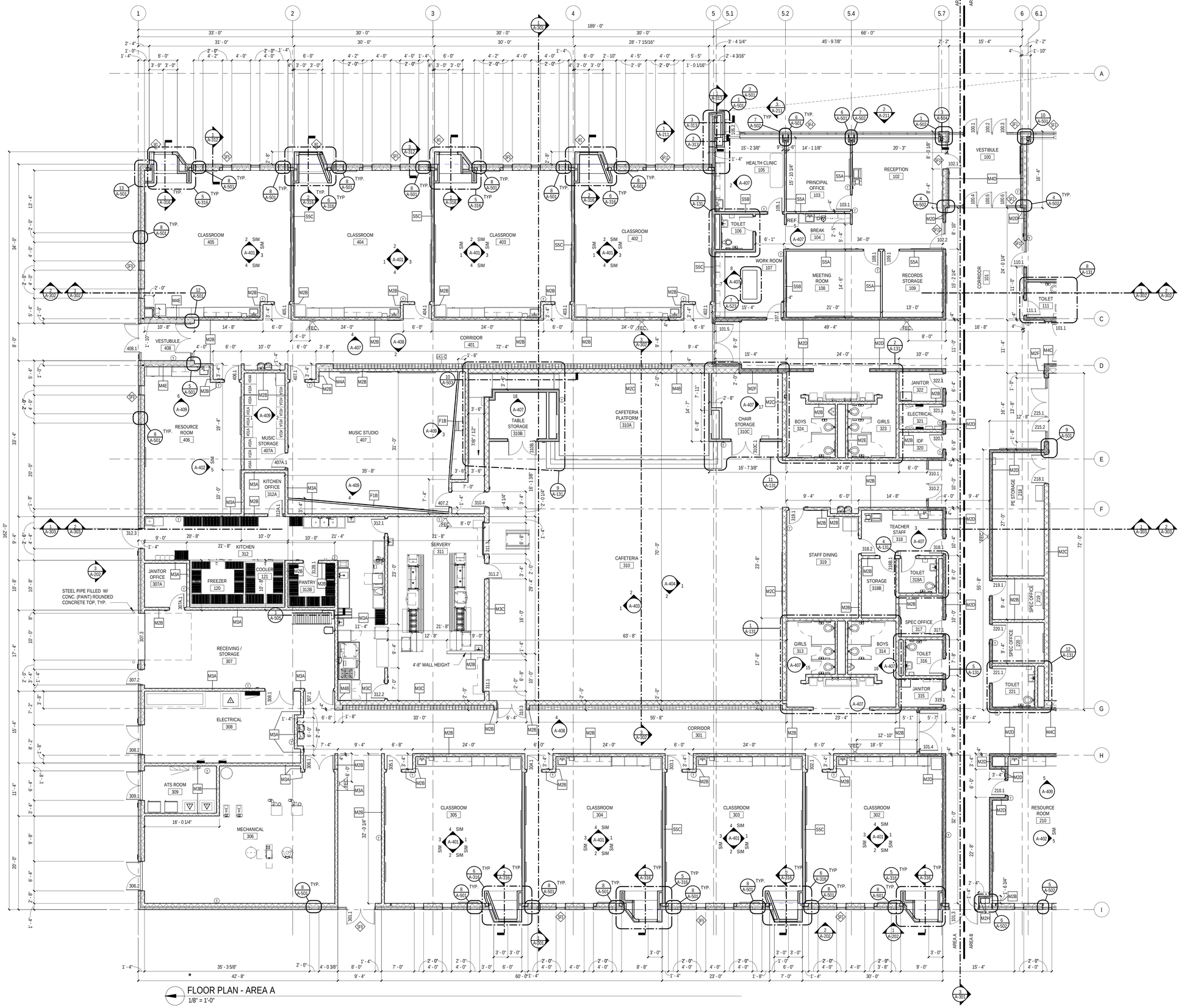
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE



FLOOR PLAN - AREA A
1/8" = 1'-0"

PARTITION TYPE GENERAL NOTES

1. PROVIDE HI-IMPACT CEMENT BACKERBOARD AT ALL SHOWER WALLS, TYP.
2. IF NOT SHOWN ON DRAWINGS, PROVIDE CONTROL JOINTS IN GYPSUM BOARD ASSEMBLIES AS DESCRIBED IN ASTM C 840-08 OR GA-216-2013.

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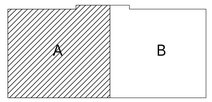

KEY PLAN
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FLOOR PLAN - AREA A

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BLACK

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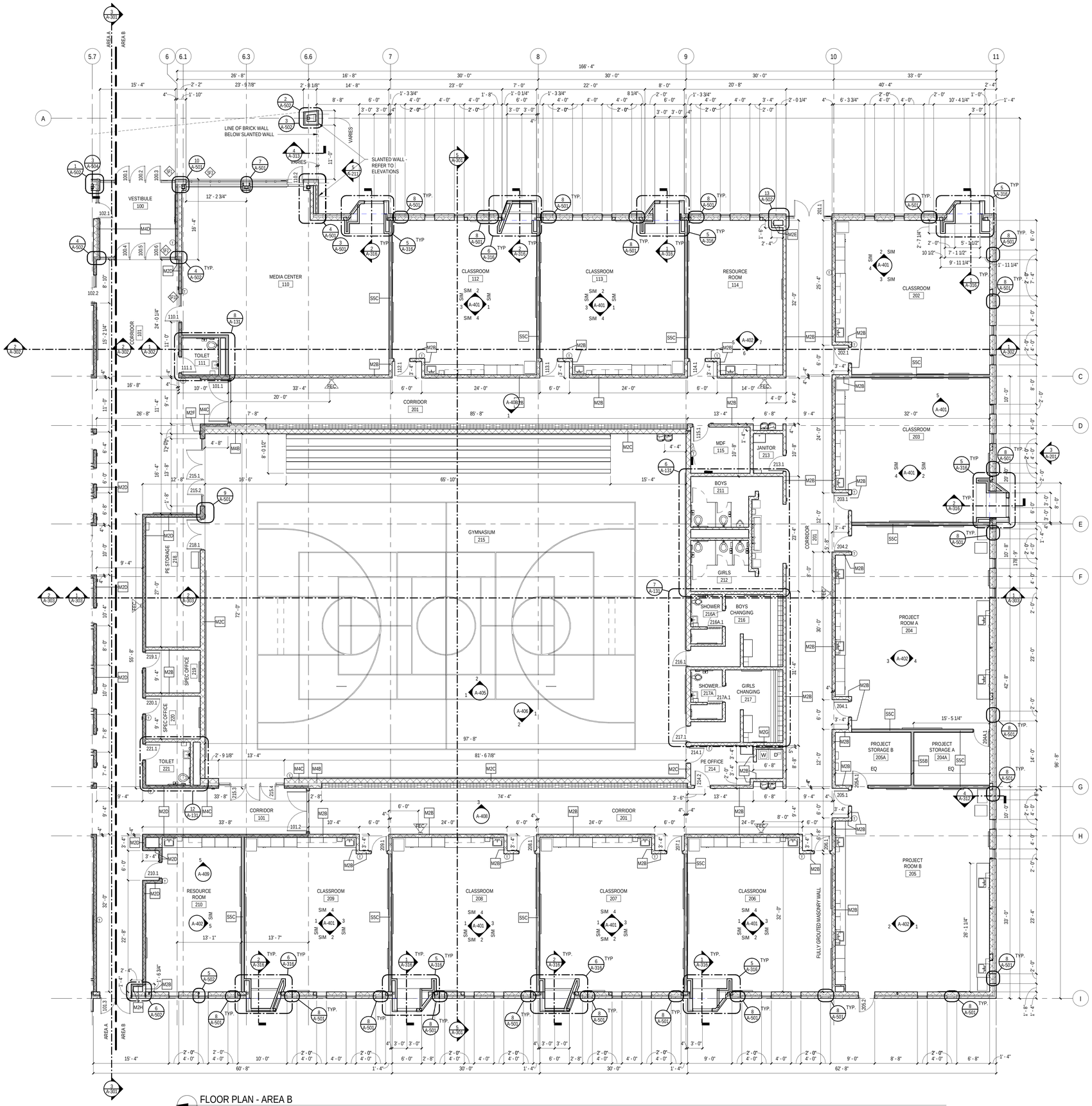

FLOOR PLAN - AREA B
1/8" = 1'-0"

KEY PLAN
NOT TO SCALE

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FLOOR PLAN - AREA B

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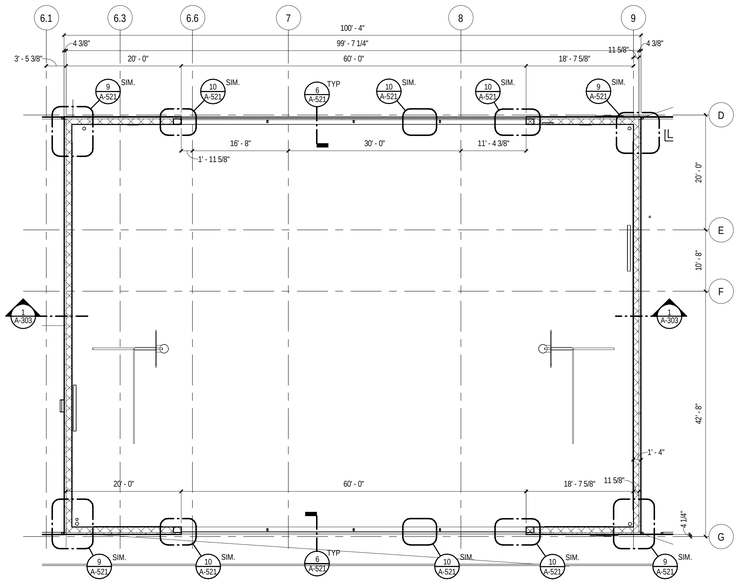
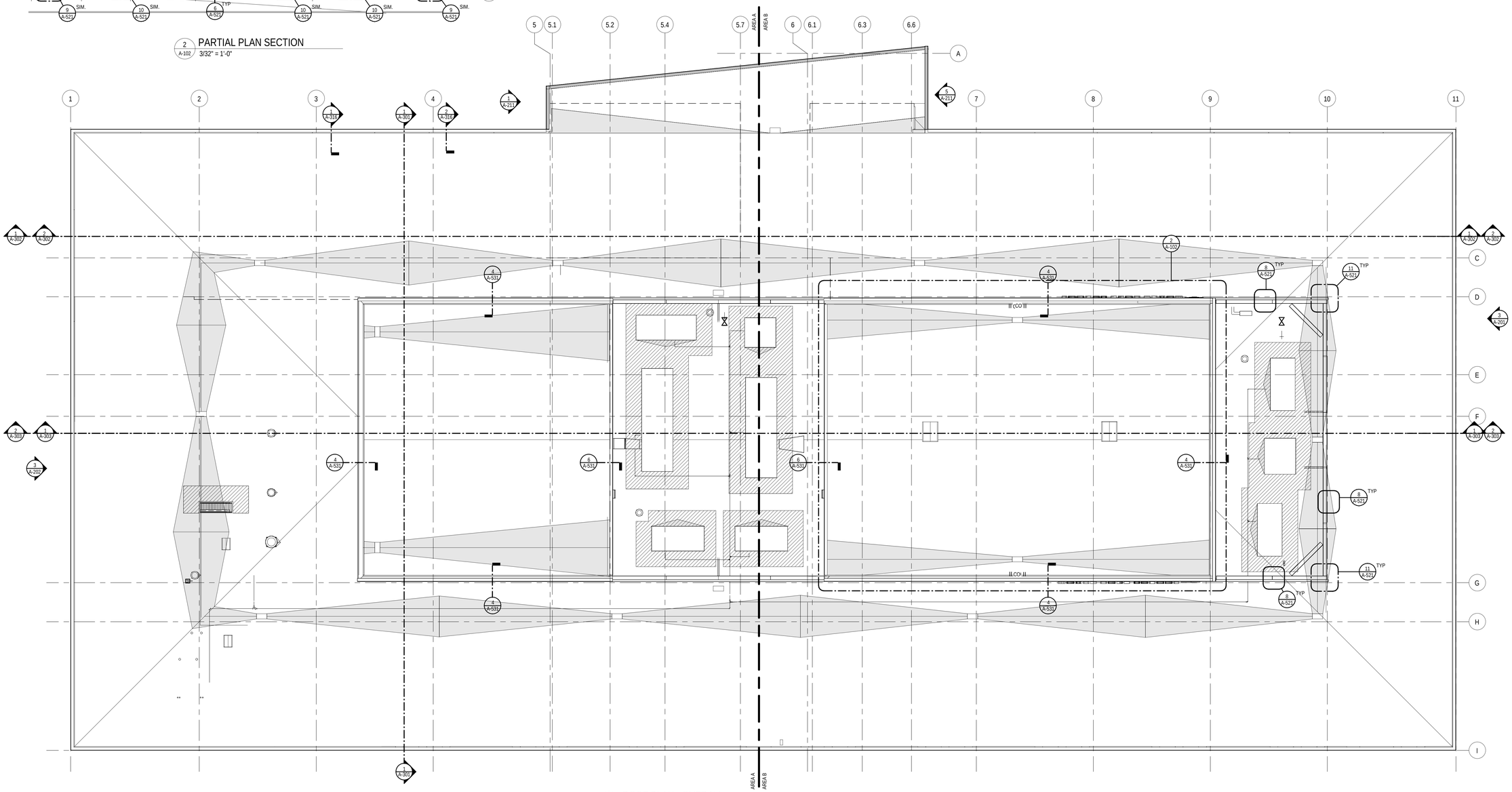


2 A-102 PARTIAL PLAN SECTION
3/32" = 1'-0"



ROOF PLAN - OVERALL
3/32" = 1'-0"

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WHITE

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ROOF PLAN

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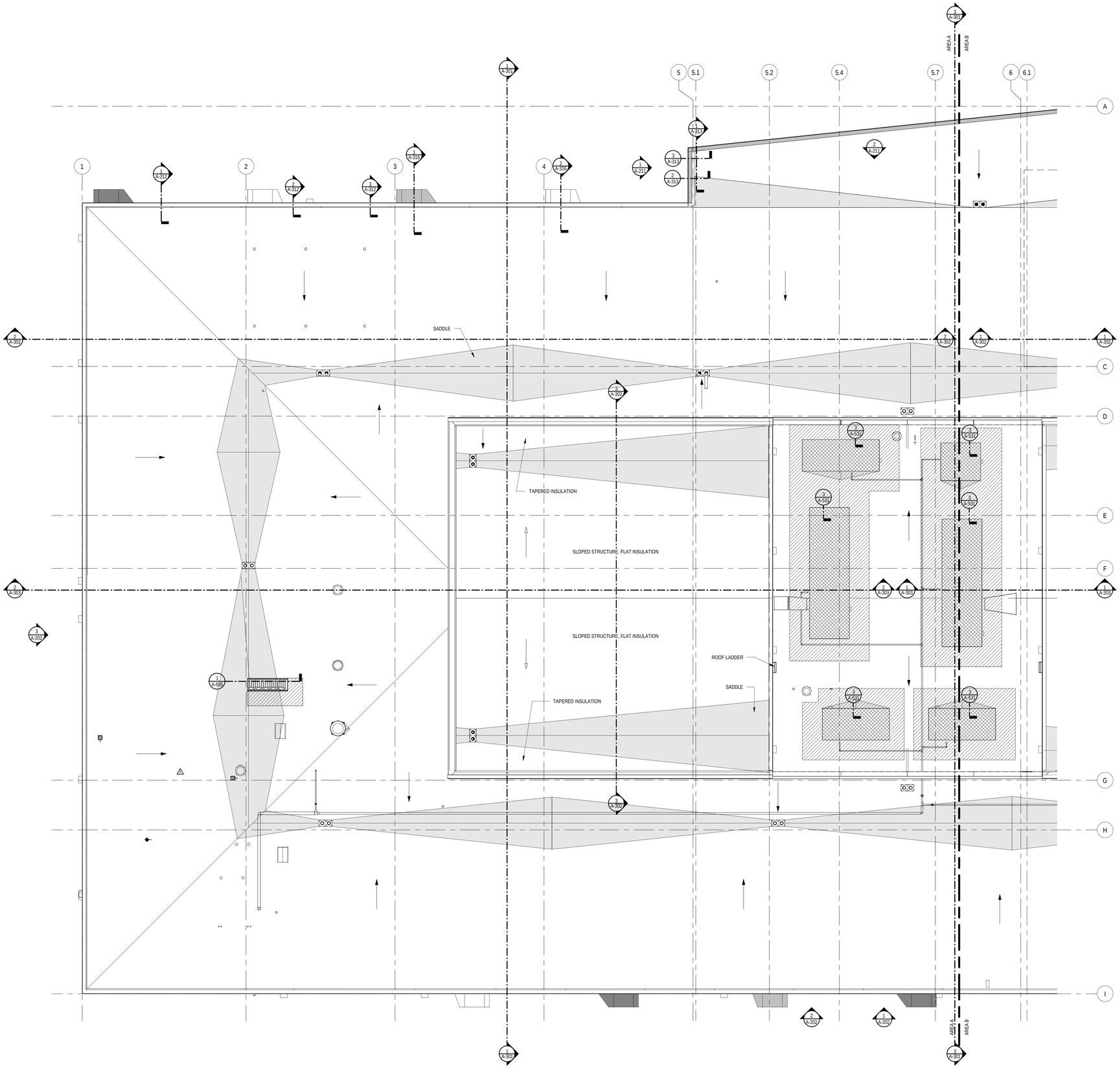
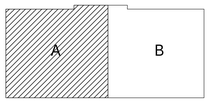


ROOF PLAN - AREA A
1/8" = 1'-0"

ROOF LEGEND

- TAPERED INSULATION ROOF SADDLES
- DENOTES REINF. MEMBRANE WALKWAY MATS - SEE SPECIFICATIONS.
- TAPERED INSULATION - ARROW INDICATES DIRECTION OF SLOPE.
- DENOTES MECHANICAL UNIT - SEE HVAC PLANS
- DENOTES EXHAUST FAN OR RELIEF VENT, SEE MECHANICAL PLANS FOR SPECIFICATIONS.
- EFFECTIVE DIRECTION OF ROOF SLOPE DUE TO STRUCTURE
- RD = ROOF DRAIN
- OD = OVERFLOW DRAIN
- SD = SCUPPER DRAIN
- CONDENSING UNIT

NOTE:
FINAL TAPERED INSULATION DESIGN IS THE RESPONSIBILITY OF ROOFER.



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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

ROOF PLAN - AREA A

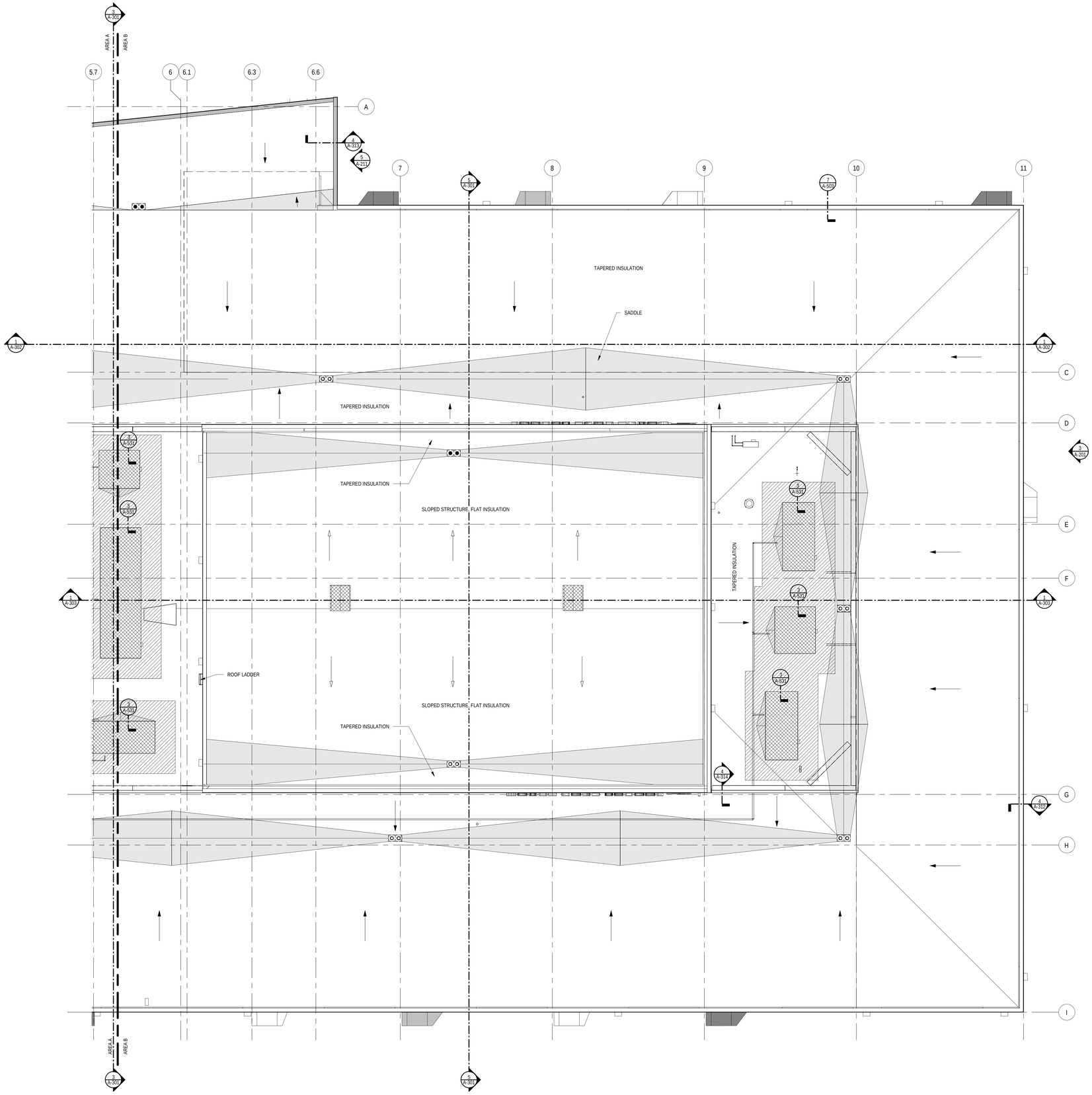
REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-102A

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
6/28/2023 12:29:36 PM
Autodesk Docs://220116_LSD - Mt HOPE/220116_A.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



ROOF PLAN - AREA B
1/8" = 1'-0"

ROOF LEGEND

- TAPERED INSULATION ROOF SADDLES
- DENOTES REINF. MEMBRANE WALKWAY MATS - SEE SPECIFICATIONS.
- TAPERED INSULATION - ARROW INDICATES DIRECTION OF SLOPE.
- DENOTES MECHANICAL UNIT - SEE HVAC PLANS
- DENOTES EXHAUST FAN OR RELIEF VENT, SEE MECHANICAL PLANS FOR SPECIFICATIONS.
- EFFECTIVE DIRECTION OF ROOF SLOPE DUE TO STRUCTURE
- RD = ROOF DRAIN
- OD = OVERFLOW DRAIN
- SD = SCUPPER DRAIN
- CONDENSING UNIT

NOTE:
FINAL TAPERED INSULATION DESIGN IS THE RESPONSIBILITY OF ROOFER.

KEY PLAN
NOT TO SCALE

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Mt. Hope
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ROOF PLAN - AREA B

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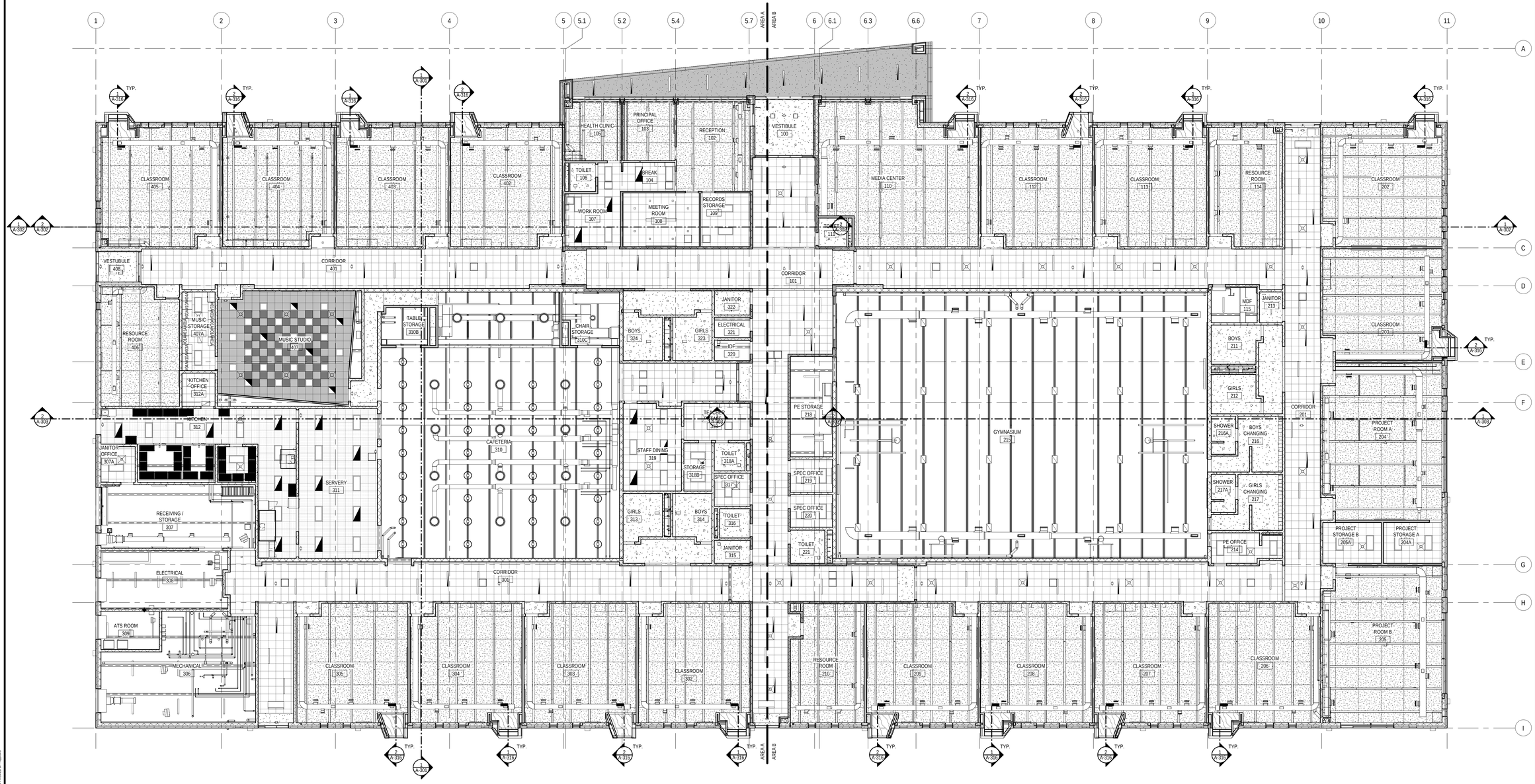

REFLECTED CEILING PLAN
3/32" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

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Mt. Hope
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REFLECTED CEILING PLAN - OVERALL

REVISIONS

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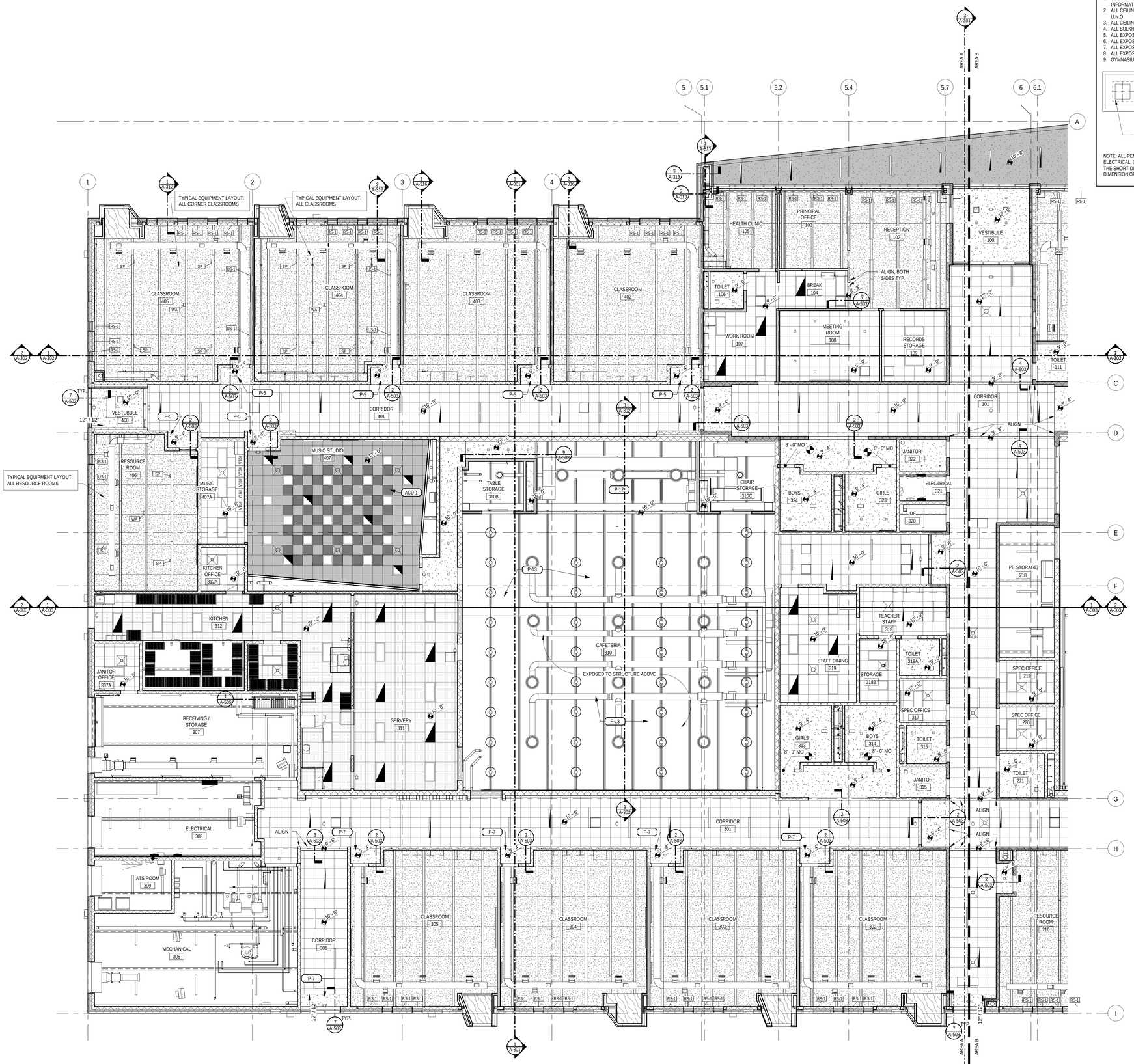
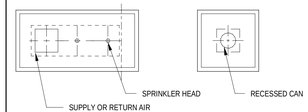


REFLECTED CEILING PLAN - AREA A
1/8" = 1'-0"

REFLECTED CEILING PLAN GENERAL NOTES:

1. SEE MECHANICAL & ELECTRICAL DRAWINGS FOR ADDITIONAL INFORMATION.
2. ALL CEILING GRIDS TO BE CENTERED IN THE SPACE(BOTH DIRECTIONS), U.N.O
3. ALL CEILING TO BE 10' - 0", U.N.O.
4. ALL BULKHEADS TO BE 9' - 8", U.N.O.
5. ALL EXPOSED FIRE SUPPRESSION TO BE PAINTED P-8.
6. ALL EXPOSED ELECTRICAL CONDUIT TO BE PAINTED P-8.
7. ALL EXPOSED HVAC TO BE PAINTED P-10 EXCEPT IN CLASSROOMS
8. ALL EXPOSED WATERLINES TO BE PAINTED P-11.
9. GYMNASIUM CEILING EXPOSED DUCTWORK TO BE PAINTED P-14.



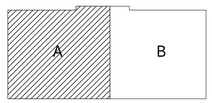
NOTE: ALL PENETRATIONS OF ACOUSTICAL CEILING PANELS , MECHANICAL, ELECTRICAL, OR FIRE SUPPRESSION COMPONENTS SHALL BE CENTERED IN THE SHORT DIMENSION AND BE CENTERED OR AT 1/4 POINTS IN THE LONG DIMENSION OF A PANEL AS INDICATED.

REFLECTED CEILING PLAN LEGEND:

- EXPOSED (P-1, U.N.O.)
- GYPSUM BOARD (P-1, U.N.O.)
- 2X2 ACOUSTIC CEILING PANEL (ACP-1)
- 2X2 WASHABLE ACOUSTIC CEILING PANEL (ACP-2)
- 2X2 HIGH NRC ACOUSTIC CEILING PANEL (ACP-3)
- 3" TECTUM DECK PAINTED P-15
- 5/8" EXTERIOR GYP SHEATHING
- WOOD VENEER
- CEILING HEIGHT- ABOVE FINISH FLOOR
- EX. CEILING HEIGHT- ABOVE FINISH FLOOR
- 2'x2' LIGHT FIXTURE
- 2'x4' LIGHT FIXTURE
- LINEAR LIGHT FIXTURE
- LINEAR PENDANT LIGHT FIXTURE
- 2'x4' RECESSED LIGHT FIXTURE
- CIRCULAR PENDANT LIGHT FIXTURE
- RECESSED ROUND/SQUARE LIGHT FIXTURE (EMERGENCY FIXTURES SHADED)
- SUPPLY DIFFUSER
- SUPPLY DIFFUSER
- LINEAR DIFFUSER
- TRANSFER GRILLE AND/OR EXHAUST FAN
- FIRE EXIT SIGN LOCATION
- S SPEAKER LOCATION (SEE ELECTRICAL COMMUNICATIONS)
- C CAMERA LOCATION (SEE ELECTRICAL COMMUNICATIONS)
- SPRINKLER LOCATION (SEE FIRE PROTECTION DRAWINGS)

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY	NOTES
BH-1	BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BH-2	SIDE FOLDING CEILING MOUNTED BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BKS	BASKETBALL BACKBOARD KEYSWITCH	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
CAB-1	Wenger Narrow Acoustic Cabinet #01 - Comp Grille Doors	Wenger Corporation	#01A	CONTRACTOR	CONTRACTOR	
CAB-2	Wenger Acoustic Cabinet #03 - Comp Grille Doors	Wenger Corporation	#03A	CONTRACTOR	CONTRACTOR	
CAB-3	Wenger Acoustic Cabinet #04 - Comp Grille Doors	Wenger Corporation	#04A	CONTRACTOR	CONTRACTOR	
CAB-4	Wenger Acoustic Cabinet #10 - Comp Grille Doors	Wenger Corporation	#10A	CONTRACTOR	CONTRACTOR	
CB	CALL BUTTON / AUDIO AMPLIFIER	--	--	CONTRACTOR	CONTRACTOR	--
CM	COFFEE MAKER	--	--	OWNER	OWNER	--
DO	ADA DOOR OPERATOR PUSH BUTTON	--	--	CONTRACTOR	CONTRACTOR	--
DW	DISHWASHER	--	--	CONTRACTOR	CONTRACTOR	--
LC-1	LAPTOP CART	--	--	OWNER	OWNER	--
LK1-C	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-5
LK1-D	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-4
LK-1A	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-7
LK-1B	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-2	LOCKER 12" x 12" x 3'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-3	LOCKER 12" x 12" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR	--
REF	REFRIGERATOR	--	--	CONTRACTOR	CONTRACTOR	--
RS-1	ROLLER SHADE	DRAPER	--	CONTRACTOR	CONTRACTOR	--
SB-1	SCOREBOARD	--	--	CONTRACTOR	CONTRACTOR	--
SP	SPEAKER	--	--	CONTRACTOR	CONTRACTOR	--
TCB	TELESCOPIC BLEACHERS	INTERKAL	MICHIGAN BLUE 25	CONTRACTOR	CONTRACTOR	--
TV-1	CLEVERTOUCH	--	--	CONTRACTOR	CONTRACTOR	
TV-2	86" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
TV-3	55" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
US-1	UNISTRUT	--	--	CONTRACTOR	CONTRACTOR	TO MATCH CEILING COLOR
WA	WIRELESS ACCESS POINT	--	--	CONTRACTOR	CONTRACTOR	--
WP-1	GYMNASIUM WALL PAD	DRAPER INC.	NAVY BLUE	CONTRACTOR	CONTRACTOR	--



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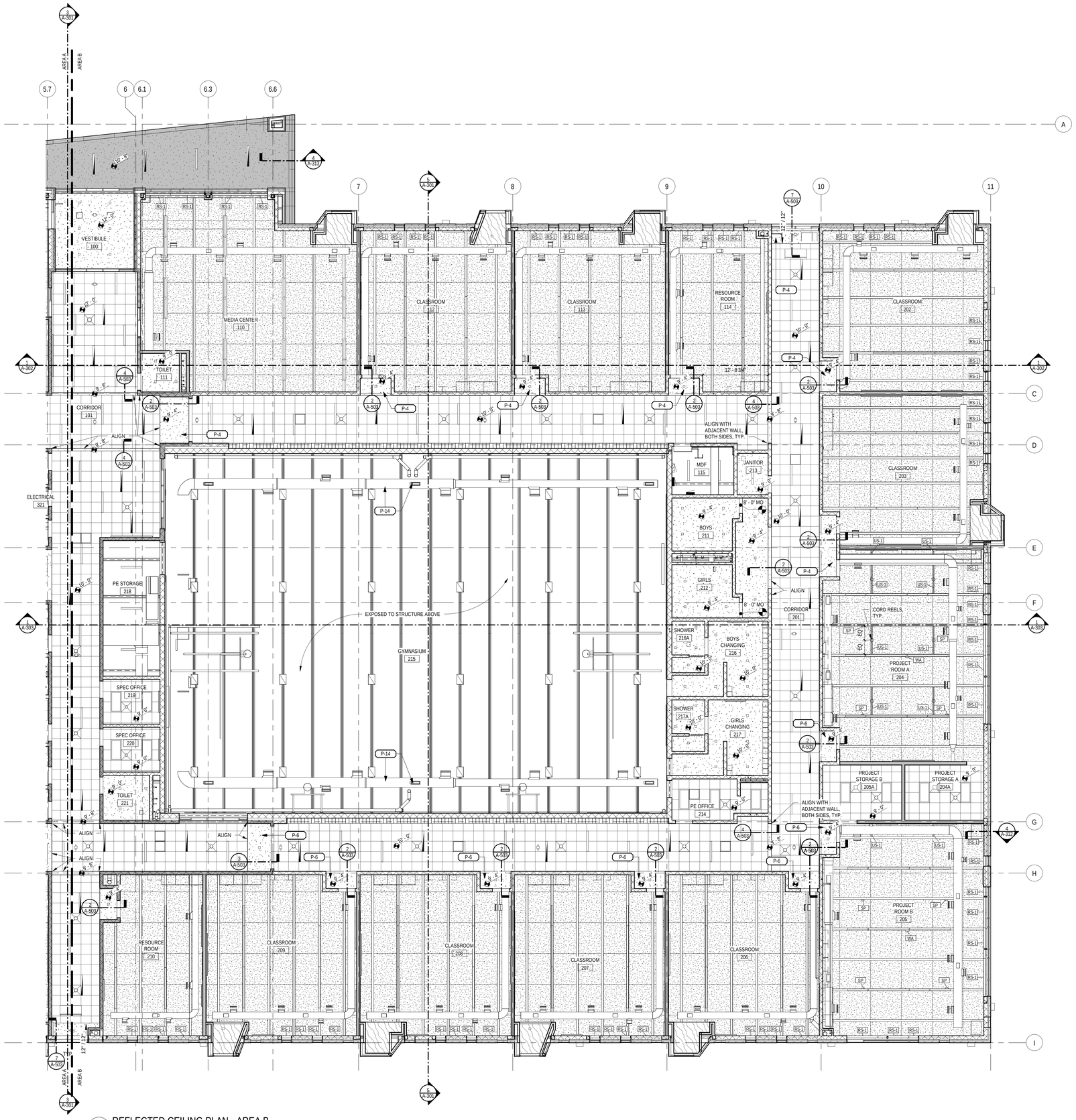

REFLECTED CEILING PLAN - AREA B
1/8" = 1'-0"

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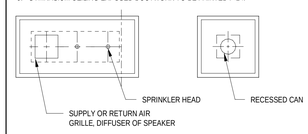

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- 2X2 HIGH NRC ACOUSTIC CEILING PANEL (ACP-3)
- 3" TECTUM DECK PAINTED P-15
- 5/8" EXTERIOR GYP SHEATHING
- WOOD VENEER
- X'-X" CEILING HEIGHT- ABOVE FINISH FLOOR
- X'-X" EX. CEILING HEIGHT- ABOVE FINISH FLOOR
- 2'x2' LIGHT FIXTURE
- 2'x4' LIGHT FIXTURE
- LINEAR LIGHT FIXTURE
- LINEAR PENDANT LIGHT FIXTURE
- 2'x4' RECESSED LIGHT FIXTURE
- CIRCULAR PENDANT LIGHT FIXTURE
- RECESSED ROUND/SQUARE LIGHT FIXTURE (EMERGENCY FIXTURES SHADED)
- SUPPLY DIFFUSER
- SUPPLY DIFFUSER
- LINEAR DIFFUSER
- TRANSFER GRILLE AND/OR EXHAUST FAN
- FIRE EXIT SIGN LOCATION
- S SPEAKER LOCATION (SEE ELECTRICAL COMMUNICATIONS)
- C CAMERA LOCATION (SEE ELECTRICAL COMMUNICATIONS)
- SPRINKLER LOCATION (SEE FIRE PROTECTION DRAWINGS)

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY	NOTES
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BH-2	SIDE FOLDING CEILING MOUNTED BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BKS	BASKETBALL BACKBOARD KEYSWITCH	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
CAB-1	Wenger Narrow Acoustic Cabinet #01 - Comp Grille Doors	Wenger Corporation	#01A	CONTRACTOR	CONTRACTOR	
CAB-2	Wenger Acoustic Cabinet #03 - Comp Grille Doors	Wenger Corporation	#03A	CONTRACTOR	CONTRACTOR	
CAB-3	Wenger Acoustic Cabinet #04 - Comp Grille Doors	Wenger Corporation	#04A	CONTRACTOR	CONTRACTOR	
CAB-4	Wenger Acoustic Cabinet #10 - Comp Grille Doors	Wenger Corporation	#10A	CONTRACTOR	CONTRACTOR	
CB	CALL BUTTON / AUDIO AMPLIFIER	--	--	CONTRACTOR	CONTRACTOR	--
CM	COFFEE MAKER	--	--	OWNER	OWNER	--
DO	ADA DOOR OPERATOR PUSH BUTTON	--	--	CONTRACTOR	CONTRACTOR	--
DW	DISHWASHER	--	--	CONTRACTOR	CONTRACTOR	--
LC-1	LAPTOP CART	--	--	OWNER	OWNER	--
LK1-C	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-5
LK1-D	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-4
LK-1A	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-7
LK-1B	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-2	LOCKER 12" x 12" x 3'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-3	LOCKER 12" x 12" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR	--
REF	REFRIGERATOR	--	--	CONTRACTOR	CONTRACTOR	--
RS-1	ROLLER SHADE	DRAPER	--	CONTRACTOR	CONTRACTOR	--
SB-1	SCOREBOARD	--	--	CONTRACTOR	CONTRACTOR	--
SP	SPEAKER	--	--	CONTRACTOR	CONTRACTOR	--
TCB	TELESCOPIC BLEACHERS	INTERKAL	MICHIGAN BLUE 25	CONTRACTOR	CONTRACTOR	--
TV-1	CLEVERTOUCH	--	--	CONTRACTOR	CONTRACTOR	
TV-2	86" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
TV-3	55" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
US-1	UNISTRUT	--	--	CONTRACTOR	CONTRACTOR	TO MATCH CEILING COLOR
WA	WIRELESS ACCESS POINT	--	--	CONTRACTOR	CONTRACTOR	--
WP-1	GYMNASIUM WALL PAD	DRAPER INC.	NAVY BLUE	CONTRACTOR	CONTRACTOR	--

KEY PLAN
NOT TO SCALE

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REFLECTED CEILING PLAN - AREA B

REVISIONS

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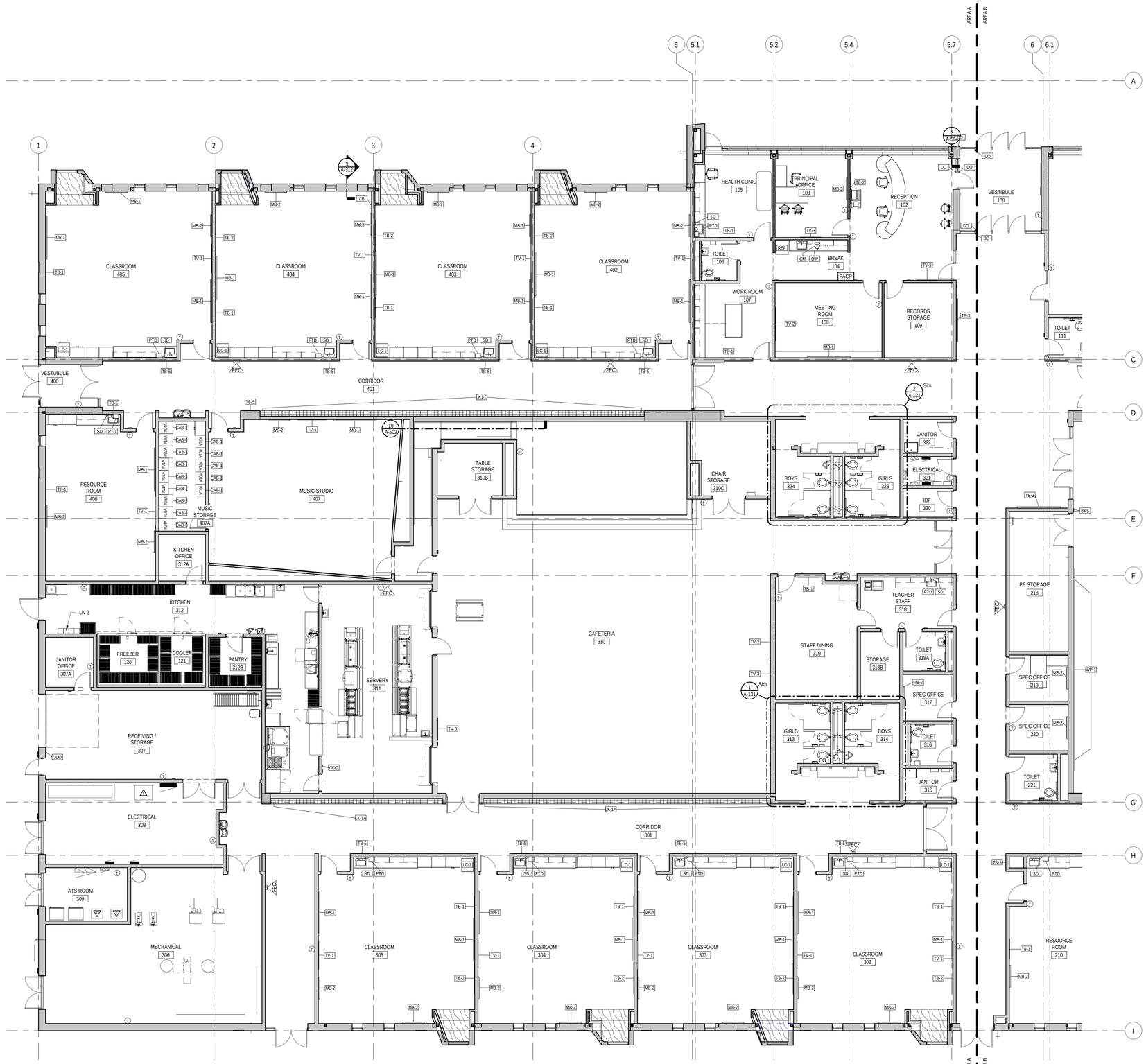

EQUIPMENT FLOOR PLAN - AREA A
1/8" = 1'-0"

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY	NOTES
BH-1	BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BH-2	SIDE FOLDING CEILING MOUNTED BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
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CAB-1	Wenger Narrow Acoustic Cabinet #01 - Comp Grille Doors	Wenger Corporation	#01A	CONTRACTOR	CONTRACTOR	
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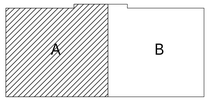
CAB-3	Wenger Acoustic Cabinet #04 - Comp Grille Doors	Wenger Corporation	#04A	CONTRACTOR	CONTRACTOR	
CAB-4	Wenger Acoustic Cabinet #10 - Comp Grille Doors	Wenger Corporation	#10A	CONTRACTOR	CONTRACTOR	
CB	CALL BUTTON / AUDIO AMPLIFIER	--	--	CONTRACTOR	CONTRACTOR	--
CM	COFFEE MAKER	--	--	OWNER	OWNER	--
DO	ADA DOOR OPERATOR PUSH BUTTON	--	--	CONTRACTOR	CONTRACTOR	--
DW	DISHWASHER	--	--	CONTRACTOR	CONTRACTOR	--
LC-1	LAPTOP CART	--	--	OWNER	OWNER	--
LK1-C	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-5
LK1-D	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-4
LK-1A	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-7
LK-1B	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-2	LOCKER 12" x 12" x 3'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-3	LOCKER 12" x 12" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR	--
REF	REFRIGERATOR	--	--	CONTRACTOR	CONTRACTOR	--
RS-1	ROLLER SHADE	DRAPER	--	CONTRACTOR	CONTRACTOR	--
SB-1	SCOREBOARD	--	--	CONTRACTOR	CONTRACTOR	--
SP	SPEAKER	--	--	CONTRACTOR	CONTRACTOR	--
TCB	TELESCOPIC BLEACHERS	INTERKAL	MICHIGAN BLUE 25	CONTRACTOR	CONTRACTOR	--
TV-1	CLEVERTOUCH	--	--	CONTRACTOR	CONTRACTOR	
TV-2	86" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
TV-3	55" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
US-1	UNISTRUT	--	--	CONTRACTOR	CONTRACTOR	TO MATCH CEILING COLOR
WA	WIRELESS ACCESS POINT	--	--	CONTRACTOR	CONTRACTOR	--
WP-1	GYMNASIUM WALL PAD	DRAPER INC.	NAVY BLUE	CONTRACTOR	CONTRACTOR	--

ACCESSORY SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY
GB1	36" GRAB BAR	BRADLEY	812-001-36	CONTRACTOR	CONTRACTOR
GB2	42" GRAB BAR	BRADLEY	812-001-42	CONTRACTOR	CONTRACTOR
GB3	18" GRAB BAR VERTICAL	BRADLEY	812-001-18	CONTRACTOR	CONTRACTOR
GB4	48" GRAB BAR	BRADLEY	812-001-48	CONTRACTOR	CONTRACTOR
GB5	18" GRAB BAR	BRADLEY	812-001-18	CONTRACTOR	CONTRACTOR
MB-1	MAGNETIC WHITE BOARD, 4' X 8'	--	--	CONTRACTOR	CONTRACTOR
MB-2	MAGNETIC WHITE BOARD, 4' X 4'	--	--	CONTRACTOR	CONTRACTOR
MB-3	MAGNETIC WHITE BOARD, 3' X 3'	--	--	CONTRACTOR	CONTRACTOR
MR-1	36" x 72" MIRROR	--	--	CONTRACTOR	CONTRACTOR
MR-2	24" X 36" MIRROR	--	--	CONTRACTOR	CONTRACTOR
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR
SCR	SHOWER CURTAIN & ROD	--	--	CONTRACTOR	CONTRACTOR
SD	SOAP DISPENSER	--	--	OWNER	CONTRACTOR
SND	SANITARY NAPKIN DISPOSAL	BRADLEY	4722-15	CONTRACTOR	CONTRACTOR
SS-1	SHOWER SEAT	--	--	CONTRACTOR	CONTRACTOR
TB-1	4' X '4 TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TB-2	6' X 4' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TB-3	4' x 8' BULLETIN BOARD CABINET (REFER TO MATERIAL SCHEDULE)	CLARIDGE	--	CONTRACTOR	CONTRACTOR
TB-5	4' X 3' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TR	WASTE RECEPTACLE - SQUARE	--	--	OWNER	OWNER
TTD	TOILET TISSUE DISPENSER	--	--	OWNER	CONTRACTOR

NOTE:
- SEE RCP FOR WINDOW SHADES
- MANUFACTURERS AS LISTED ARE CONSIDERED BASIS OF DESIGN



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EQUIPMENT PLAN - AREA A

REVISIONS

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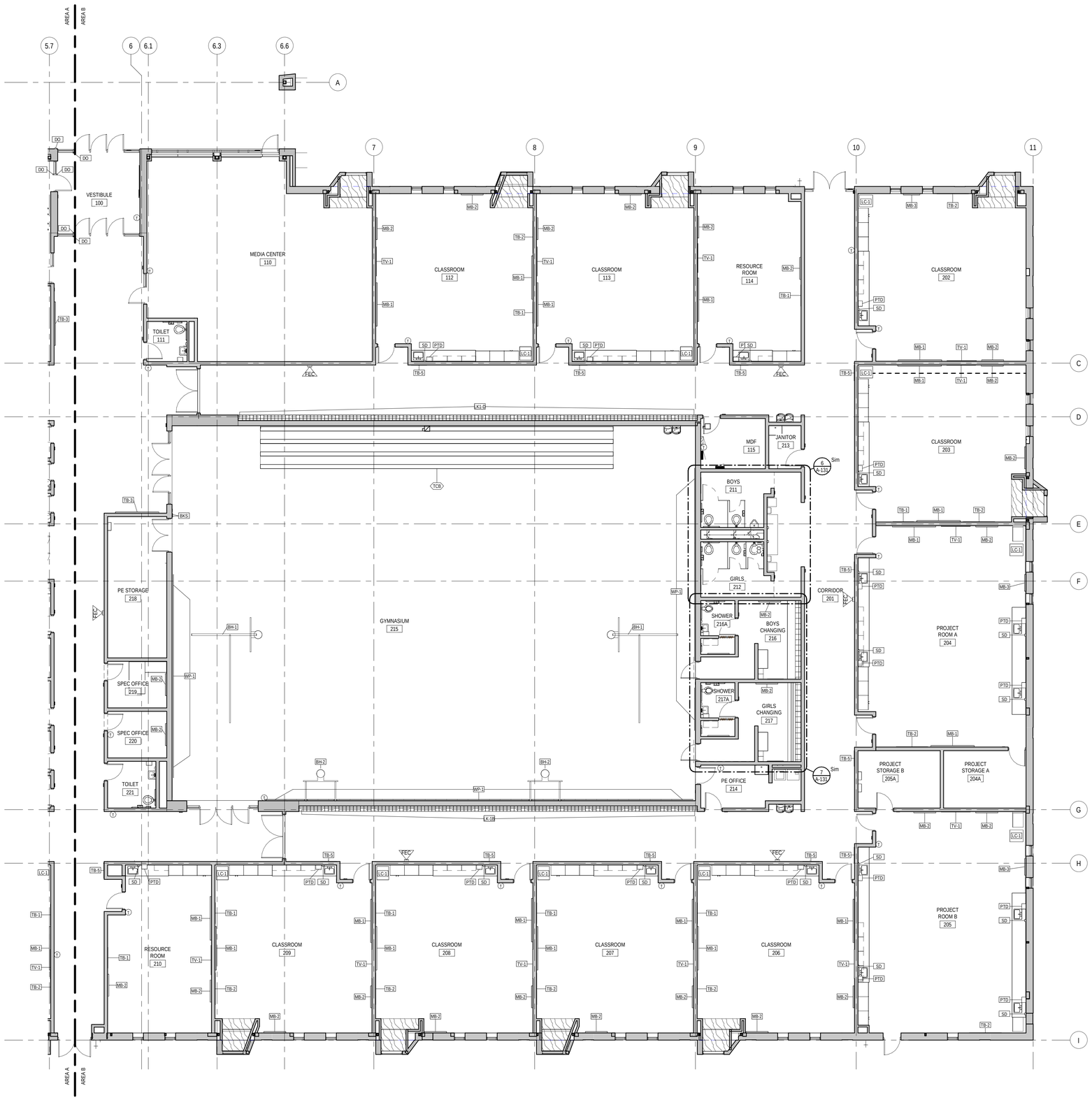
WHITE
WE RECYCLE



EQUIPMENT FLOOR PLAN - AREA B
1/8" = 1'-0"

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY	NOTES
BH-1	BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BH-2	SIDE FOLDING CEILING MOUNTED BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BKS	BASKETBALL BACKBOARD KEYSWITCH	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
CAB-1	Wenger Narrow Acoustic Cabinet #01 - Comp Grille Doors	Wenger Corporation	#01A	CONTRACTOR	CONTRACTOR	
CAB-2	Wenger Acoustic Cabinet #03 - Comp Grille Doors	Wenger Corporation	#03A	CONTRACTOR	CONTRACTOR	
CAB-3	Wenger Acoustic Cabinet #04 - Comp Grille Doors	Wenger Corporation	#04A	CONTRACTOR	CONTRACTOR	
CAB-4	Wenger Acoustic Cabinet #10 - Comp Grille Doors	Wenger Corporation	#10A	CONTRACTOR	CONTRACTOR	
CB	CALL BUTTON / AUDIO AMPLIFIER	--	--	CONTRACTOR	CONTRACTOR	--
CM	COFFEE MAKER	--	--	OWNER	OWNER	--
DO	ADA DOOR OPERATOR PUSH BUTTON	--	--	CONTRACTOR	CONTRACTOR	--
DW	DISHWASHER	--	--	CONTRACTOR	CONTRACTOR	--
LC-1	LAPTOP CART	--	--	OWNER	OWNER	--
LK1-C	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-5
LK1-D	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-4
LK-1A	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-7
LK-1B	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-2	LOCKER 12" x 12" x 3'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-3	LOCKER 12" x 12" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR	--
REF	REFRIGERATOR	--	--	CONTRACTOR	CONTRACTOR	--
RS-1	ROLLER SHADE	DRAPER	--	CONTRACTOR	CONTRACTOR	--
SB-1	SCOREBOARD	--	--	CONTRACTOR	CONTRACTOR	--
SP	SPEAKER	--	--	CONTRACTOR	CONTRACTOR	--
TCB	TELESCOPIC BLEACHERS	INTERKAL	MICHIGAN BLUE 25	CONTRACTOR	CONTRACTOR	--
TV-1	CLEVERTOUCH	--	--	CONTRACTOR	CONTRACTOR	
TV-2	86" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
TV-3	55" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
US-1	UNISTRUT	--	--	CONTRACTOR	CONTRACTOR	TO MATCH CEILING COLOR
WA	WIRELESS ACCESS POINT	--	--	CONTRACTOR	CONTRACTOR	--
WP-1	GYMNASIUM WALL PAD	DRAPER INC.	NAVY BLUE	CONTRACTOR	CONTRACTOR	--

ACCESSORY SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY
GB1	36" GRAB BAR	BRADLEY	812-001-36	CONTRACTOR	CONTRACTOR
GB2	42" GRAB BAR	BRADLEY	812-001-42	CONTRACTOR	CONTRACTOR
GB3	18" GRAB BAR VERTICAL	BRADLEY	812-001-18	CONTRACTOR	CONTRACTOR
GB4	48" GRAB BAR	BRADLEY	812-001-48	CONTRACTOR	CONTRACTOR
GB5	18" GRAB BAR	BRADLEY	812-001-18	CONTRACTOR	CONTRACTOR
MB-1	MAGNETIC WHITE BOARD, 4' X 8'	--	--	CONTRACTOR	CONTRACTOR
MB-2	MAGNETIC WHITE BOARD, 4' X 4'	--	--	CONTRACTOR	CONTRACTOR
MB-3	MAGNETIC WHITE BOARD, 3' X 3'	--	--	CONTRACTOR	CONTRACTOR
MR-1	36" x 72" MIRROR	--	--	CONTRACTOR	CONTRACTOR
MR-2	24" X 36" MIRROR	--	--	CONTRACTOR	CONTRACTOR
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR
SCR	SHOWER CURTAIN & ROD	--	--	CONTRACTOR	CONTRACTOR
SD	SOAP DISPENSER	--	--	OWNER	CONTRACTOR
SND	SANITARY NAPKIN DISPOSAL	BRADLEY	4722-15	CONTRACTOR	CONTRACTOR
SS-1	SHOWER SEAT	--	--	CONTRACTOR	CONTRACTOR
TB-1	4' X' 4 TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TB-2	6' X 4' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TB-3	4' x 8' BULLETIN BOARD CABINET (REFER TO MATERIAL SCHEDULE)	CLARIDGE	--	CONTRACTOR	CONTRACTOR
TB-5	4' X 3' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TR	WASTE RECEPTACLE - SQUARE	--	--	OWNER	OWNER
TTD	TOILET TISSUE DISPENSER	--	--	OWNER	CONTRACTOR

NOTE:
- SEE RCP FOR WINDOW SHADES
- MANUFACTURERS AS LISTED ARE CONSIDERED BASIS OF DESIGN

KEY PLAN
NOT TO SCALE

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E M Hope Ave, Lansing, MI 48910

EQUIPMENT PLAN - AREA B

REVISIONS

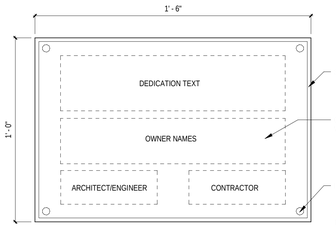
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-121B

100% CONSTRUCTION DOCUMENTS

THE BLACK BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/26/2023 12:30:47 PM
Autodesk Docs://220116_LSD - Mt HOPE/220116_A.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



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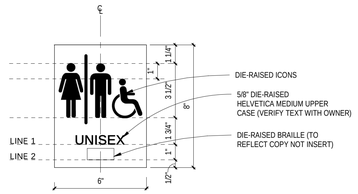

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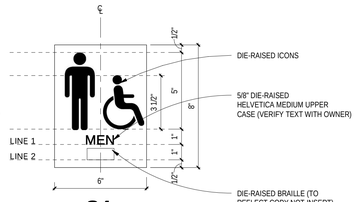

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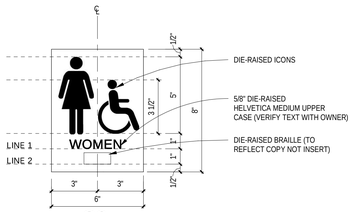

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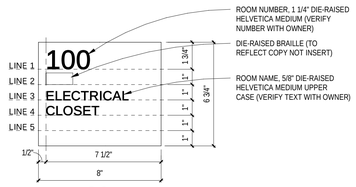

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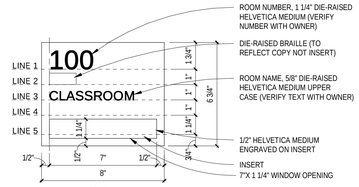
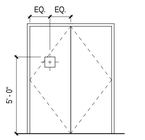
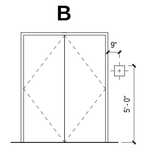


S1

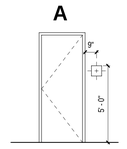
SIGN TYPES
3" = 1'-0"



NOTE: SIGN MUST BE MOUNTED TO THE INACTIVE LEAF



NOTE: SIGN MUST BE MOUNTED TO THE RIGHT OF THE RIGHT HAND DOOR

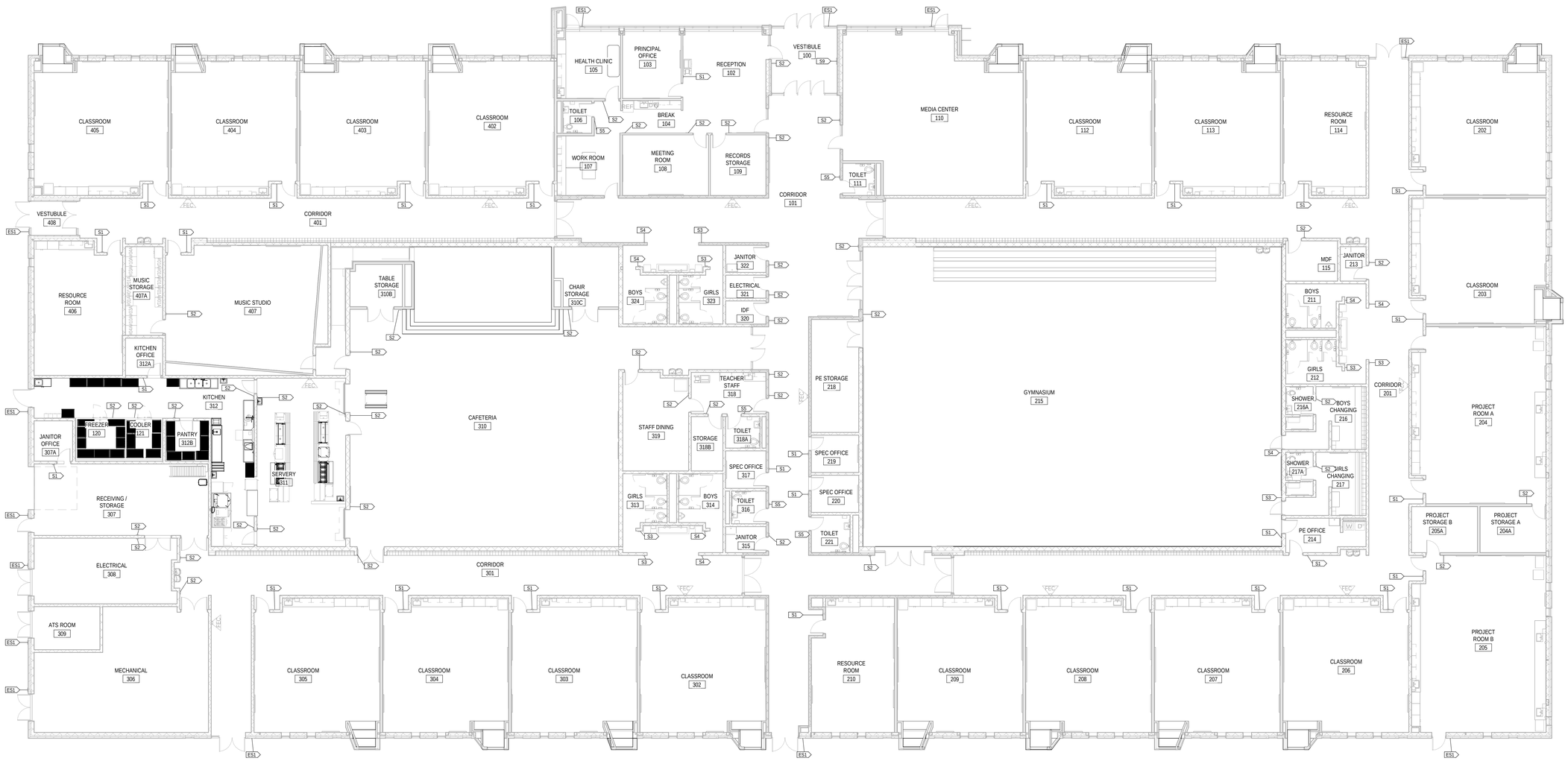


NOTE: SIGN MOUNTING TYPICAL TO DOOR LATCH SIDE

SIGN MOUNTING HEIGHTS
1/4" = 1'-0"

SIGNAGE SCHEDULE - INTERIOR			
TAG	TEXT: ROOM NAME	TEXT: ROOM NUMBER	MOUNTING
S1	CLASSROOM	402	A
S1	CLASSROOM	403	A
S1	CLASSROOM	404	A
S1	CLASSROOM	305	A
S1	CLASSROOM	304	A
S1	CLASSROOM	303	A
S1	CLASSROOM	302	A
S1	CLASSROOM	209	A
S1	CLASSROOM	208	A
S1	CLASSROOM	207	A
S1	CLASSROOM	206	A
S1	PROJECT ROOM B	205	A
S1	PROJECT ROOM A	204	A
S1	CLASSROOM	203	A
S1	CLASSROOM	202	A
S1	RESOURCE ROOM	210	A
S1	PRINCIPAL OFFICE	103	A
S1	CLASSROOM	405	A
S1	RESOURCE ROOM	406	A
S1	MUSIC STUDIO	407	A
S1	CLASSROOM	112	A
S1	CLASSROOM	113	A
S1	RESOURCE ROOM	114	A
S1	PE OFFICE	214	A
S1	PE OFFICE	214	A
S1	SPEC OFFICE	219	A
S1	SPEC OFFICE	220	A
S1	SPEC OFFICE	317	A
S1	JANITOR OFFICE	307A	A
S1	KITCHEN OFFICE	312A	A
S1: 30			
S2	RECORDS STORAGE	109	A
S2	MEETING ROOM	108	A
S2	WORK ROOM	107	A
S2	HEALTH CLINIC	105	A
S2	MDF	115	A
S2	JANITOR	213	A
S2	PROJECT STORAGE B	205A	A
S2	PROJECT STORAGE A	204A	A
S2	STAFF DINING	319	A
S2	TEACHER STAFF	318	A
S2	TEACHER STAFF	318	A
S2	STORAGE	318B	A
S2	SERVERY	311	E
S2	IDF	320	A
S2	ELECTRICAL	321	A
S2	JANITOR	322	A
S2	CHAIR STORAGE	310C	A
S2	SERVERY	311	A
S2	CAFETERIA PLATFORM	310A	A
S2	MUSIC STORAGE	407A	A
S2	ELECTRICAL	308	A
S2	RECEIVING / STORAGE	307	A
S2	FREEZER	120	A

SIGNAGE SCHEDULE - INTERIOR			
TAG	TEXT: ROOM NAME	TEXT: ROOM NUMBER	MOUNTING
S2	COOLER	121	A
S2	PANTRY	312B	A
S2	CAFETERIA	310	A
S2	KITCHEN	312	A
S2	SERVERY	311	A
S2	KITCHEN	312	A
S2	SERVERY	311	A
S2	TABLE STORAGE	310B	A
S2	SERVERY	311	A
S2	SHOWER	216A	A
S2	SHOWER	217A	A
S2	JANITOR	315	A
S2	ELECTRICAL	308	A
S2	ELECTRICAL	308	E
S2	MEDIA CENTER	110	A
S2	RECEPTION	102	A
S2	GYMNASIUM	215	A
S2	CORRIDOR	101	A
S2	CORRIDOR	101	A
S2	GYMNASIUM	215	A
S2	MUSIC STUDIO	407	A
S2	RECEPTION	102	A
S2: 45			
S3	CORRIDOR	101	A
S3	CORRIDOR	201	A
S3	GIRLS	212	A
S3	GIRLS	323	A
S3	CORRIDOR	301	A
S3	GIRLS	313	A
S3	GIRLS CHANGING	217	A
S3: 7			
S4	CORRIDOR	101	A
S4	CORRIDOR	201	A
S4	BOYS	211	A
S4	BOYS	324	A
S4	SHOWER	217A	A
S4	CORRIDOR	301	A
S4	BOYS	314	A
S4: 7			
S5	TOILET	106	A
S5	TOILET	111	A
S5	TOILET	221	A
S5	TOILET	318A	A
S5	TOILET	316	A
S5: 5			
S9	VESTIBULE	100	
S9: 1			



SIGNAGE PLAN
3/32" = 1'-0"

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LANSING SCHOOL DISTRICT
Mt. Hope
1219 E Mt Hope Ave, Lansing, MI 48910

INTERIOR SIGNAGE

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-122

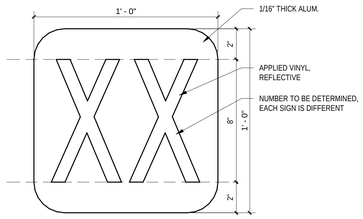
100% CONSTRUCTION DOCUMENTS

6/28/2023 12:31:01 PM
Autodesk Docs://220116_LSD - Mt HOPE/220116_A.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

SIGNAGE SCHEDULE - EXTERIOR					
TAG	TEXT: ROOM NAME	TEXT: ROOM NUMBER	MOUNTING	Description	NOTES
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1				SIGN 'EXIT'	
ES1: 13					

NOTE:

REFER TO SIGNAGE PLAN ON A-122 FOR EXTERIOR SIGNAGE LOCATIONS



ES1

NOTE:
SIGN TO BE MOUNTED OVER EXISTING PAINTED NUMBERS. WHEN MOUNTING ON GLASS, ELIMINATE ALUMINUM PANEL & ADHERE NUMBER DIRECTLY TO GLASS.

EXTERIOR SIGNAGE TYPE
3" = 1'-0"

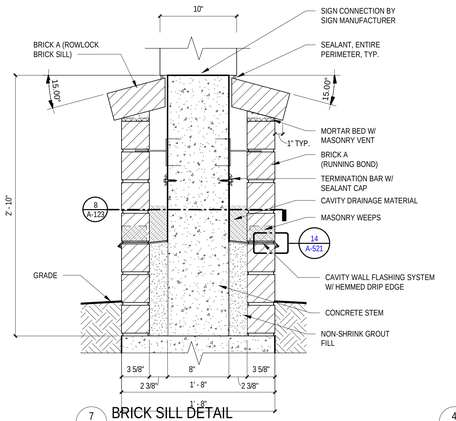
ES2

CONTRACTOR TO VERIFY WITH OWNER PRIOR TO FABRICATION.

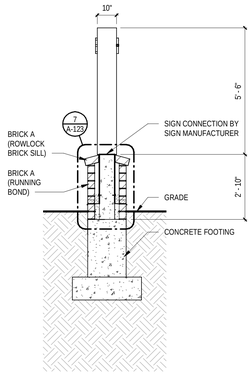
REFER TO ELEVATIONS FOR PLACEMENT

ES3

MT HOPE SIGNAGE LOGO
3/8" = 1'-0"

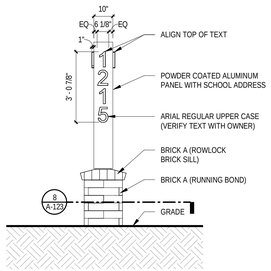


7 A-123 BRICK SILL DETAIL
1 1/2" = 1'-0"



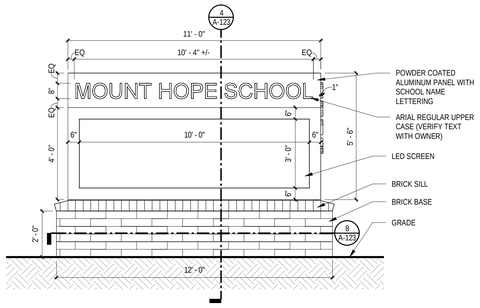
4 A-123 MONUMENT SIGN DETAIL SECTION
3/8" = 1'-0"

CONTRACTOR TO VERIFY WITH OWNER PRIOR TO FABRICATION

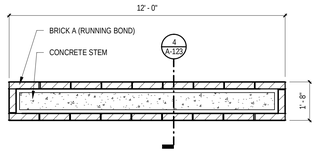


3 A-123 MONUMENT SIGN SIDE ELEVATION
3/8" = 1'-0"

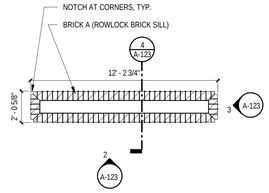
CONTRACTOR TO VERIFY WITH OWNER PRIOR TO FABRICATION



2 A-123 MONUMENT SIGN FRONT & BACK
3/8" = 1'-0"



8 A-123 LOWER MONUMENT SIGN PLAN DETAIL
3/8" = 1'-0"



1 UPPER MONUMENT SIGN PLAN DETAIL
1/4" = 1'-0"

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Mt. Hope
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EXTERIOR SIGNAGE

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116

DATE: 23-JUN-2023

SHEET

A-123

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
6/26/2023 8:42:31 AM
Autodesk Docs://220116_LSD - Mt HOPE/220116_A.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

EQUIPMENT SCHEDULE

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BH-2	SIDE FOLDING CEILING MOUNTED BASKETBALL BACKSTOP	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
BKS	BASKETBALL BACKBOARD KEYSWITCH	DRAPER INC.	--	CONTRACTOR	CONTRACTOR	--
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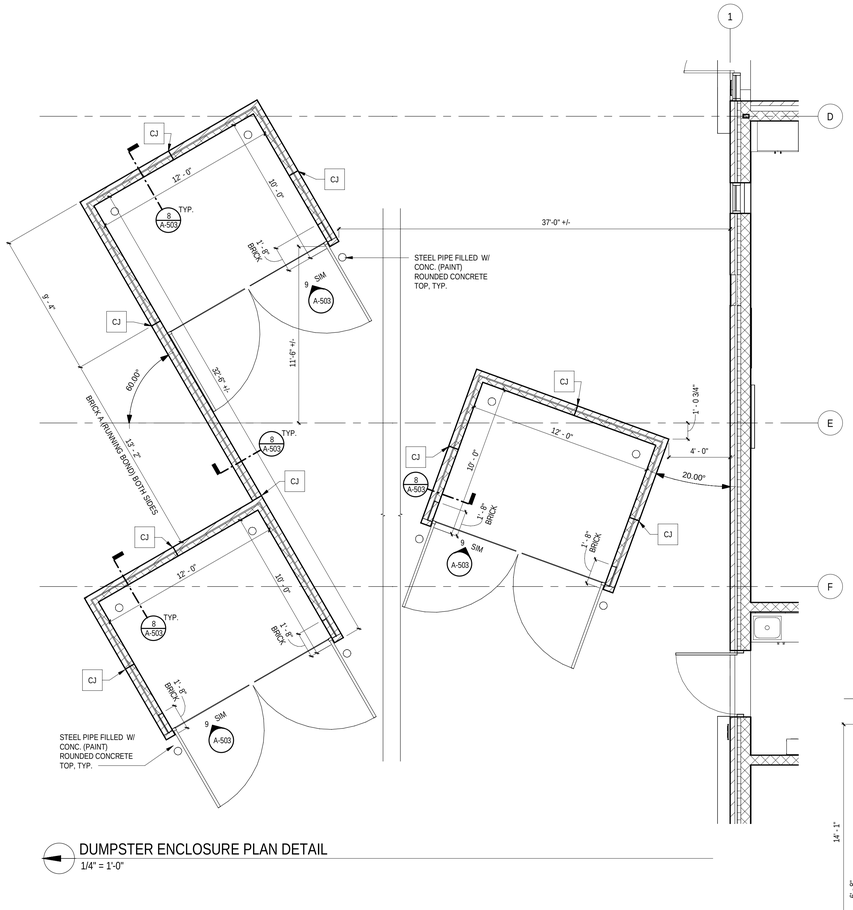
CAB-2	Wenger Acoustic Cabinet #03 - Comp Grille Doors	Wenger Corporation	#03A	CONTRACTOR	CONTRACTOR	
CAB-3	Wenger Acoustic Cabinet #04 - Comp Grille Doors	Wenger Corporation	#04A	CONTRACTOR	CONTRACTOR	
CAB-4	Wenger Acoustic Cabinet #10 - Comp Grille Doors	Wenger Corporation	#10A	CONTRACTOR	CONTRACTOR	
CB	CALL BUTTON / AUDIO AMPLIFIER	--	--	CONTRACTOR	CONTRACTOR	--
CM	COFFEE MAKER	--	--	OWNER	OWNER	--
DO	ADA DOOR OPERATOR PUSH BUTTON	--	--	CONTRACTOR	CONTRACTOR	--
DW	DISHWASHER	--	--	CONTRACTOR	CONTRACTOR	--
LC-1	LAPTOP CART	--	--	OWNER	OWNER	--
LK1-C	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-5
LK1-D	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-4
LK-1A	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-7
LK-1B	LOCKER 12" x 8" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-2	LOCKER 12" x 12" x 3'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
LK-3	LOCKER 12" x 12" x 6'-0"	--	--	CONTRACTOR	CONTRACTOR	TO MATCH COLOR P-6
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR	--
REF	REFRIGERATOR	--	--	CONTRACTOR	CONTRACTOR	--
RS-1	ROLLER SHADE	DRAPER	--	CONTRACTOR	CONTRACTOR	--
SB-1	SCOREBOARD	--	--	CONTRACTOR	CONTRACTOR	--
SP	SPEAKER	--	--	CONTRACTOR	CONTRACTOR	--
TCB	TELESCOPIC BLEACHERS	INTERKAL	MICHIGAN BLUE 25	CONTRACTOR	CONTRACTOR	--
TV-1	CLEVERTOUCH	--	--	CONTRACTOR	CONTRACTOR	
TV-2	86" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
TV-3	55" TELEVISION	--	--	CONTRACTOR	CONTRACTOR	
US-1	UNISTRUT	--	--	CONTRACTOR	CONTRACTOR	TO MATCH CEILING COLOR
WA	WIRELESS ACCESS POINT	--	--	CONTRACTOR	CONTRACTOR	
WP-1	GYMNASIUM WALL PAD	DRAPER INC.	NAVY BLUE	CONTRACTOR	CONTRACTOR	--

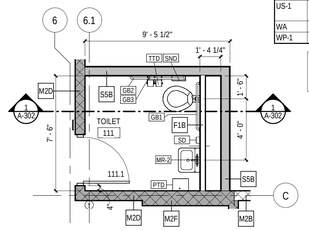
NOTE:
- SEE RCP FOR WINDOW SHADES
- MANUFACTURERS AS LISTED ARE CONSIDERED BASIS OF DESIGN

ACCESSORY SCHEDULE

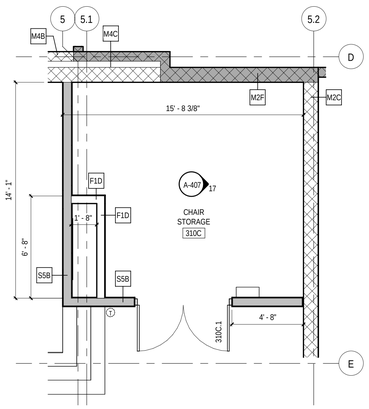
TAG	DESCRIPTION	MANUFACTURER	MODEL	SUPPLIED BY	INSTALLED BY
GB1	36" GRAB BAR	BRADLEY	812-001-36	CONTRACTOR	CONTRACTOR
GB2	42" GRAB BAR	BRADLEY	812-001-42	CONTRACTOR	CONTRACTOR
GB3	18" GRAB BAR VERTICAL	BRADLEY	812-001-18	CONTRACTOR	CONTRACTOR
GB4	48" GRAB BAR	BRADLEY	812-001-48	CONTRACTOR	CONTRACTOR
GB5	18" GRAB BAR	BRADLEY	812-001-18	CONTRACTOR	CONTRACTOR
MB-1	MAGNETIC WHITE BOARD, 4' X 8'	--	--	CONTRACTOR	CONTRACTOR
MB-2	MAGNETIC WHITE BOARD, 4' X 4'	--	--	CONTRACTOR	CONTRACTOR
MB-3	MAGNETIC WHITE BOARD, 3' X 3'	--	--	CONTRACTOR	CONTRACTOR
MR-1	36" x 72" MIRROR	--	--	CONTRACTOR	CONTRACTOR
MR-2	24" X 36" MIRROR	--	--	CONTRACTOR	CONTRACTOR
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR
SCR	SHOWER CURTAIN & ROD	--	--	CONTRACTOR	CONTRACTOR
SD	SOAP DISPENSER	--	--	OWNER	CONTRACTOR
SND	SANITARY NAPKIN DISPOSAL	BRADLEY	4722-15	CONTRACTOR	CONTRACTOR
SS-1	SHOWER SEAT	--	--	CONTRACTOR	CONTRACTOR
TB-1	4' X 4' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TB-2	6' X 4' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TB-3	4' x 8' BULLETIN BOARD CABINET (REFER TO MATERIAL SCHEDULE)	CLARIDGE	--	CONTRACTOR	CONTRACTOR
TB-5	4' X 3' TACK BOARD (REFER TO MATERIAL SCHEDULE)	--	--	CONTRACTOR	CONTRACTOR
TR	WASTE RECEPTACLE - SQUARE	--	--	OWNER	OWNER
TTD	TOILET TISSUE DISPENSER	--	--	OWNER	CONTRACTOR



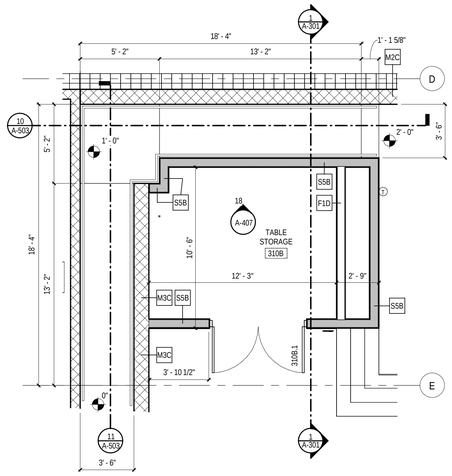
DUMPSTER ENCLOSURE PLAN DETAIL
1/4" = 1'-0"



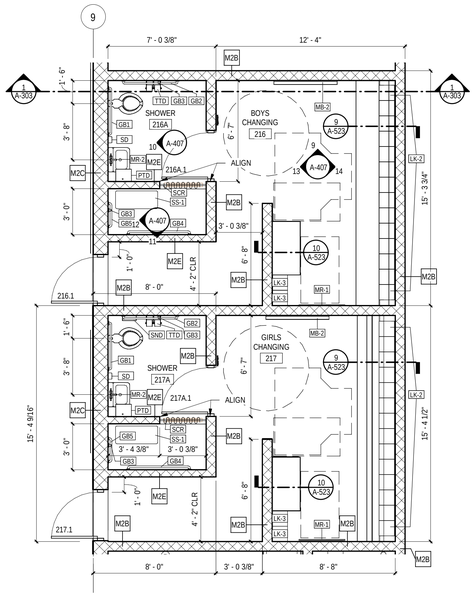
8 A-101A AREA B - TOILET ROOM
1/4" = 1'-0"



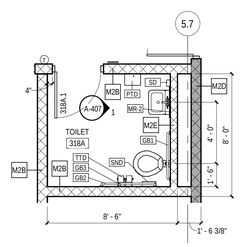
11 A-101A AREA A - PLATFORM STORAGE
1/4" = 1'-0"



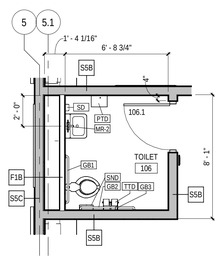
9 A-101A AREA A - PLATFORM STORAGE & RAMP
1/4" = 1'-0"



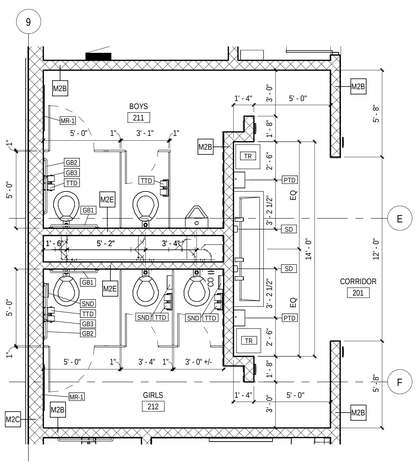
7 A-101B AREA B - LOCKER ROOMS
1/4" = 1'-0"



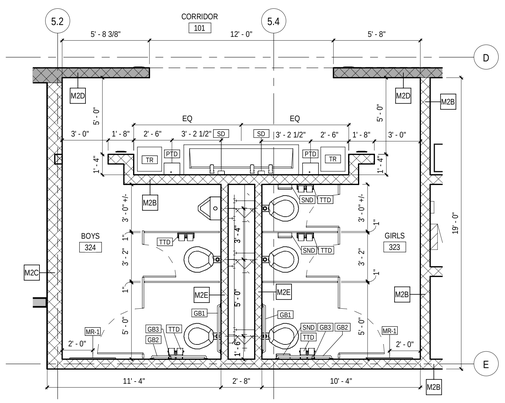
4 A-101A AREA A - SINGLE TOILET 318A
1/4" = 1'-0"



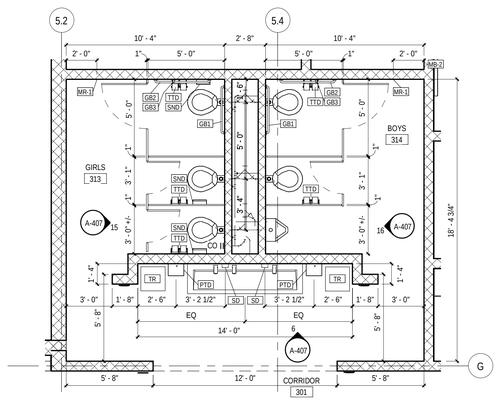
3 A-101A AREA A - TOILET ROOM
1/4" = 1'-0"



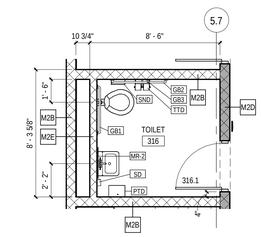
6 A-101B AREA B - GROUP TOILET ROOMS
1/4" = 1'-0"



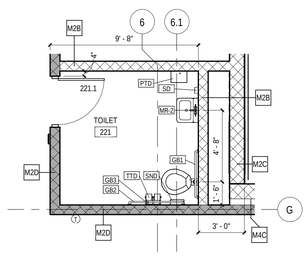
2 A-101A AREA A - ENTRY GROUP TOILET ROOMS
1/4" = 1'-0"



1 A-101A AREA A - GROUP TOILET ROOMS
1/4" = 1'-0"



5 A-101A AREA A - SINGLE TOILET 316
1/4" = 1'-0"



12 A-101A AREA B - TOILET ROOM 221
1/4" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

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ENLARGED FLOOR PLANS

REVISIONS

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SHEET
A-131

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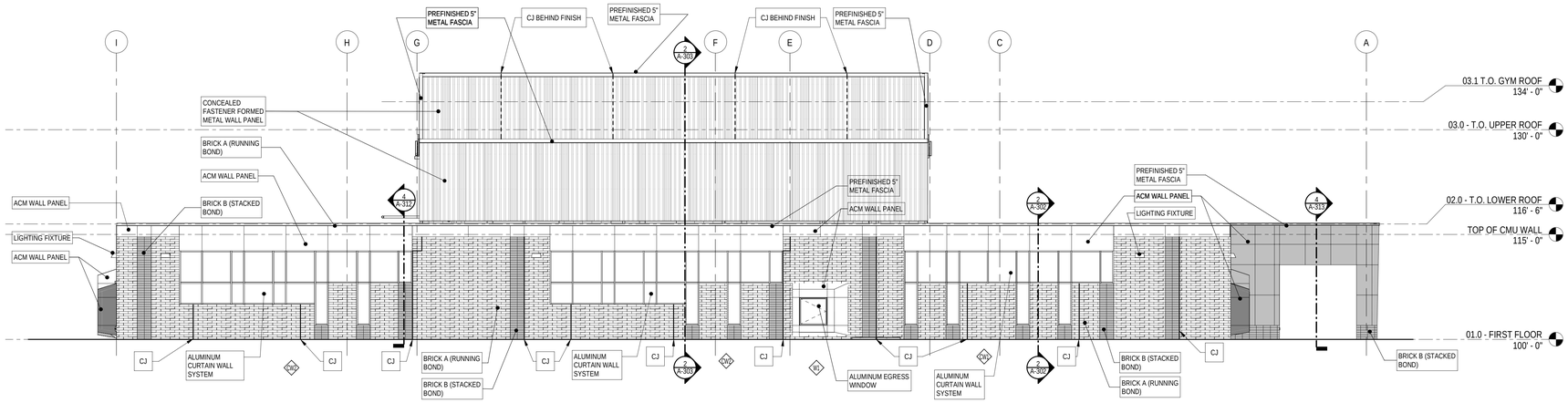
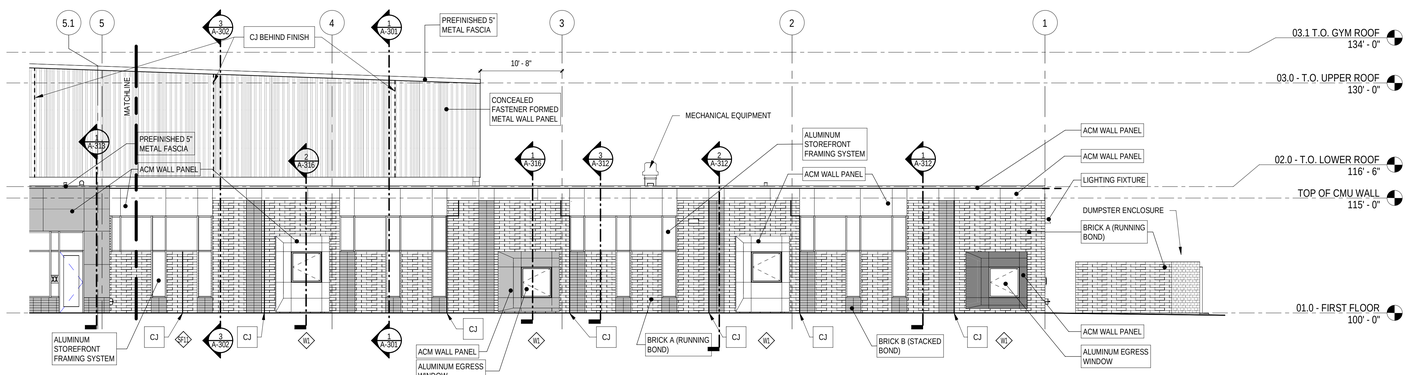


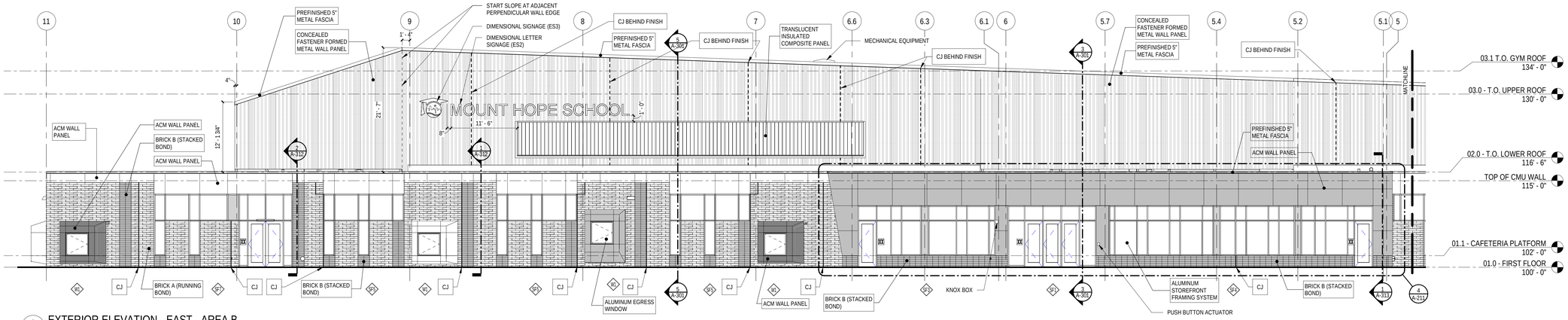
3 A-101 EXTERIOR ELEVATION - SOUTH - AREA B
1/8" = 1'-0"

EXTERIOR ELEVATION LEGEND:

- BRICK A (MONARCH SIZE, 1/2 RUNNING BOND PATTERN)
- BRICK B (UTILITY SIZE, STACKED BOND PATTERN)
- METAL CONCEALED FASTENER PANEL
- ACM WALL PANEL A
- ACM WALL PANEL B
- ACM WALL PANEL C (READING NOOKS)
- ACM WALL PANEL D (READING NOOKS)
- ACM WALL PANEL E (READING NOOKS)



2 A-101 EXTERIOR ELEVATION - EAST CONTINUED - AREA A
1/8" = 1'-0"



1 A-101 EXTERIOR ELEVATION - EAST - AREA B
1/8" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

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EXTERIOR ELEVATIONS

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SHEET
A-201

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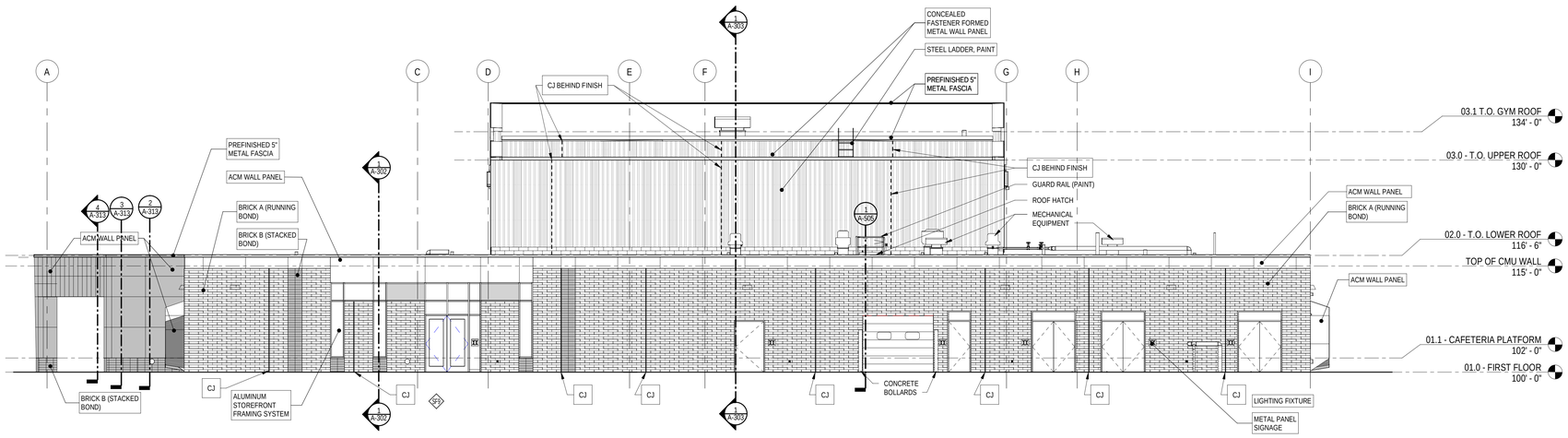
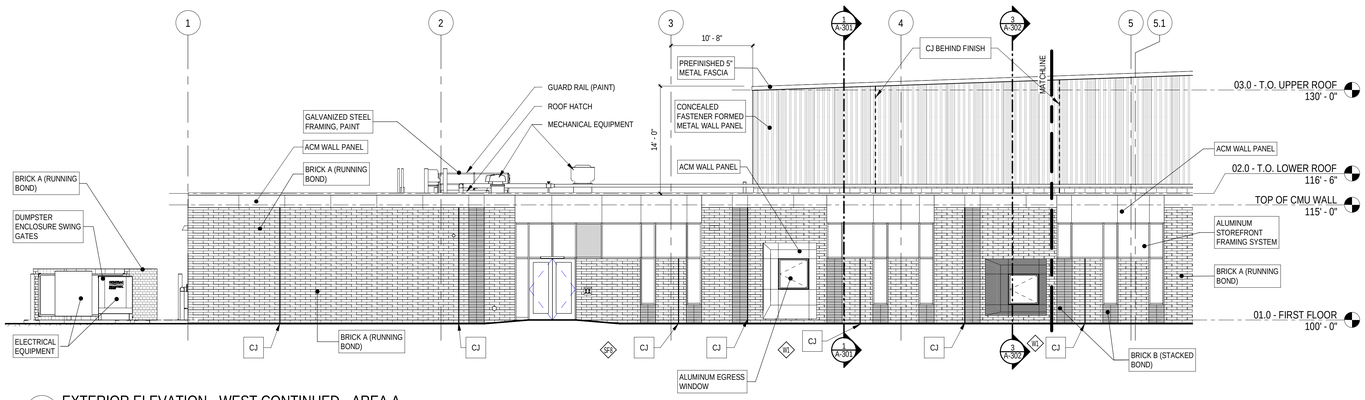


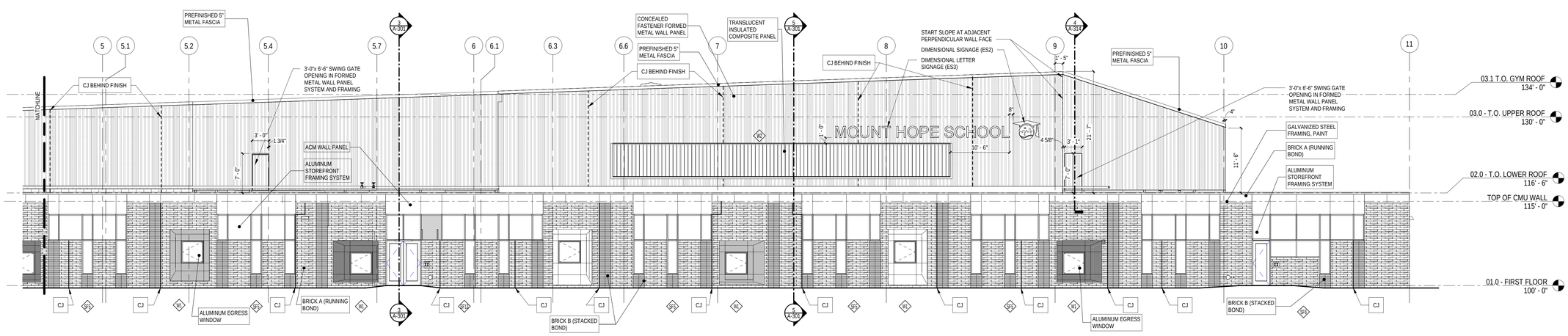
3 A-101 EXTERIOR ELEVATION - NORTH - AREA A
1/8" = 1'-0"

EXTERIOR ELEVATION LEGEND:

- BRICK A (MONARCH SIZE, 1/2 RUNNING BOND PATTERN)
- BRICK B (UTILITY SIZE, STACKED BOND PATTERN)
- METAL CONCEALED FASTENER PANEL
- ACM WALL PANEL A
- ACM WALL PANEL B
- ACM WALL PANEL C (READING NOOKS)
- ACM WALL PANEL D (READING NOOKS)
- ACM WALL PANEL E (READING NOOKS)



2 A-101 EXTERIOR ELEVATION - WEST CONTINUED - AREA A
1/8" = 1'-0"



1 A-101 EXTERIOR ELEVATION - WEST - AREA B
1/8" = 1'-0"

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EXTERIOR ELEVATIONS

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SHEET
A-202

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WHITE
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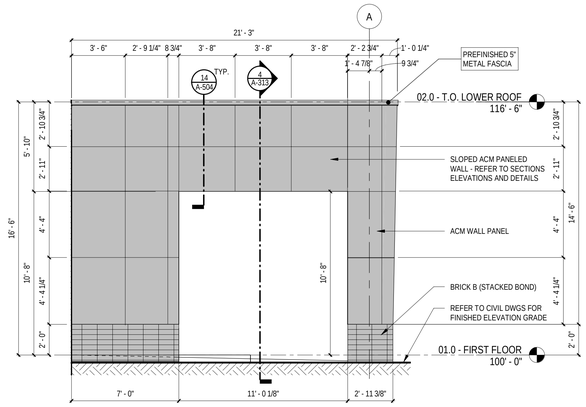
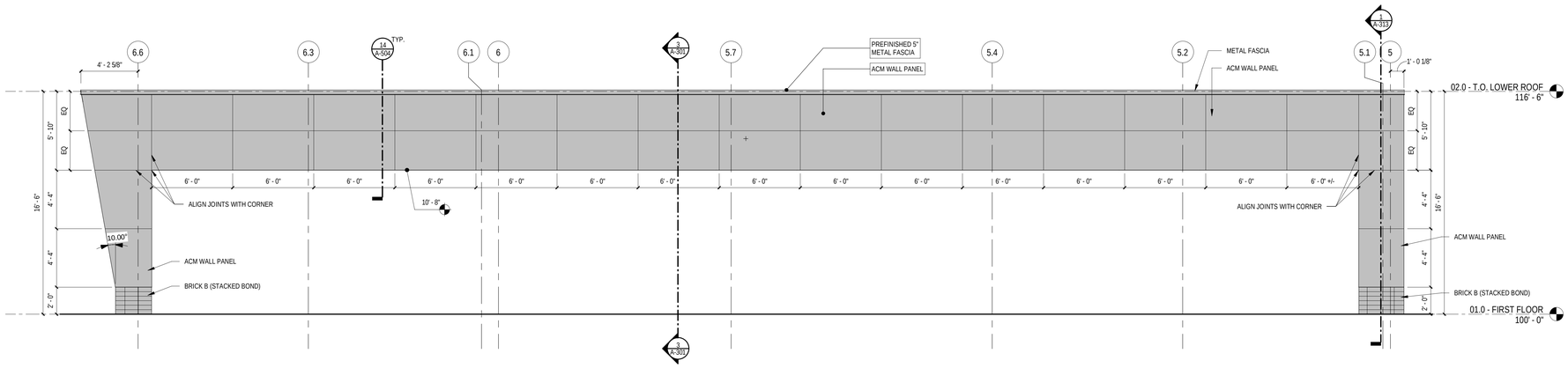
EXTERIOR ELEVATION LEGEND:

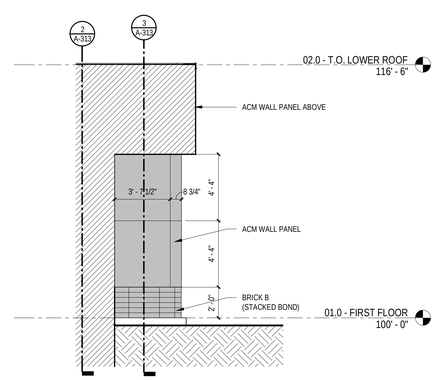
- BRICK A (MONARCH SIZE, 1/2 RUNNING BOND PATTERN)
- BRICK B (UTILITY SIZE, STACKED BOND PATTERN)
- METAL CONCEALED FASTENER PANEL
- ACM WALL PANEL A
- ACM WALL PANEL B
- ACM WALL PANEL C (READING NOOKS)
- ACM WALL PANEL D (READING NOOKS)
- ACM WALL PANEL E (READING NOOKS)



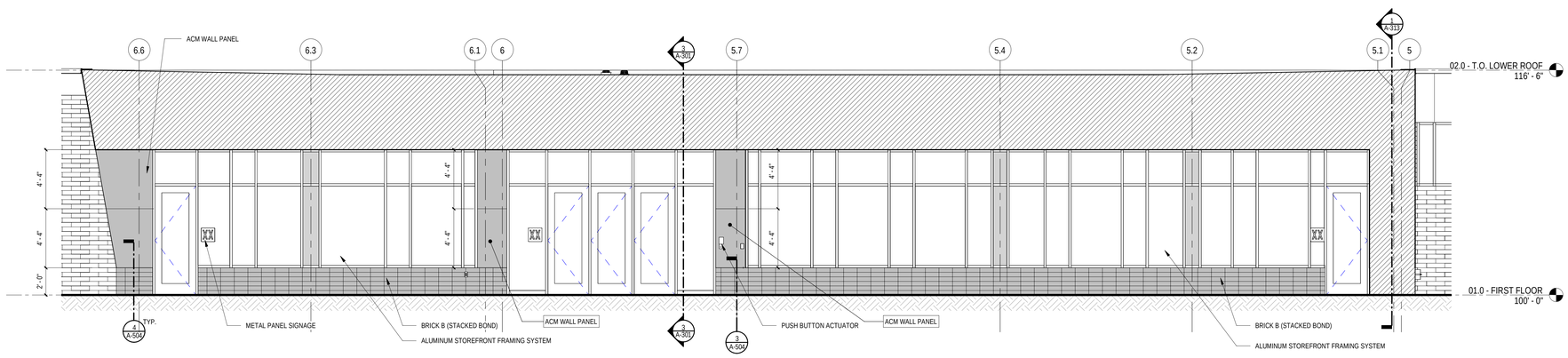
5 A-101 EXTERIOR FRONT ENTRY- SOUTH ELEVATION - DETAIL
1/4" = 1'-0"



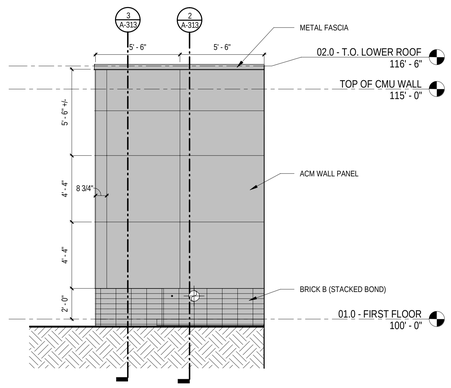
4 A-201 EXTERIOR FRONT ENTRY- EAST ELEVATION - DETAIL
1/4" = 1'-0"



3 A-101 EXTERIOR FRONT ENTRY- SOUTH ELEVATION - DETAIL
1/4" = 1'-0"



2 A-101 EXTERIOR FRONT ENTRY- EAST ELEVATION - DETAIL B
1/4" = 1'-0"



1 A-101 EXTERIOR FRONT ENTRY- NORTH ELEVATION - DETAIL
1/4" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

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CANOPY ELEVATION DETAILS

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SHEET
A-211

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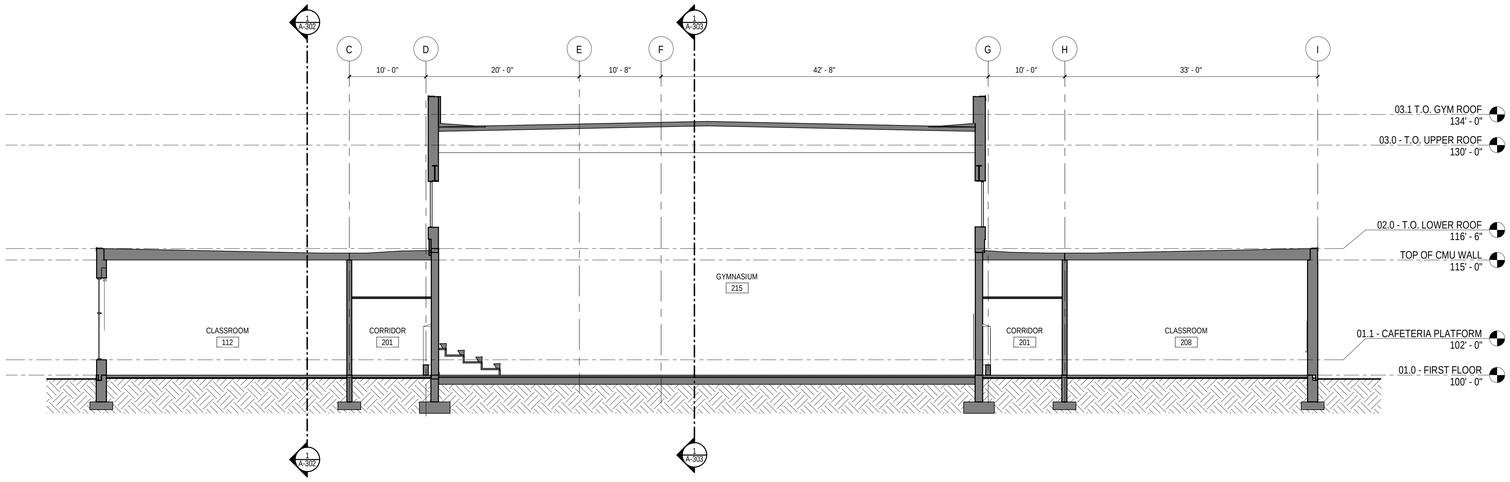
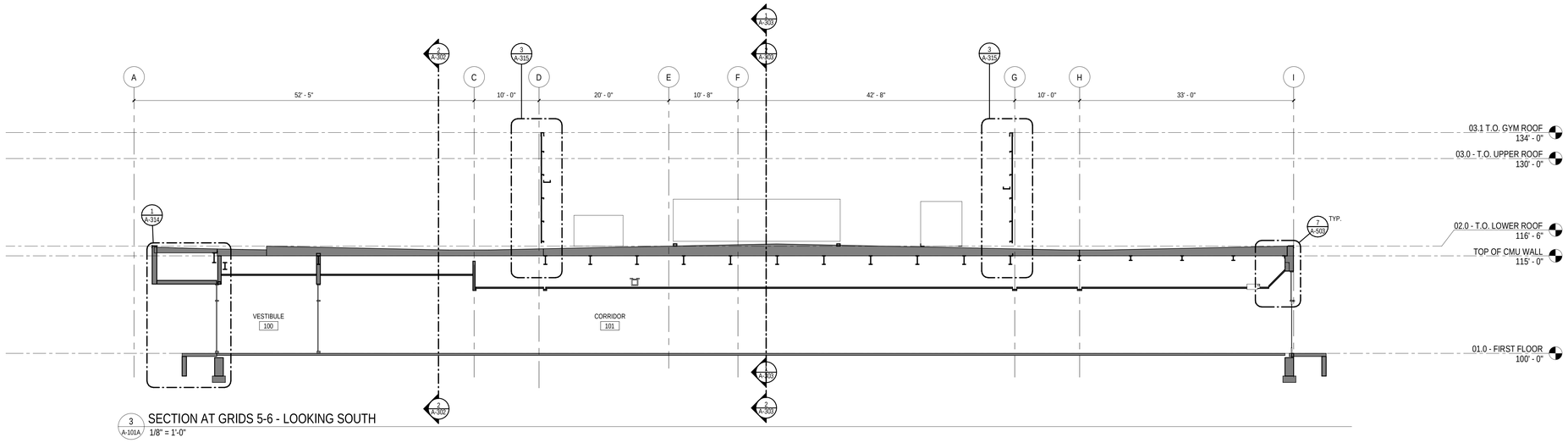
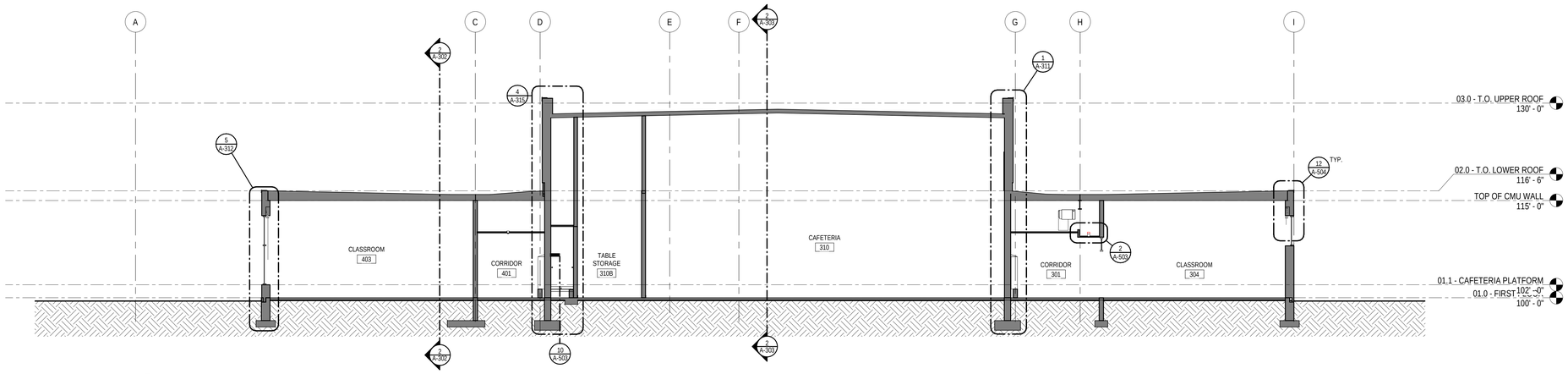


5 A-101B SECTION BETWEEN GRIDS 7-8 - LOOKING SOUTH
1/8" = 1'-0"



3 A-101A SECTION AT GRIDS 5-6 - LOOKING SOUTH
1/8" = 1'-0"



1 A-101 SECTION AT GRIDS 3-4 - LOOKING SOUTH
1/8" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK.
WHITE

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BUILDING SECTIONS

REVISIONS

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SHEET
A-301

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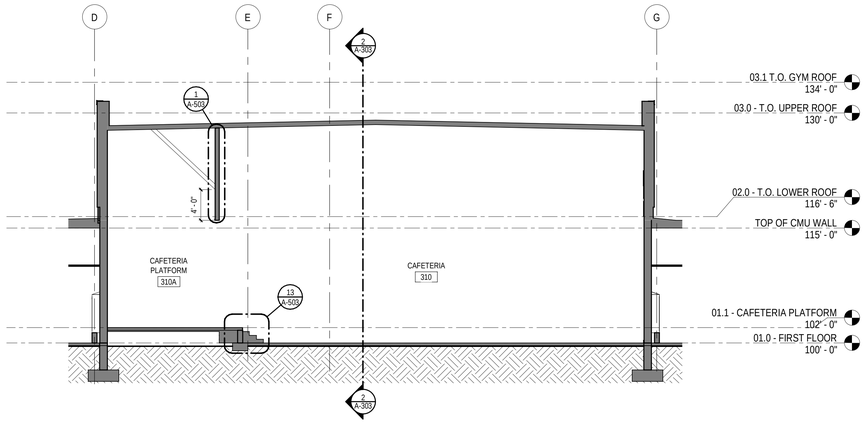
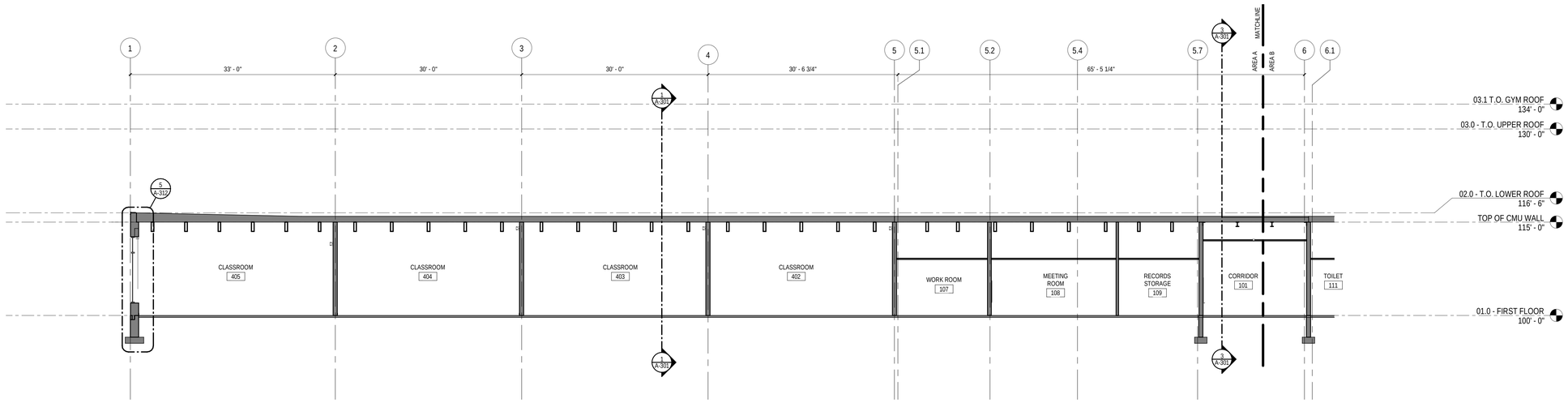
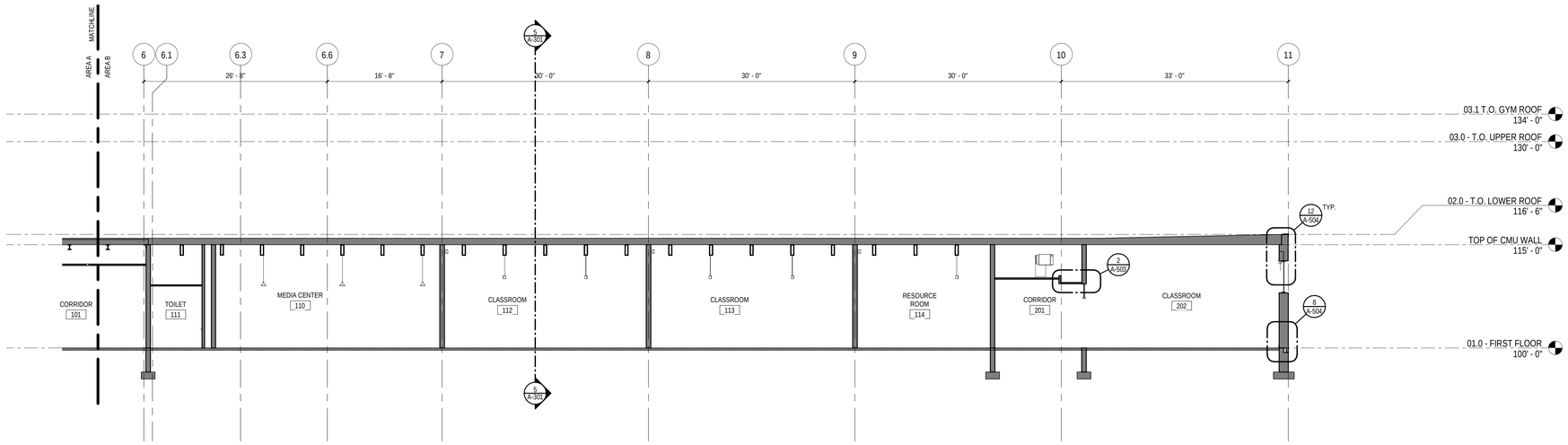


3 A-101A AREA A - BUILDING SECTION THROUGH CAFETERIA
1/8" = 1'-0"



2 A-101 SECTION NEAR GRID C - LOOKING EAST- AREA A
1/8" = 1'-0"



1 A-101 SECTION NEAR GRID C - LOOKING EAST - AREA B
1/8" = 1'-0"

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BUILDING SECTIONS

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SHEET
A-302

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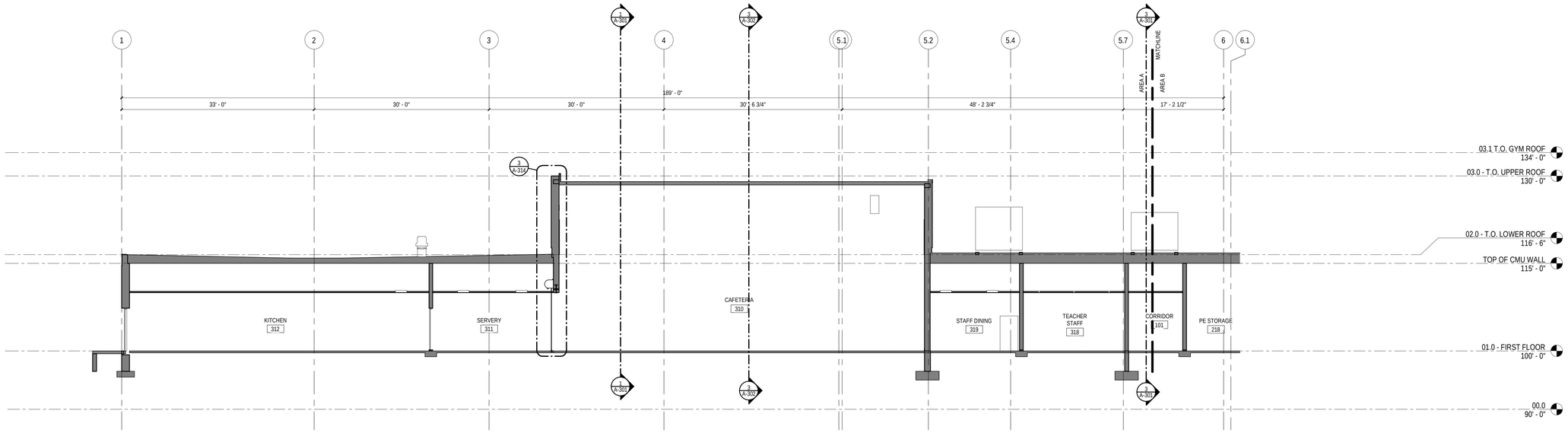
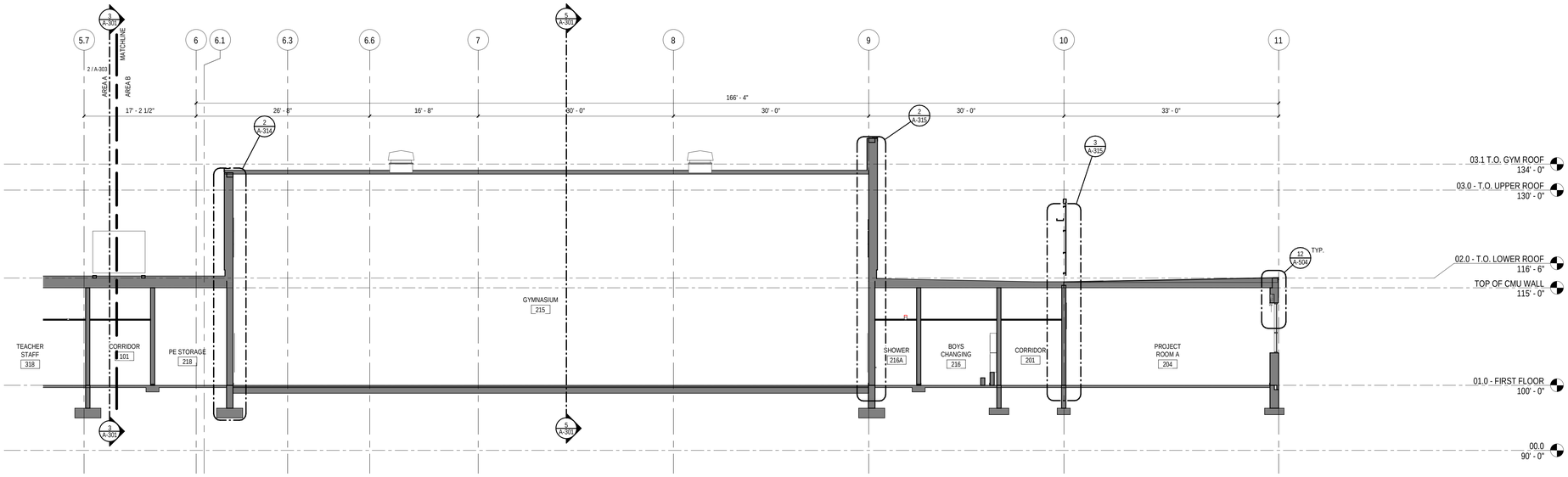


2 A-101 SECTION AT GRID F - LOOKING EAST - AREA A
1/8" = 1'-0"



1 A-101 SECTION AT GRID F - LOOKING EAST - AREA B
1/8" = 1'-0"

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WHITE BLACK
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BUILDING SECTIONS

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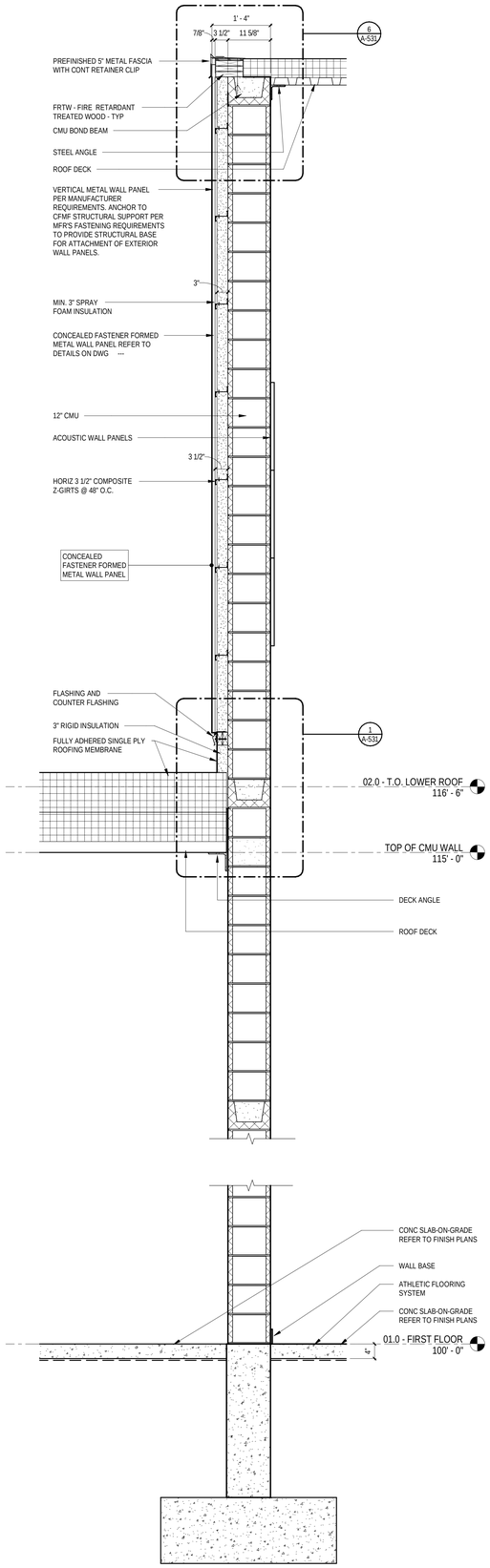
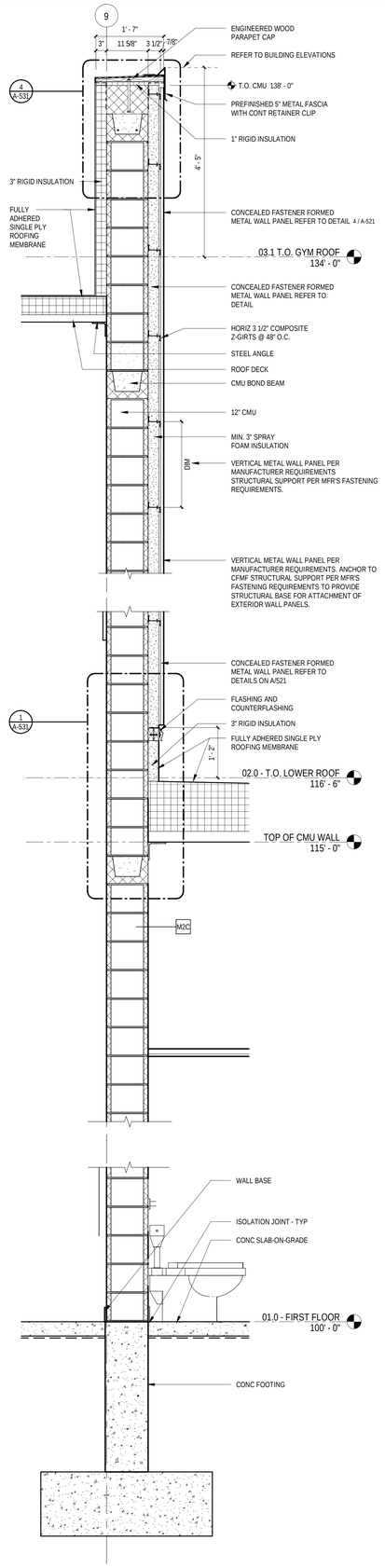
DATE: 23-JUN-2023
SHEET
A-303

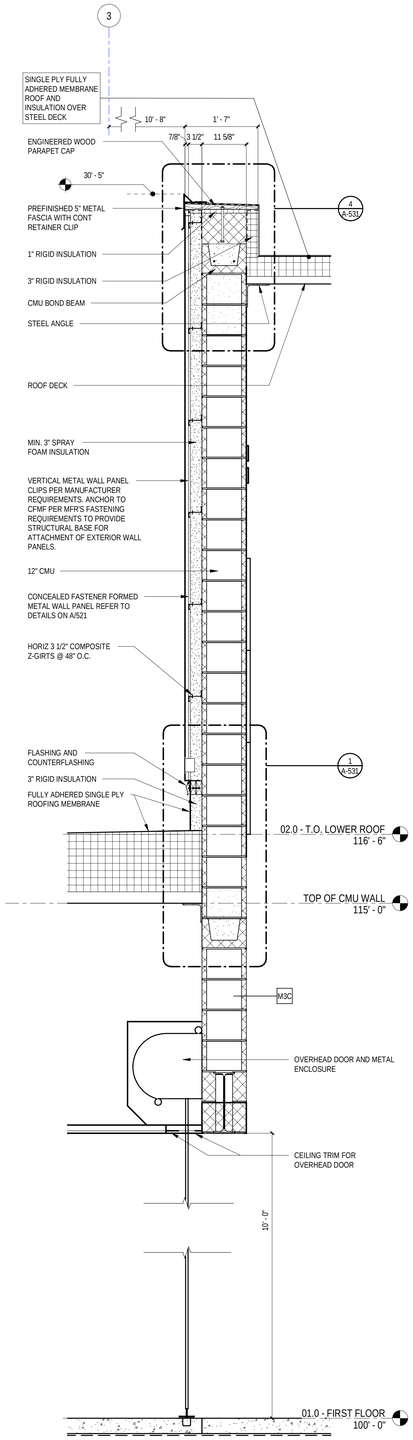
100% CONSTRUCTION DOCUMENTS



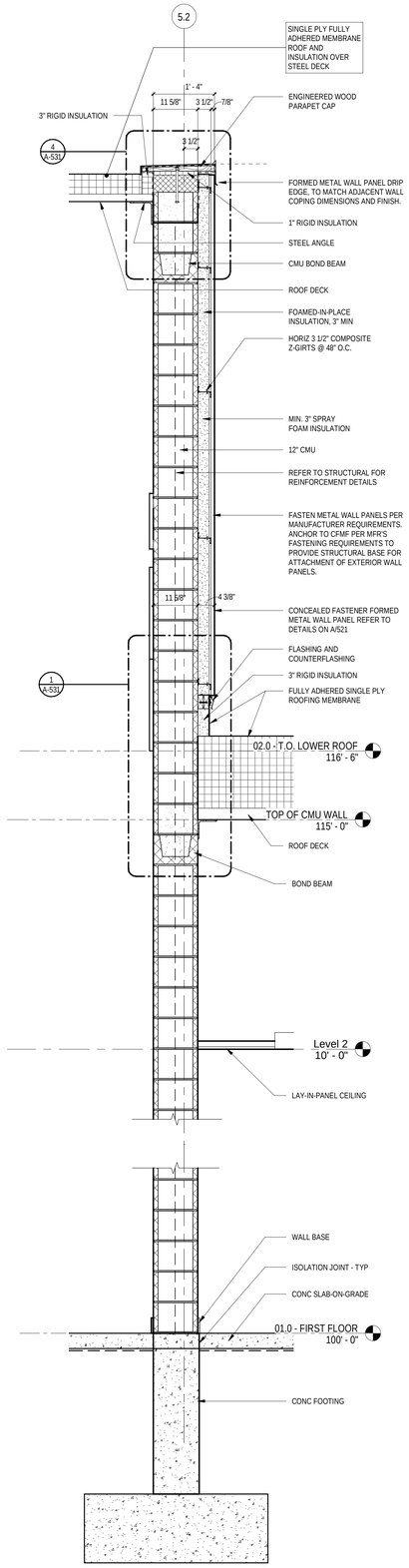
5 WALL SECTION - GYMNASIUM
3/4" = 1'-0"



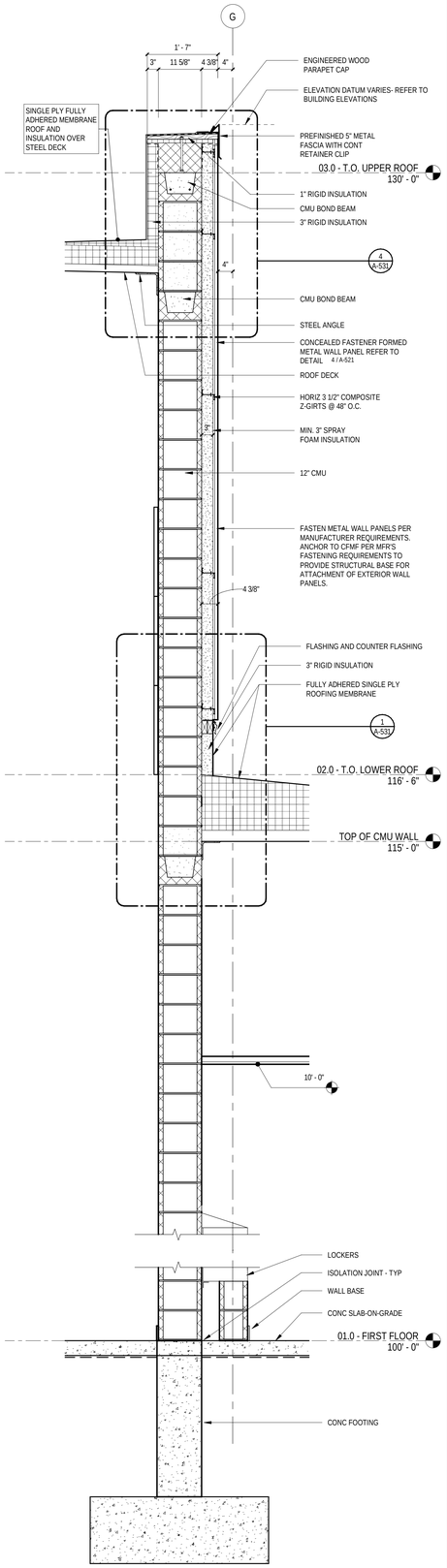
4 WALL SECTION - GYMNASIUM 2
3/4" = 1'-0"



3 WALL SECTION - CAFETERIA & SERVERY
3/4" = 1'-0"



2 WALL SECTION - CAFETERIA 2
3/4" = 1'-0"



1 A-301 WALL SECTION - CAFETERIA
3/4" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

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WALL SECTIONS

REVISIONS

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A-311

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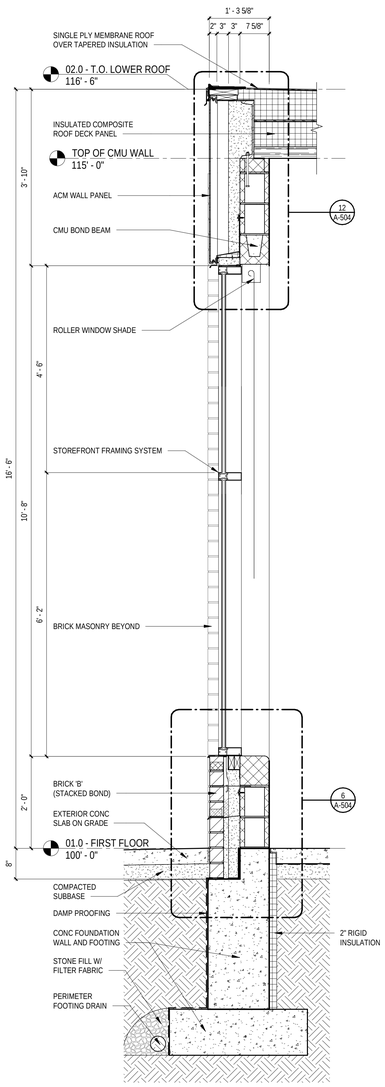
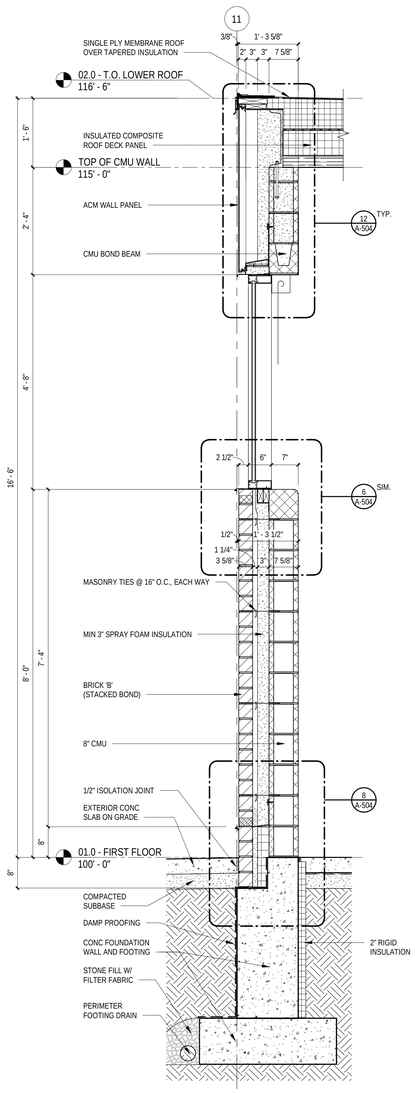
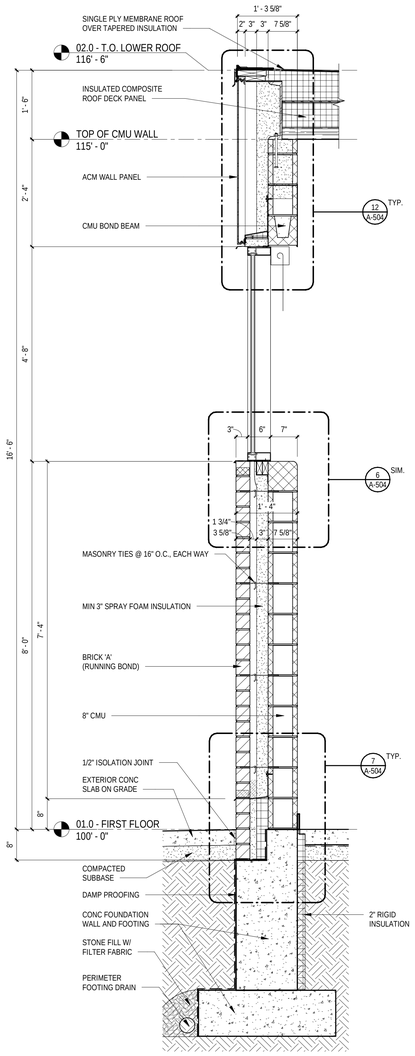
CHECKED BY: Checker APPROVED BY: Approver



5 A-301 TYP. EXTERIOR WALL SECTION @ BRICK 'B' / LOW SF
3/4" = 1'-0"



4 A-101B TYP. EXTERIOR WALL SECTION @ BRICK 'B' / HIGH SF
3/4" = 1'-0"



3 A-101A TYP. EXTERIOR WALL SECTION @ BRICK 'A' / HIGH SF
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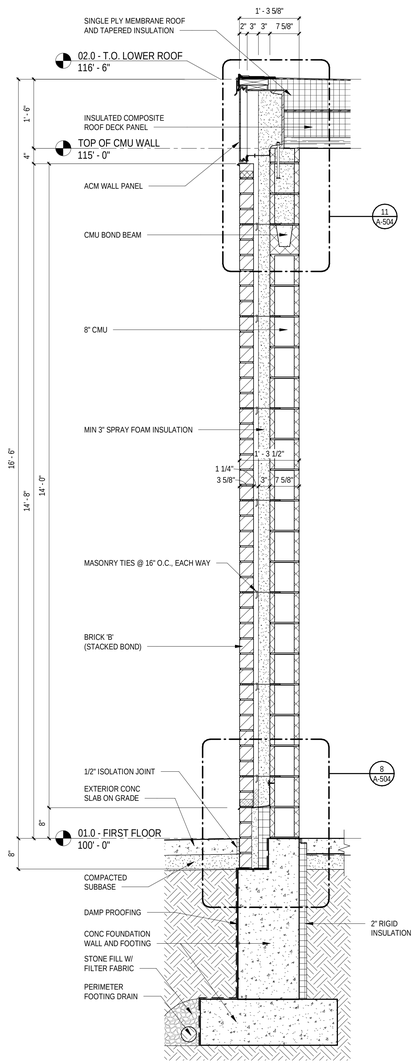
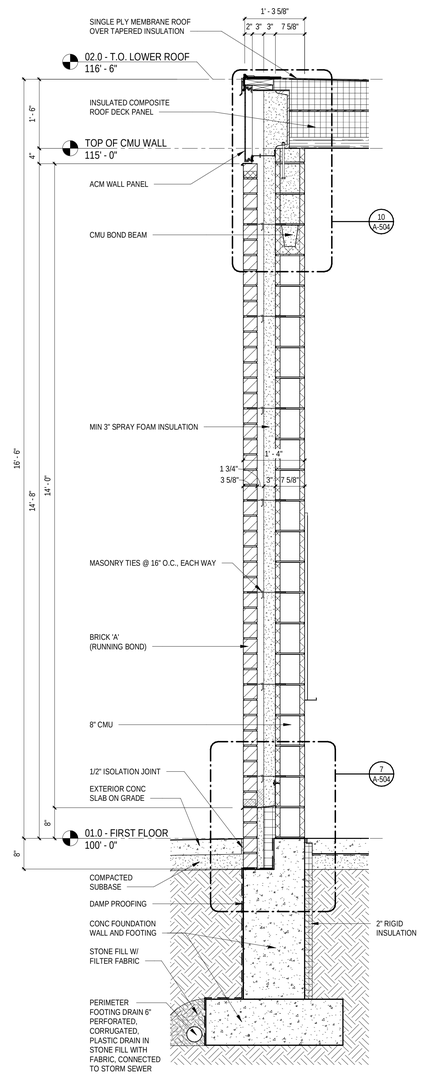


2 A-102A TYP. EXTERIOR WALL SECTION @ BRICK 'B'
3/4" = 1'-0"



1 A-101A TYP. EXTERIOR WALL SECTION @ BRICK 'A'
3/4" = 1'-0"

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WHITE
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CHECKED BY: Doctor APPROVED BY: Approver

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WALL SECTIONS

REVISIONS

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A-312

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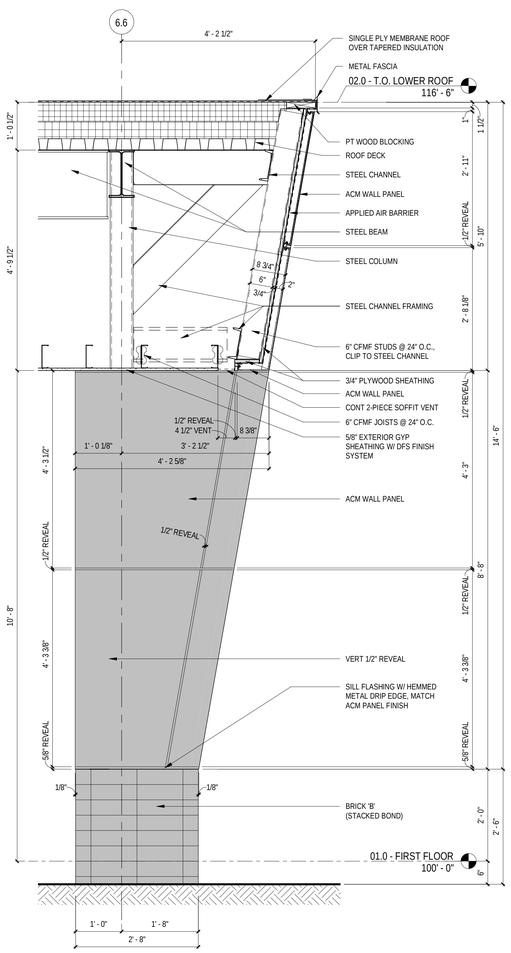
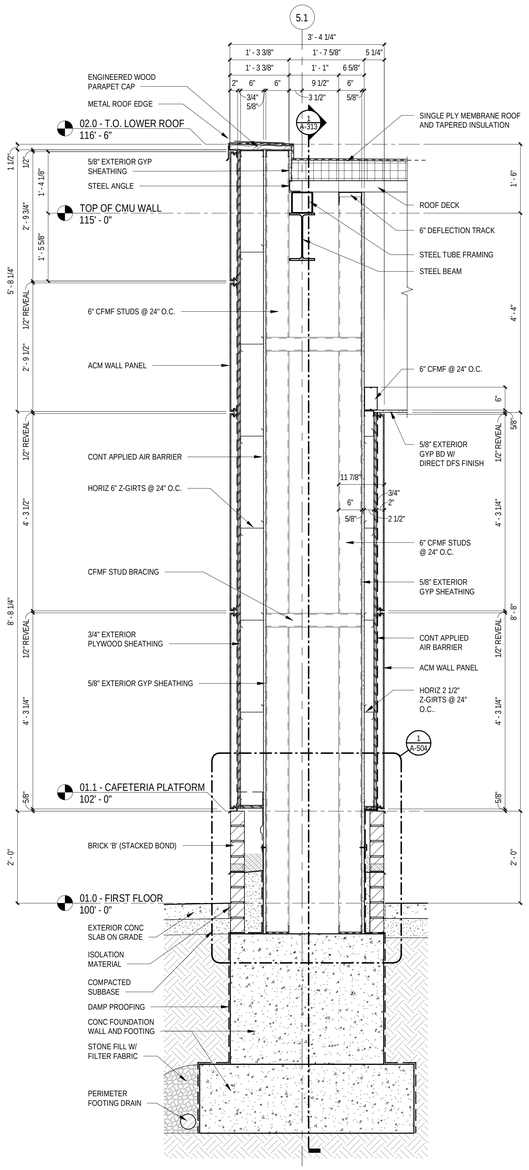
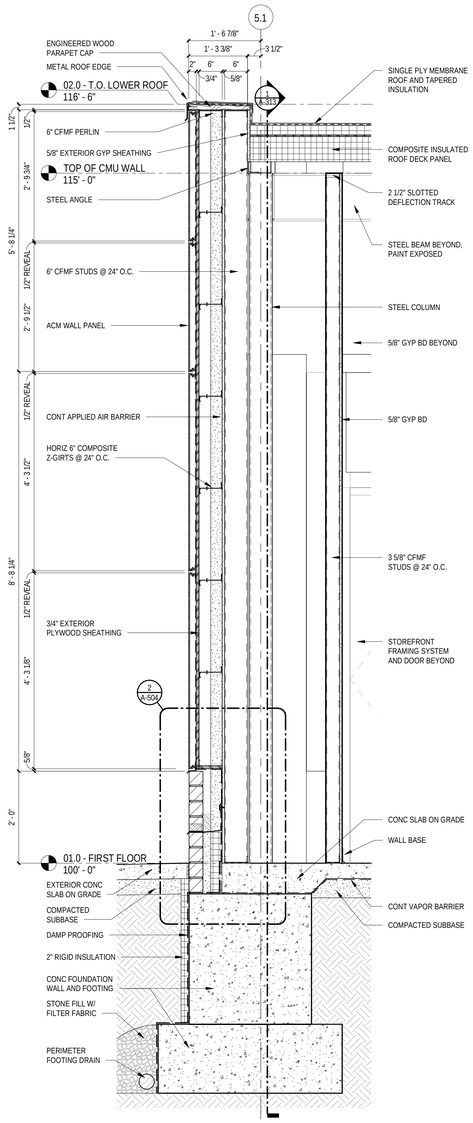


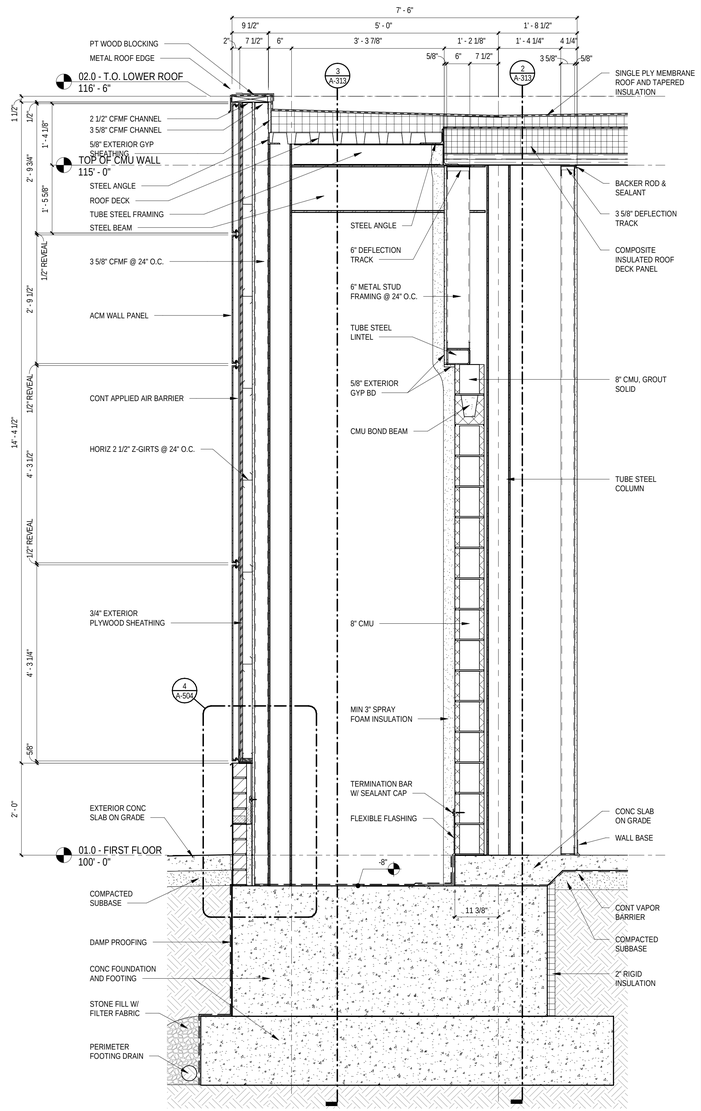
4 A-101B WALL SECTION - SOUTH CANOPY SLOPED WALL
3/4" = 1'-0"



3 A-101A WALL SECTION - NORTH CAMOPY WALL
3/4" = 1'-0"



2 A-101A WALL SECTION - ROOF CONDUCTOR CHASE
3/4" = 1'-0"



1 A-101A CANOPY NORTH WALL SECTION - E/W
3/4" = 1'-0"

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WALL SECTIONS

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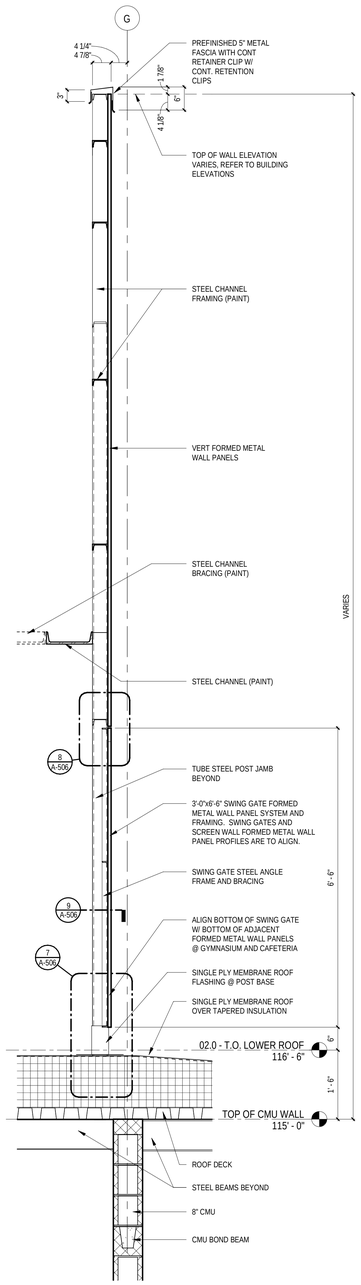
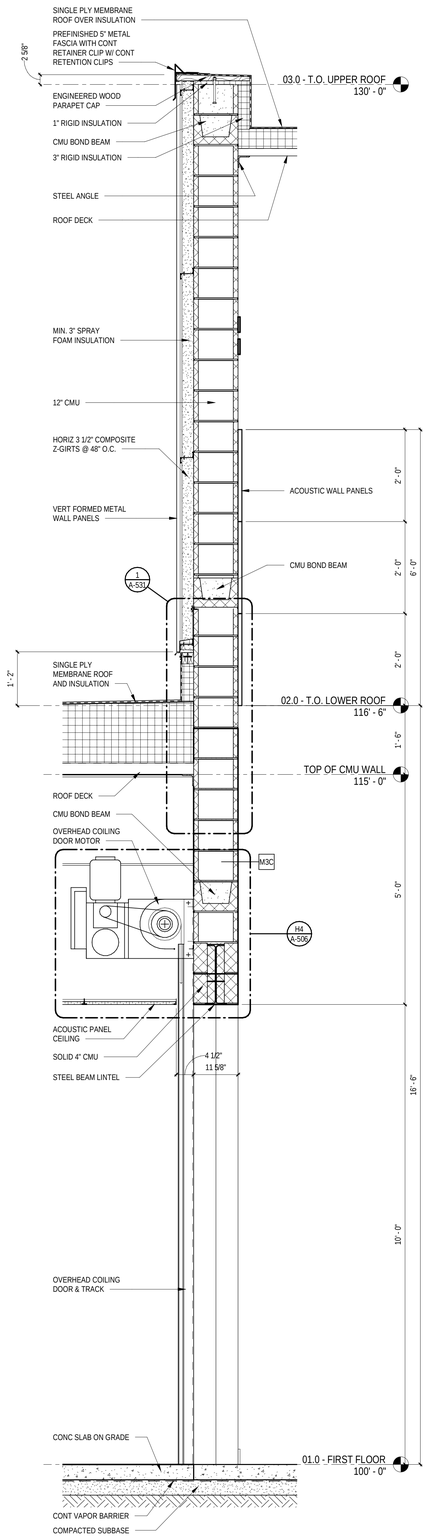
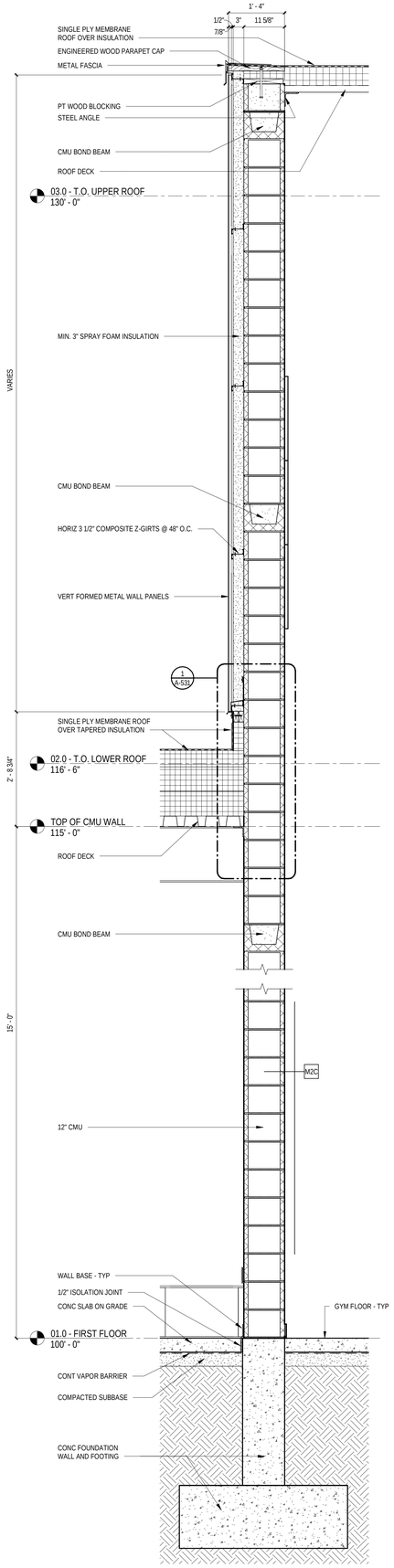


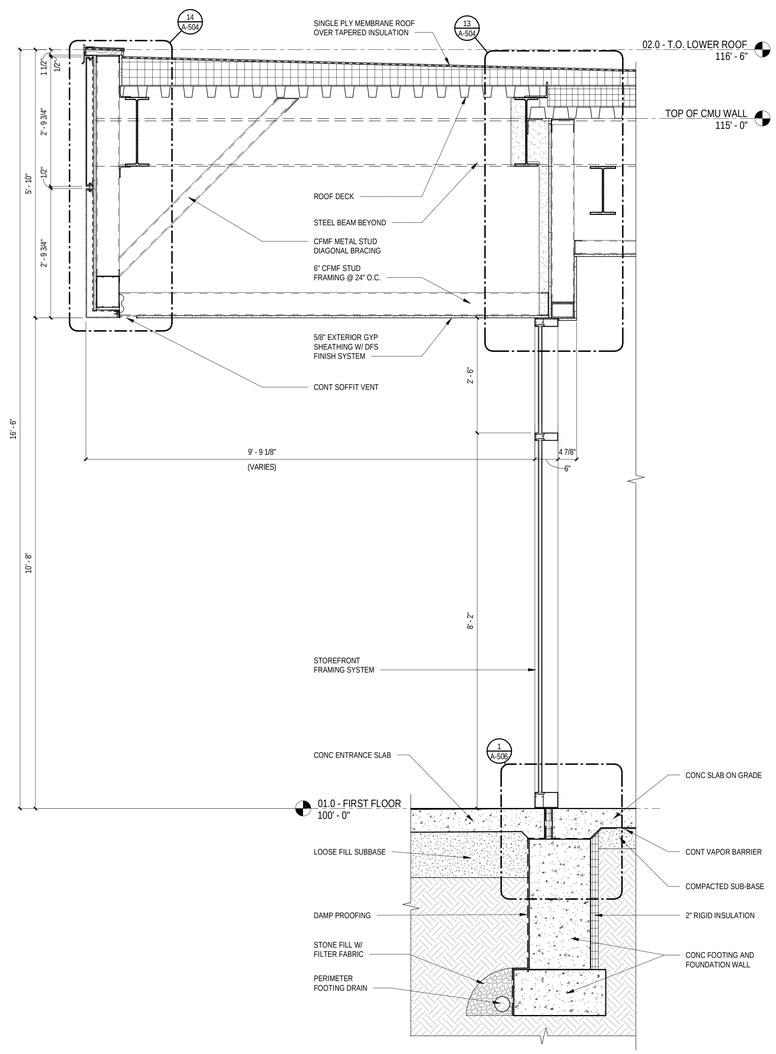
4 A-102B WALL SECTION - MECH SCREEN SOUTH OF GYM @ SWING GATE
3/4" = 1'-0"



3 A-303 WALL SECTION - SOUTH CAFETERIA WALL
3/4" = 1'-0"



2 A-303 WALL SECTION - NORTH GYMNASIUM WALL
3/4" = 1'-0"



1 A-301 WALL SECTION - ENTRY CANOPY
3/4" = 1'-0"

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WALL SECTIONS

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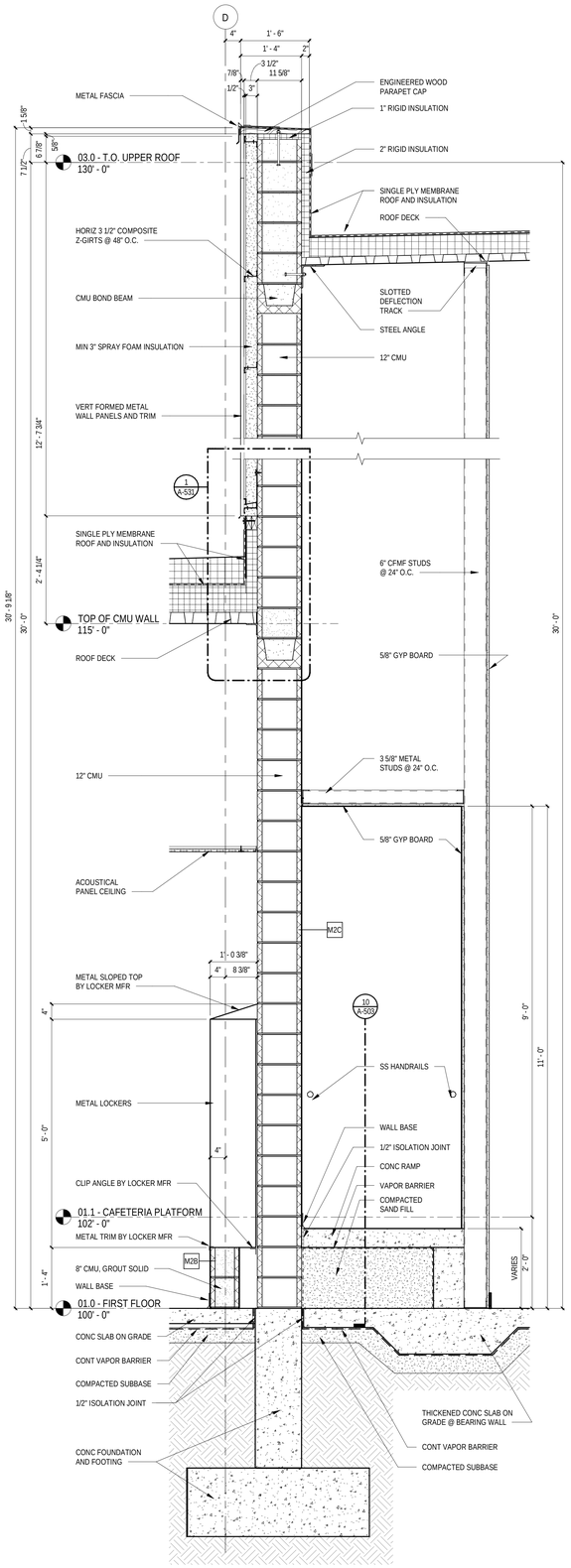
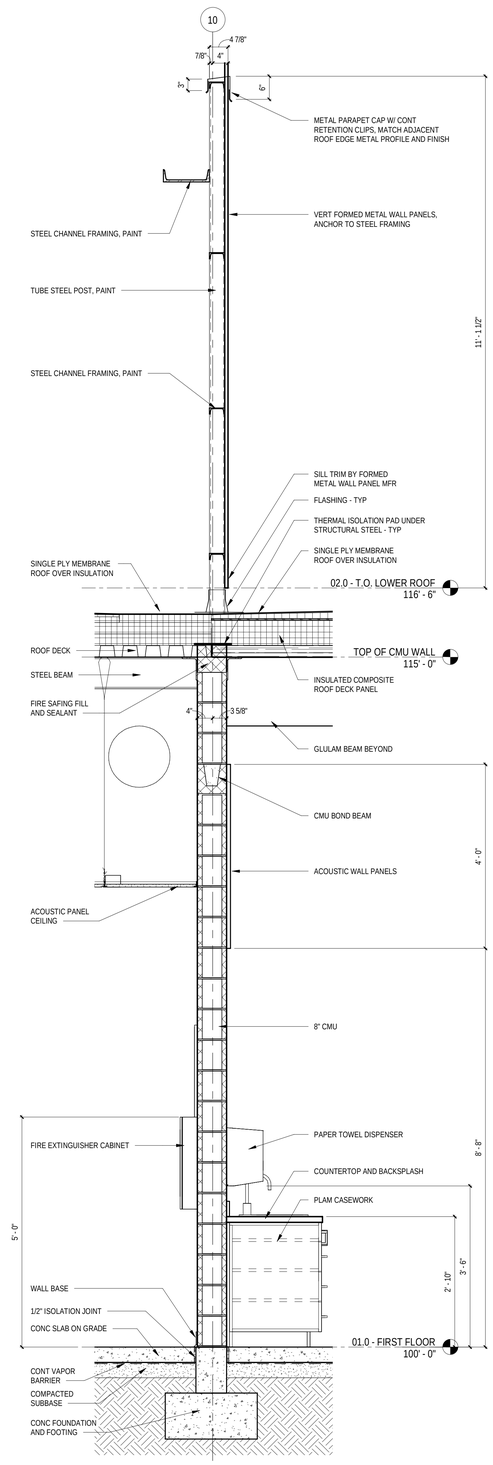
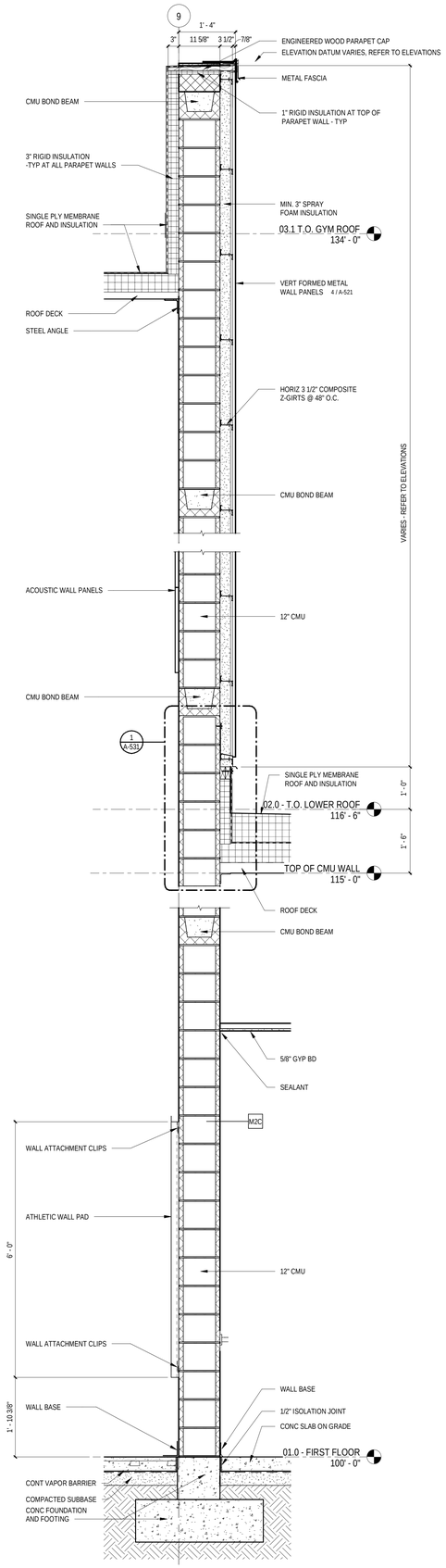


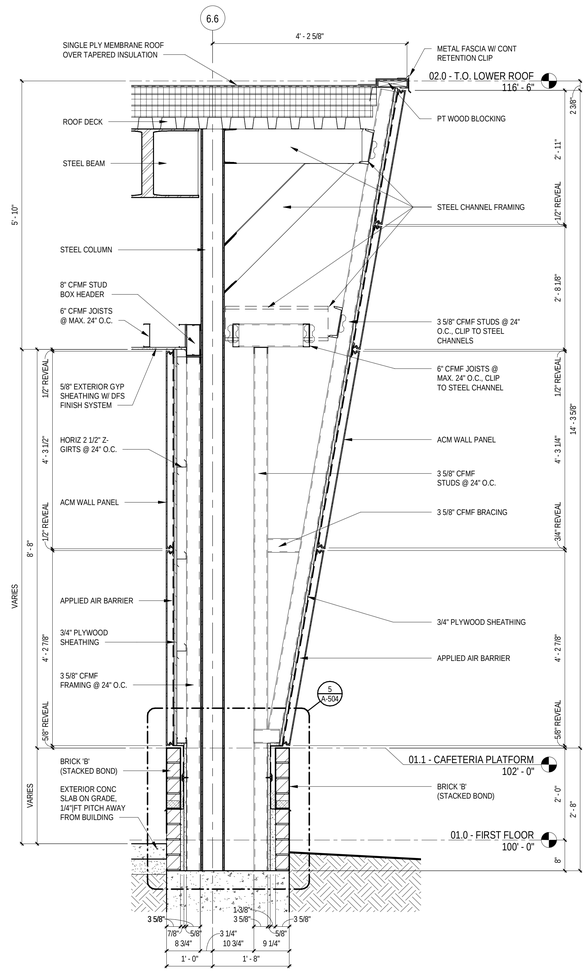
4 / A-301 WALL SECTION - CAFETERIA EAST WALL @ RAMP
3/4" = 1'-0"



3 / A-301 WALL SECTION - SOUTH MECH SCREEN WALL
3/4" = 1'-0"



2 / A-303 WALL SECTION - SOUTH GYMNASIUM WALL
3/4" = 1'-0"



1 / A-502 WALL SECTION - SOUTH CANOPY PEIR
3/4" = 1'-0"

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WALL SECTIONS

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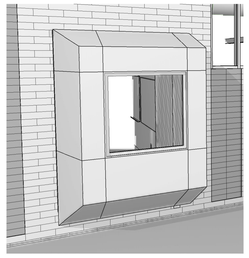
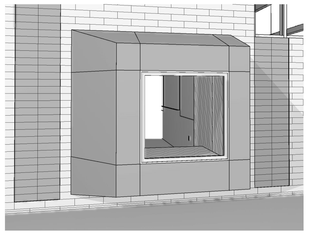
NOTE:

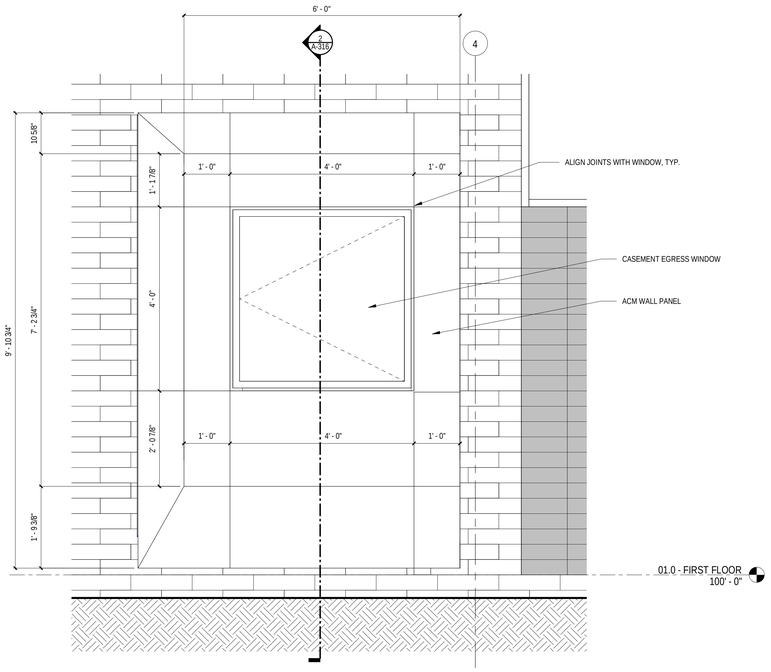
DETAILING BELOW IS PROVIDED TO CLARIFY DESIGN INTENT. ACTUAL CONNECTIONS, ASSEMBLY, AND MAKEUP IS THE RESPONSIBILITY OF THE CONTRACTOR. CONTRACTOR TO PROVIDE FULLY ASSEMBLED AND WEATHER TIGHT CONSTRUCTION.



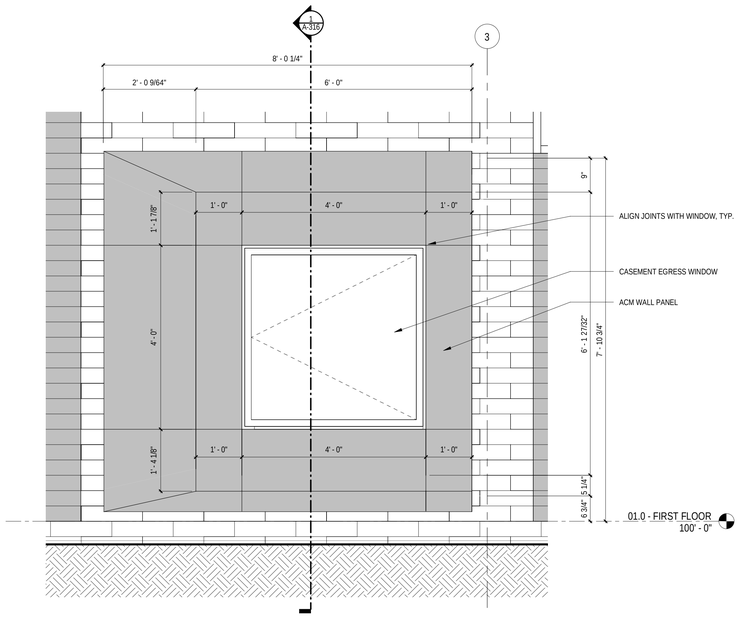
NOOK B PERSPECTIVE



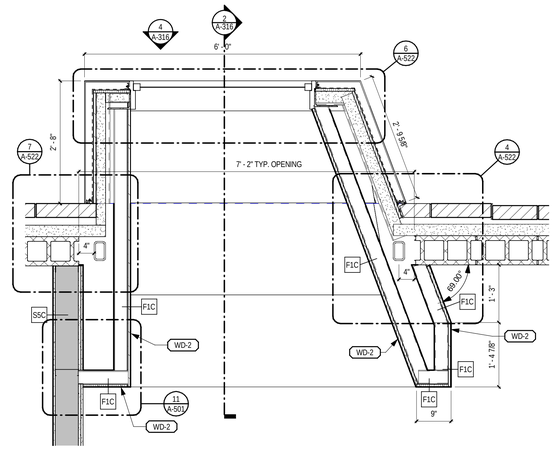
NOOK A PERSPECTIVE



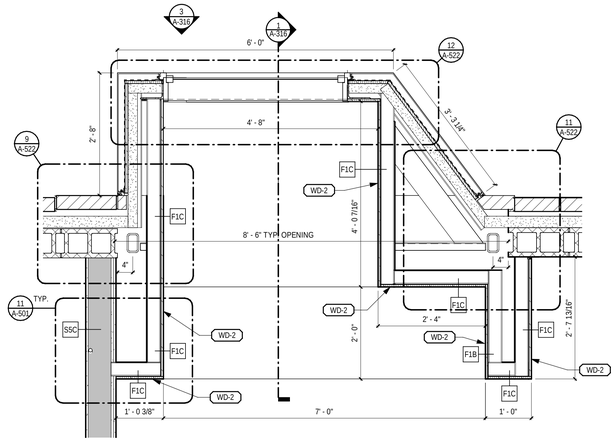
4 A-316 ELEVATION - READING NOOK B
3/4" = 1'-0"



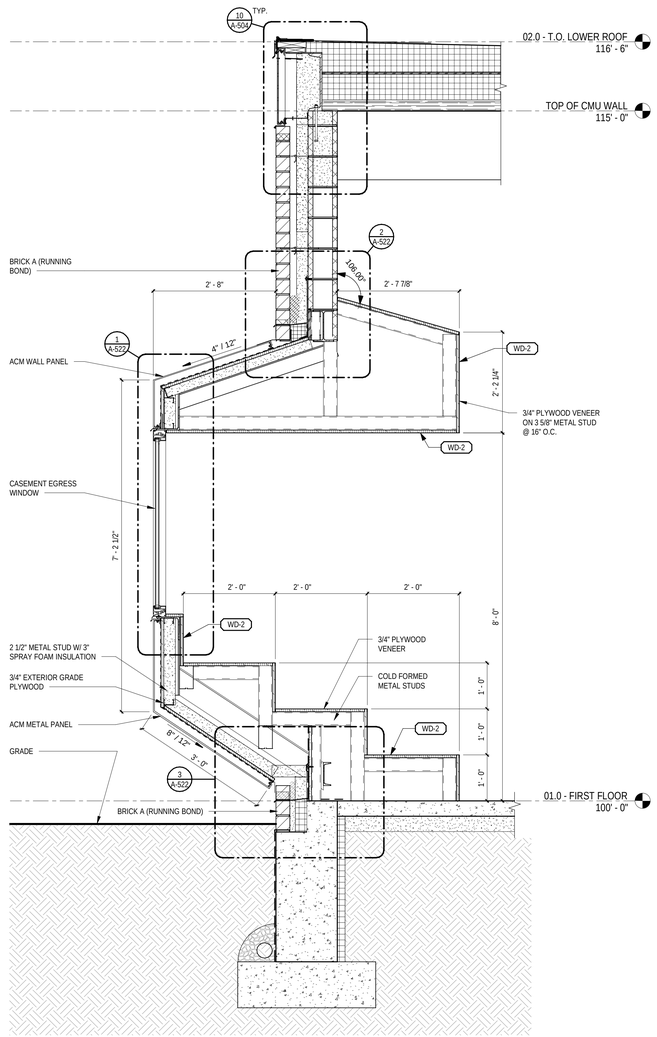
3 A-316 ELEVATION - READING NOOK A
3/4" = 1'-0"



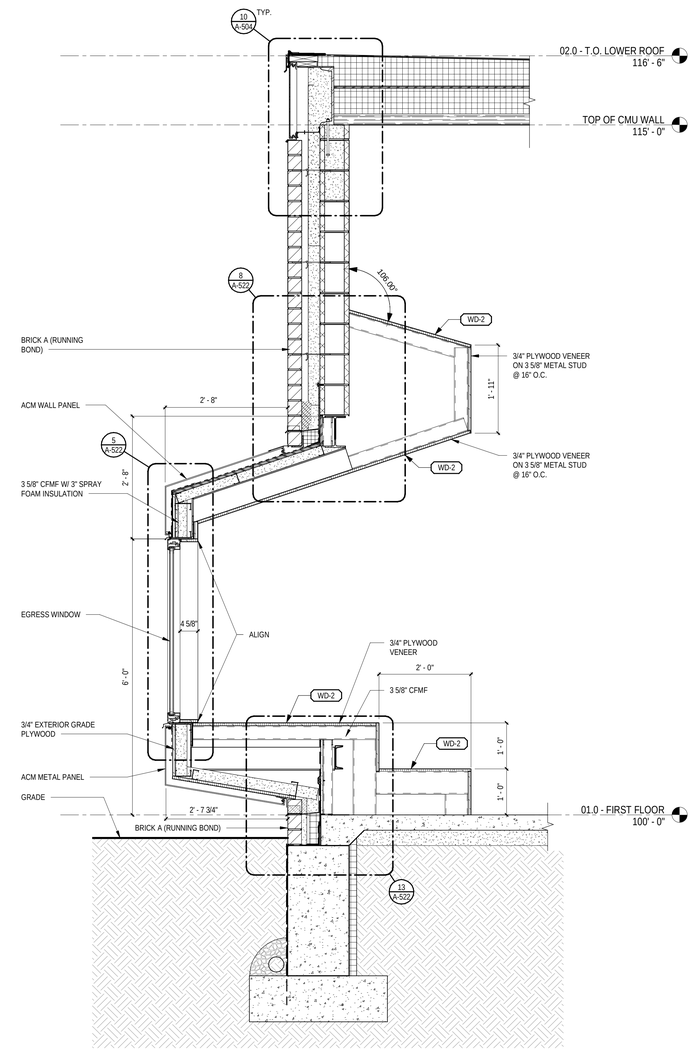
6 A-101A READING NOOK B - DETAIL PLAN
3/4" = 1'-0"



5 A-101A READING NOOK A - DETAIL PLAN
3/4" = 1'-0"



2 A-101 SECTION - READING NOOK B
3/4" = 1'-0"



1 A-101 SECTION - READING NOOK A
3/4" = 1'-0"

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READING NOOK SECTIONS AND ELEVATIONS

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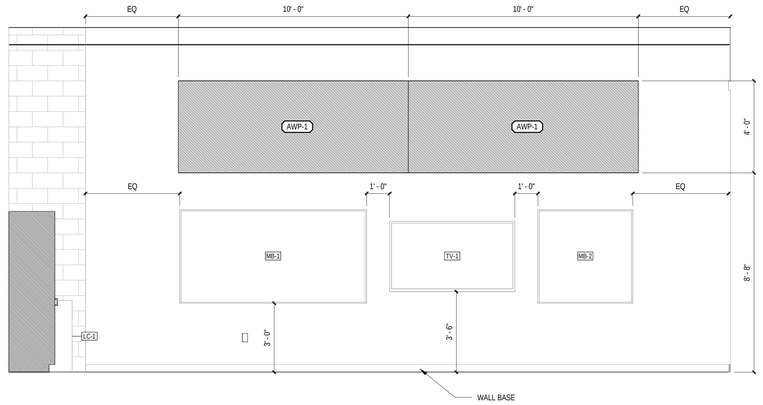
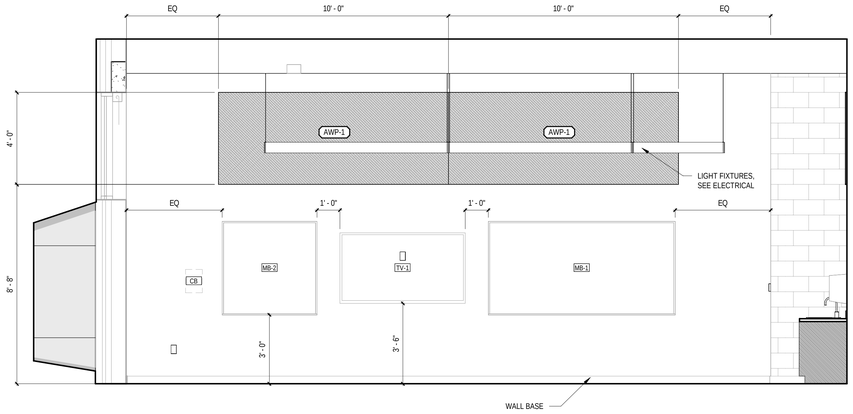
MILLWORK GENERAL NOTES:

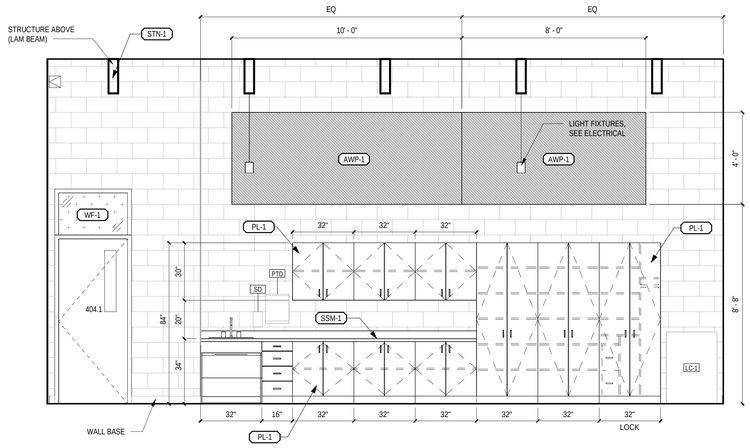
1. CONTRACTOR SHALL FIELD VERIFY ALL FINISHED DIMENSIONS PRIOR TO ORDERING / INSTALLATION.
2. ALL COUNTERTOP SUPPORTS SHALL BE SPACED 32" O.C. MAX. COORDINATE FINAL LOCATION W/ OWNER'S EQUIPMENT & FURNISHINGS PLACEMENT.
3. ALL EXPOSED SURFACES OF CABINETS ARE TO BE FINISHED TO MATCH CABINET FINISH, U.N.O.
4. GROMMETS SHALE BE SPACED 60" O.C. MAX. COORDINATE FINAL LOCATIONS WITH OWNER.
5. PROVIDE FILLER PIECE AT ALL LOCATIONS BETWEEN CABINET AND ADJACENT WALL OR CEILING. FILLER PIECE TO BE FLUSH WITH FACE OF CABINET AND SHALL MATCH MATERIAL AND FINISH OF CABINETS.
6. ALL COUNTERTOPS LOCATED ATOP BASE CABINETS TO HAVE 1" OVERHANG, U.N.O.
7. ALL BASE CABINETS SHALL BE 24"D, U.N.O.
8. ALL WALL CABINETS SHALL BE 12"D, U.N.O.
9. PROVIDE SEALANT AT ALL EDGES WHERE COUNTERTOP, SIDESPLASH OR BACKSPLASH ABUT ADJACENT SURFACES



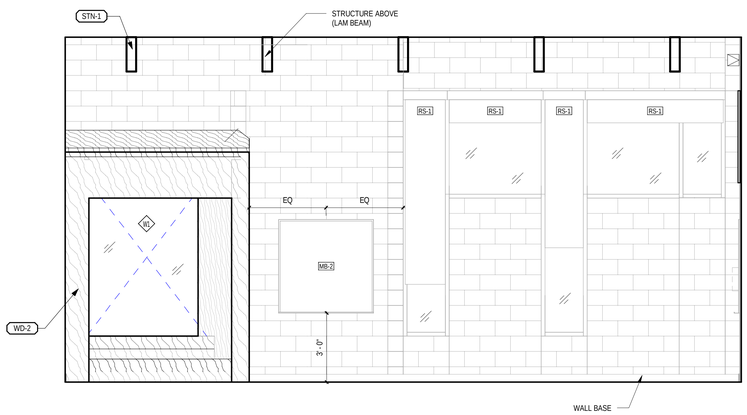
5 A-101B CLASSROOM 203 TEACHING WALL
3/8" = 1'-0"



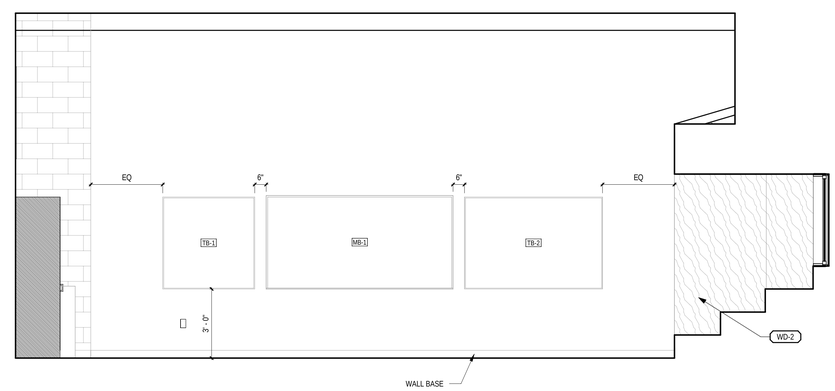
3 A-101A TYPICAL CLASSROOM- TEACHING WALL
3/8" = 1'-0"



4 A-101A TYPICAL CLASSROOM- CASEWORK WALL
3/8" = 1'-0"



2 A-101A TYPICAL CLASSROOM- NOOK WALL
3/8" = 1'-0"



1 A-101A TYPICAL CLASSROOM- BACK WALL
3/8" = 1'-0"

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INTERIOR ELEVATIONS - CLASSROOMS GENERAL

REVISIONS

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MILLWORK GENERAL NOTES:

1. CONTRACTOR SHALL FIELD VERIFY ALL FINISHED DIMENSIONS PRIOR TO ORDERING / INSTALLATION.
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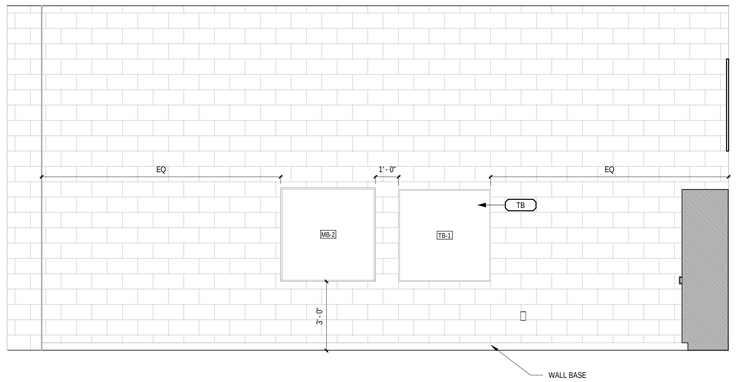
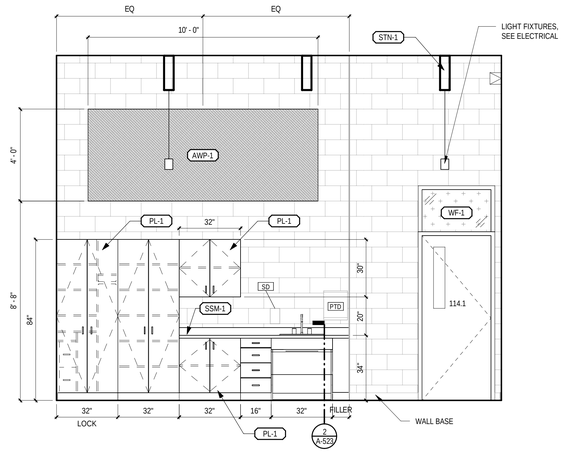
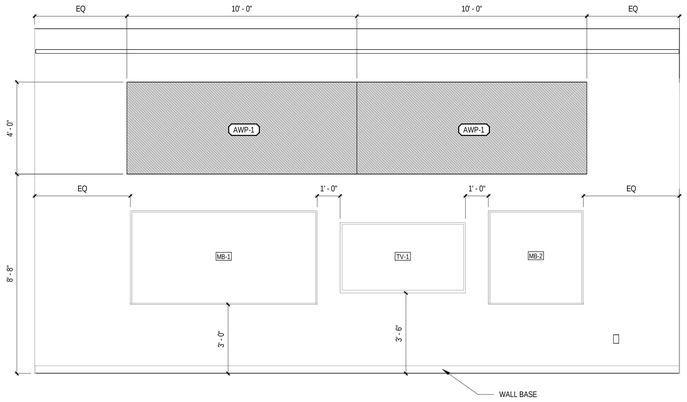
3. ALL EXPOSED SURFACES OF CABINETS ARE TO BE FINISHED TO MATCH CABINET FINISH, U.N.O.
4. GROMMETS SHALE BE SPACED 60" O.C. MAX. COORDINATE FINAL LOCATIONS WITH OWNER.
5. PROVIDE FILLER PIECE AT ALL LOCATIONS BETWEEN CABINET AND ADJACENT WALL OR CEILING. FILLER PIECE TO BE FLUSH WITH FACE OF CABINET AND SHALL MATCH MATERIAL AND FINISH OF CABINETS.
6. ALL COUNTERTOPS LOCATED ATOP BASE CABINETS TO HAVE 1" OVERHANG, U.N.O.
7. ALL BASE CABINETS SHALL BE 24"D, U.N.O.
8. ALL WALL CABINETS SHALL BE 12"D, U.N.O.
9. PROVIDE SEALANT AT ALL EDGES WHERE COUNTERTOP, SIDESPLASH OR BACKSPLASH ABUT ADJACENT SURFACES



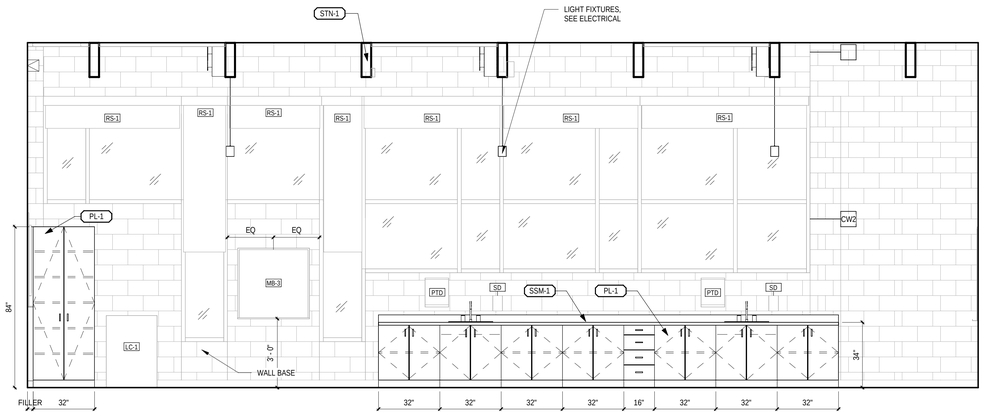
7 A-101B RESOURCE ROOM 114- SOUTH WALL
3/8" = 1'-0"



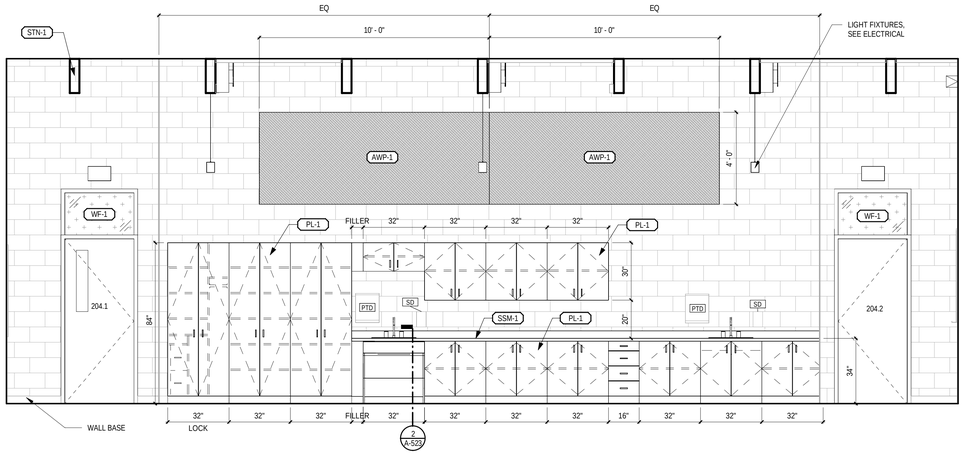
6 A-101B RESOURCE ROOM 114- WEST WALL
3/8" = 1'-0"



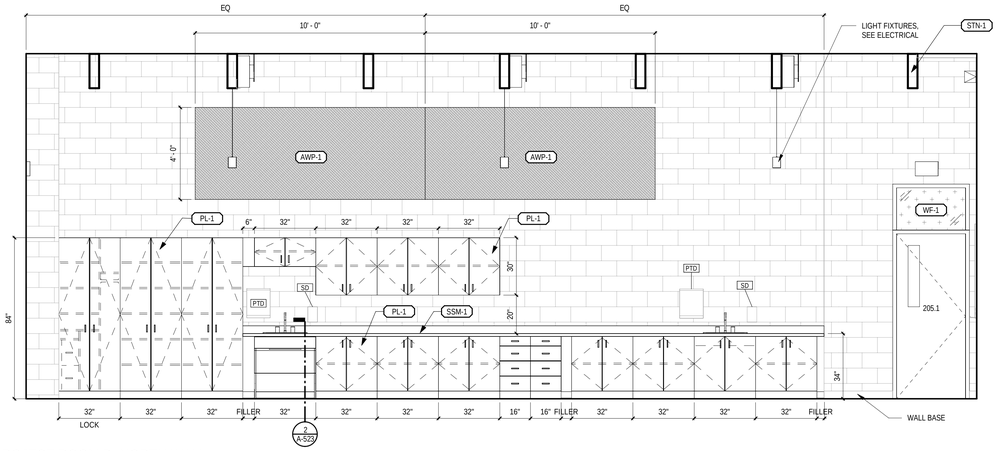
5 A-101A RESOURCE ROOM 114- NORTH WALL
3/8" = 1'-0"



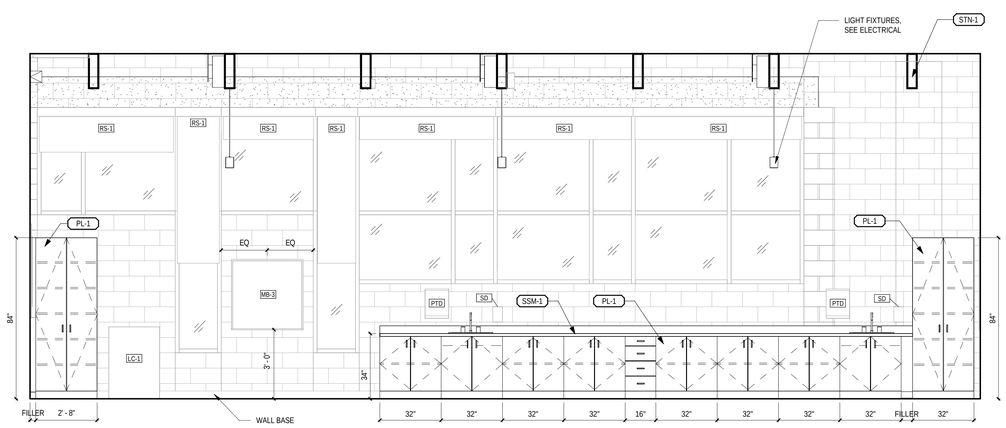
4 A-101B PROJECT ROOM A- SOUTH WALL
3/8" = 1'-0"



3 A-101B PROJECT ROOM A- NORTH WALL
3/8" = 1'-0"



2 A-101B PROJECT ROOM B- NORTH WALL
3/8" = 1'-0"



1 A-101B PROJECT ROOM B- SOUTH WALL
3/8" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

WE RECYCLE

6/26/2023 6:44:05 AM
AutoDesk Docs://220116_LSD - Mt HOPE/220116_A.rvt

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CHECKED BY: Checker APPROVED BY: Approver

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1215 E Mt Hope Ave, Lansing, MI 48910

INTERIOR ELEVATIONS - CLASSROOMS SPECIFIC

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-402

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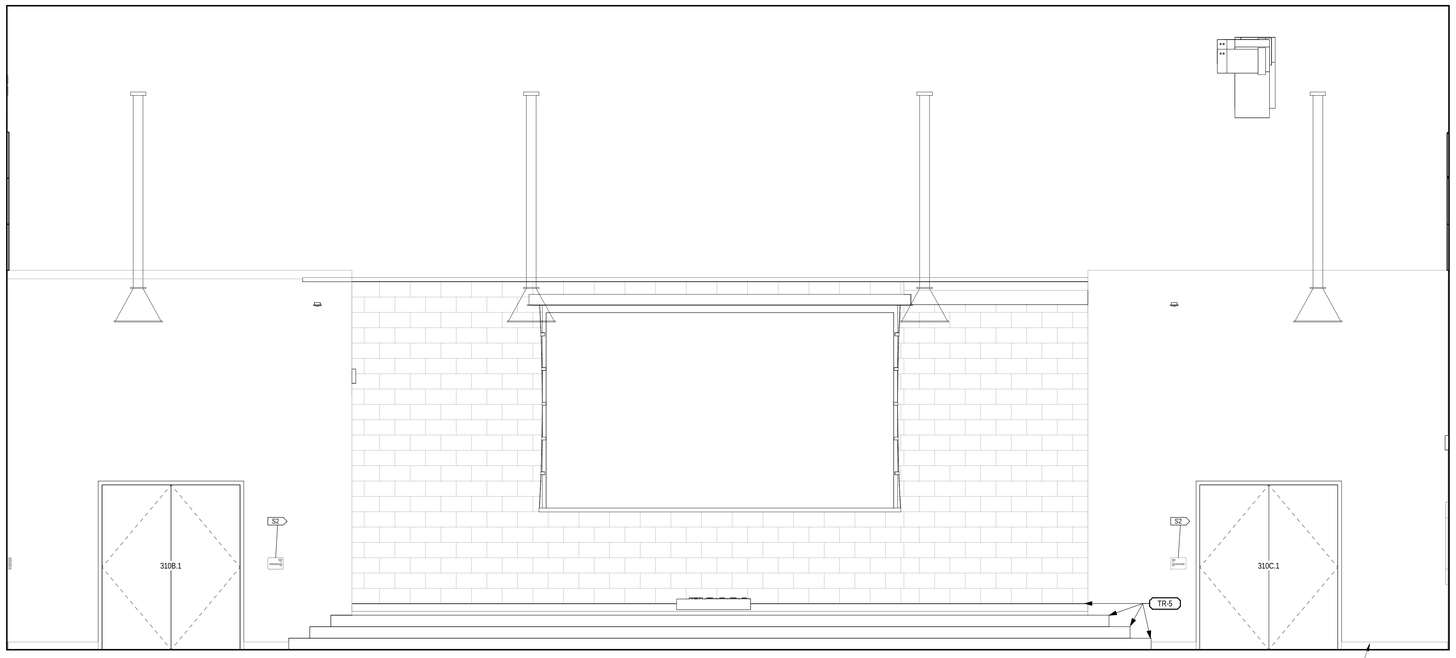
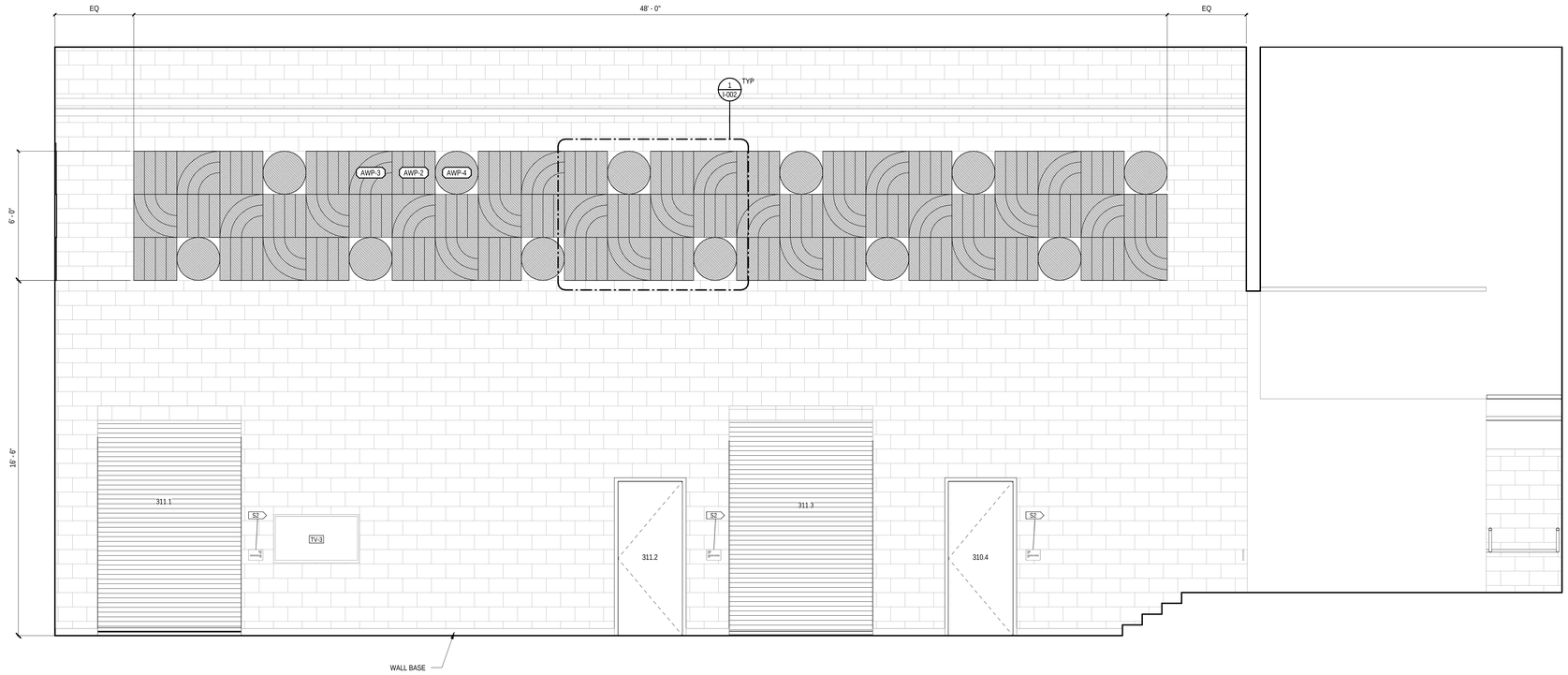


2 A-101A CAFETERIA- EAST WALL
3/8" = 1'-0"



1 A-101A CAFETERIA- NORTH WALL
3/8" = 1'-0"

MILLWORK GENERAL NOTES:

1. CONTRACTOR SHALL FIELD VERIFY ALL FINISHED DIMENSIONS PRIOR TO ORDERING / INSTALLATION.
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INTERIOR ELEVATIONS - CAFETERIA

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-403

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
WHITE BLACK
WE RECYCLE

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Autodesk Docs://220116_LSD - Mt HOPE/220116_A.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
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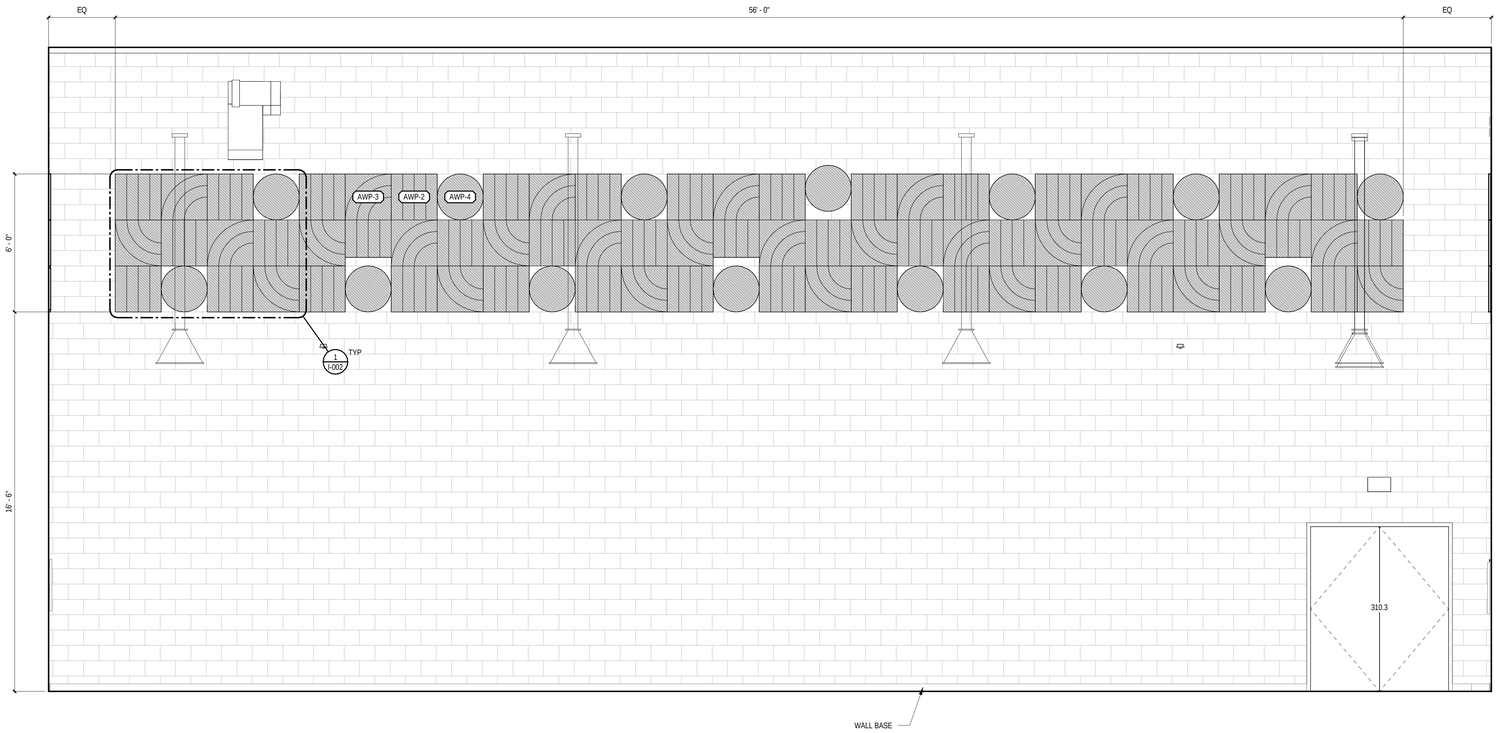
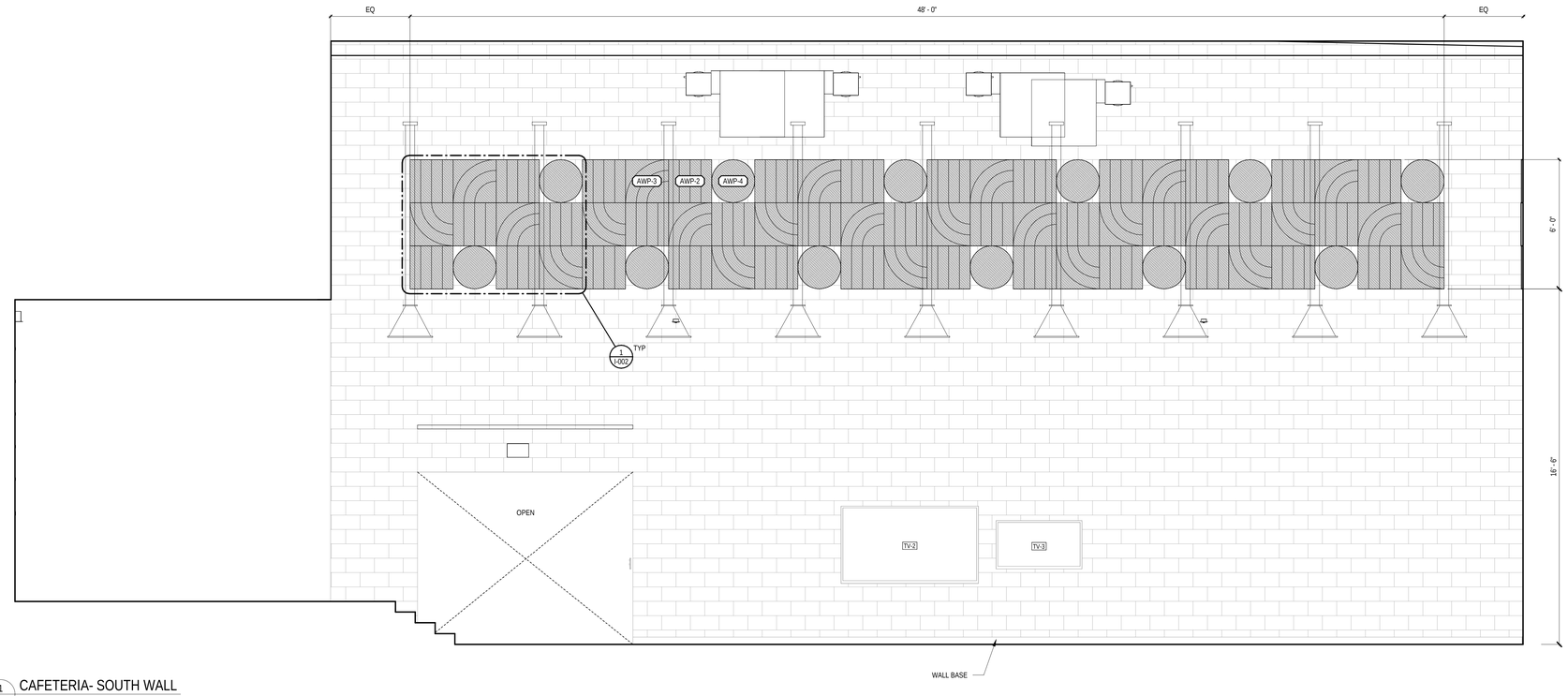
WE RECYCLE



2 A-101A CAFETERIA- WEST WALL
3/8" = 1'-0"



1 A-101A CAFETERIA- SOUTH WALL
3/8" = 1'-0"

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INTERIOR ELEVATIONS - CAFETERIA

REVISIONS

REV	DESCRIPTION	DATE

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DATE: 23-JUN-2023
SHEET
A-404

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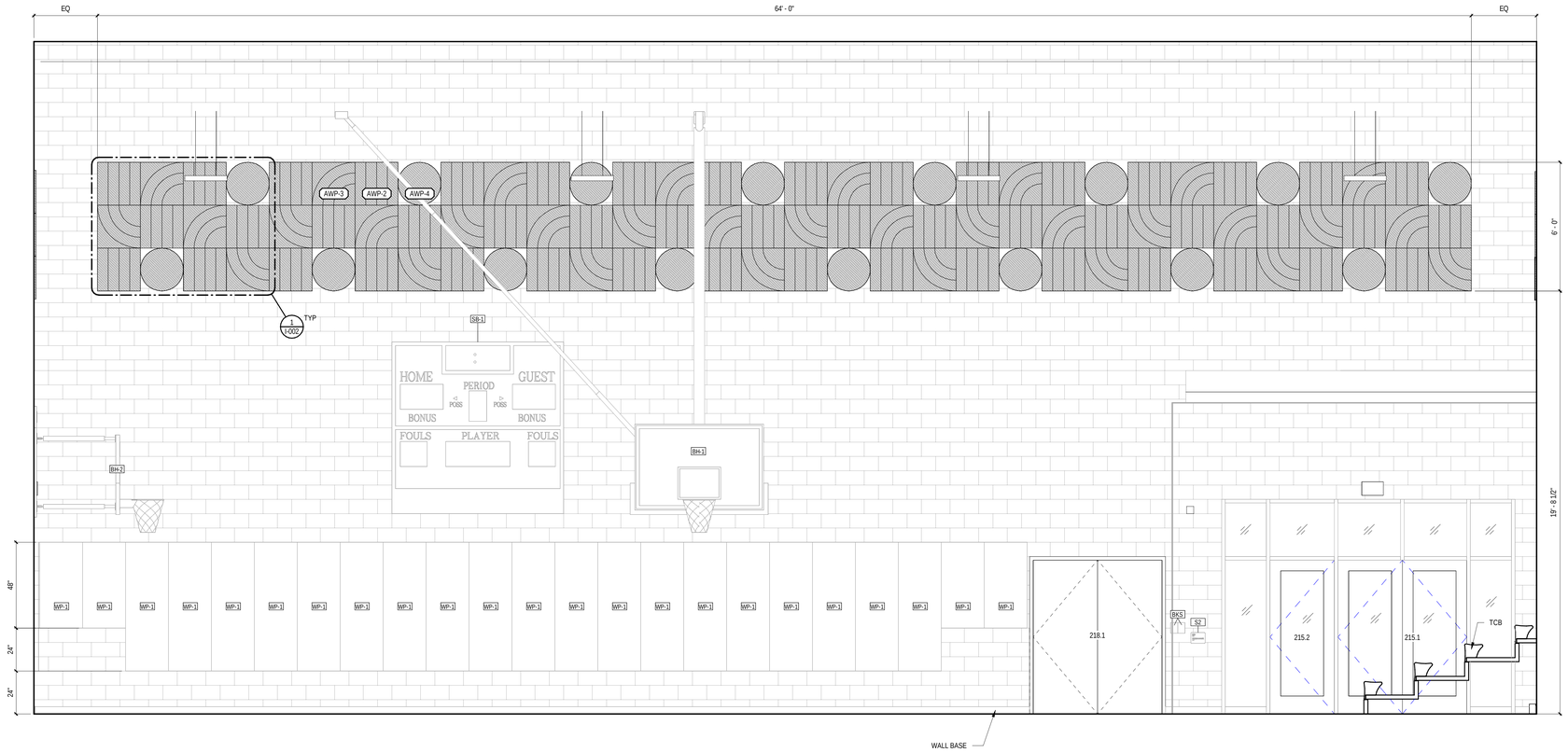
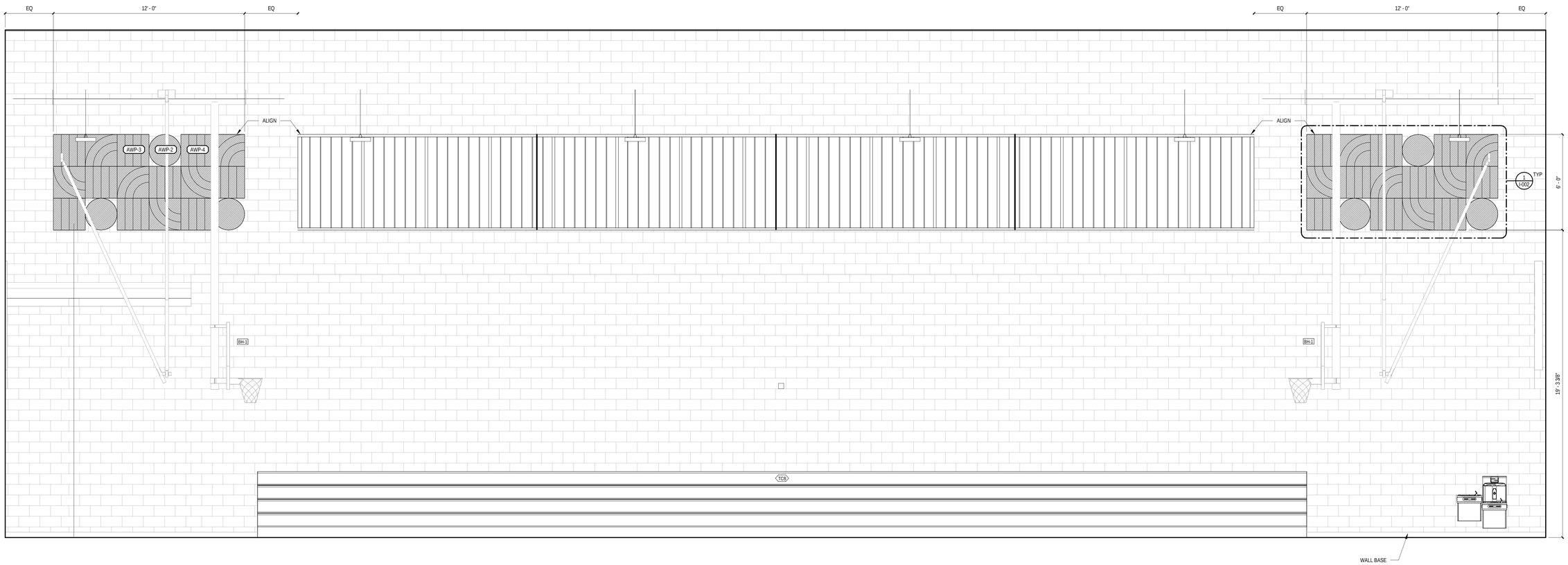


1 A-101B GYMNASIUM- NORTH WALL
3/8" = 1'-0"



2 A-101A GYMNASIUM- EAST WALL
3/8" = 1'-0"

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INTERIOR ELEVATIONS - GYMNASIUM

REVISIONS

REV	DESCRIPTION	DATE

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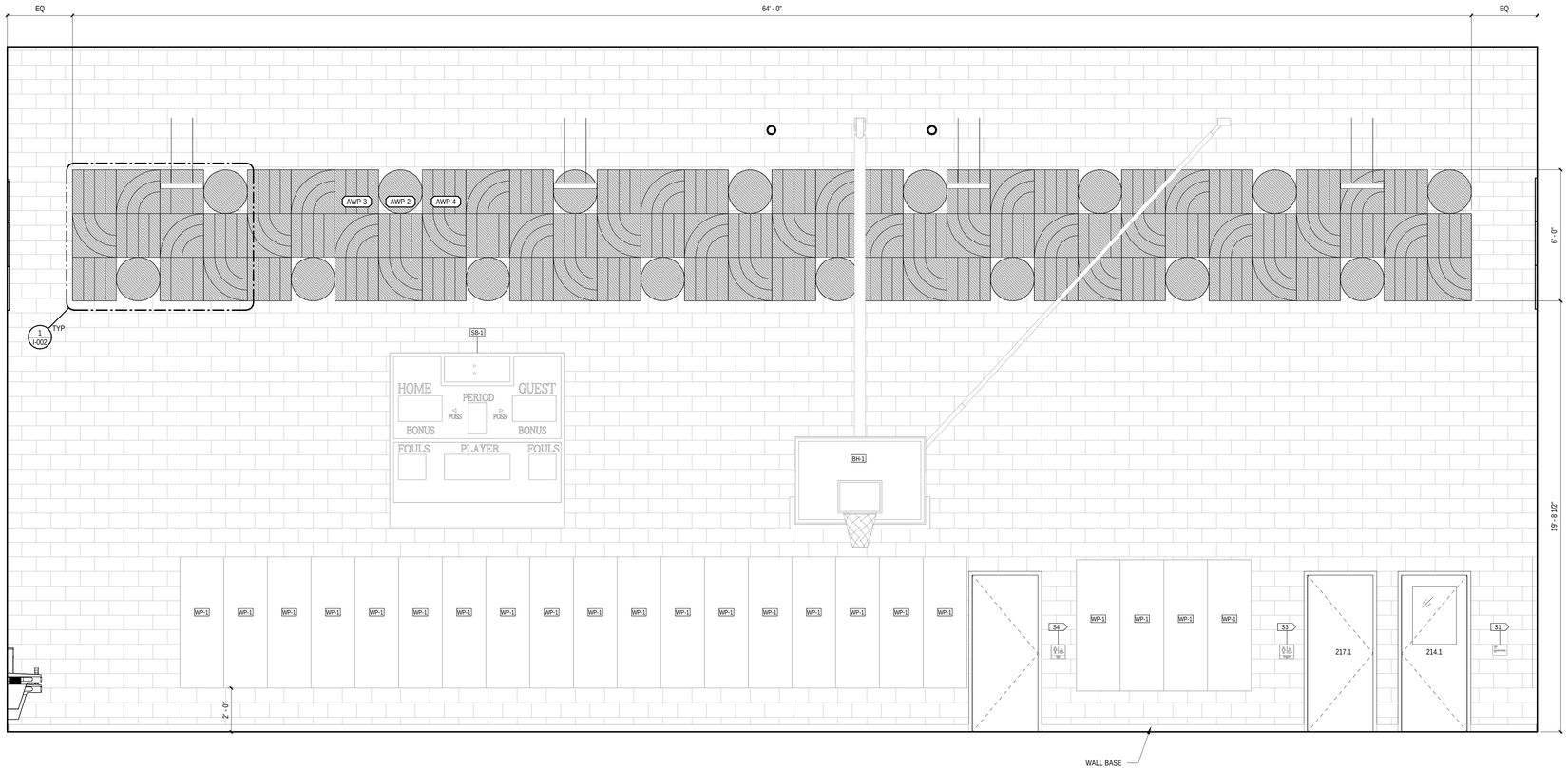
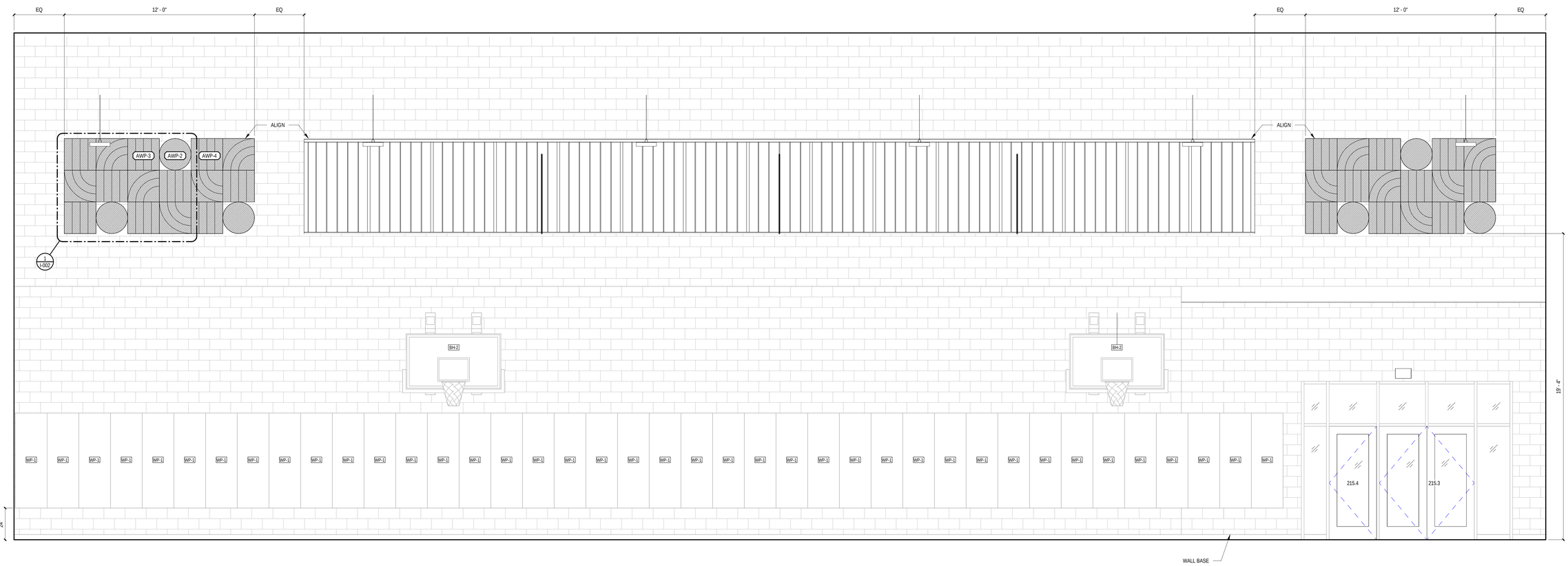


1 A-101B GYMNASIUM- SOUTH WALL
3/8" = 1'-0"



2 A-101A GYMNASIUM- WEST WALL
3/8" = 1'-0"

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INTERIOR ELEVATIONS - GYMNASIUM

REVISIONS

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DATE: 23-JUN-2023
SHEET
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100% CONSTRUCTION DOCUMENTS

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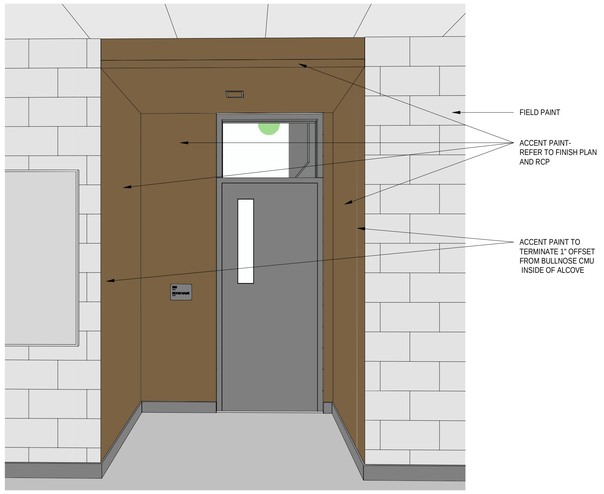
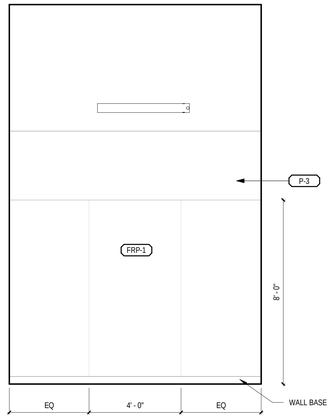
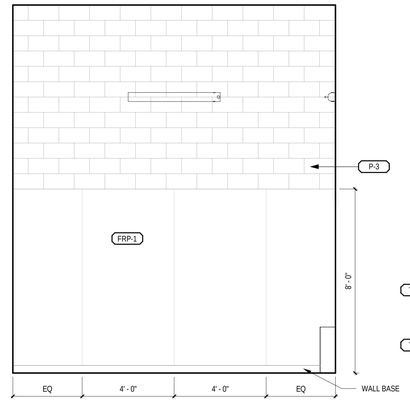


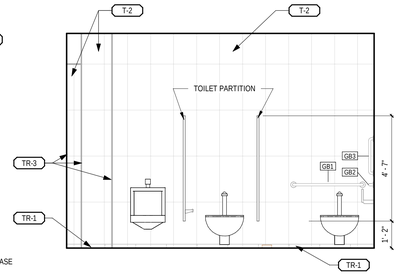
19 TYP. CLASSROOM ALCOVE



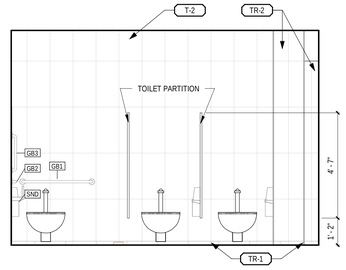
18 A-101A CAFETERIA TABLE STORAGE
3/8" = 1'-0"



17 A-101A CAFETERIA CHAIR STORAGE
3/8" = 1'-0"



16 A-101A BOYS GROUP TOILET ROOM
3/8" = 1'-0"



15 A-101A GIRLS GROUP TOILET ROOM
3/8" = 1'-0"

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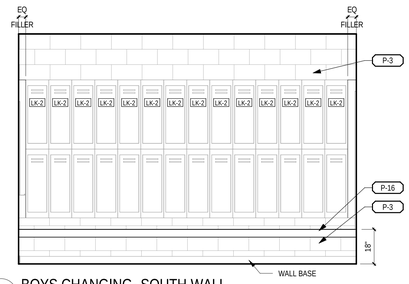
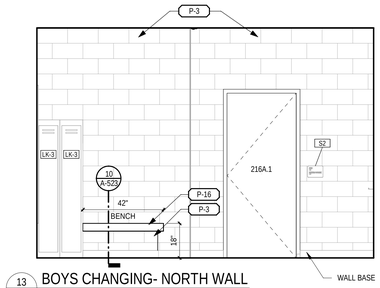
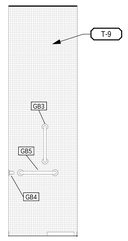


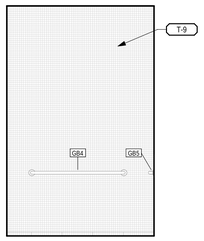
14 A-131 BOYS CHANGING- SOUTH WALL
3/8" = 1'-0"



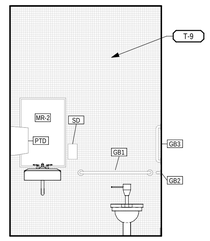
13 A-131 BOYS CHANGING- NORTH WALL
3/8" = 1'-0"



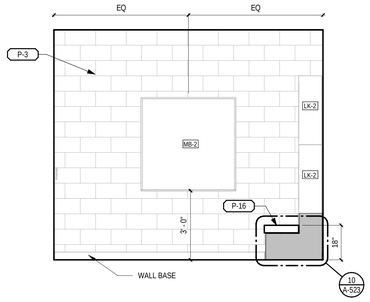
12 A-131 BOYS CHANGING SHOWER- NORTH
3/8" = 1'-0"



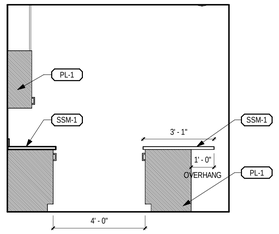
11 A-131 BOYS CHANGING SHOWER- WEST
3/8" = 1'-0"



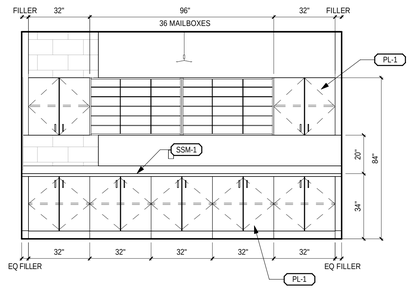
10 A-131 BOYS CHANGING TOILET
3/8" = 1'-0"



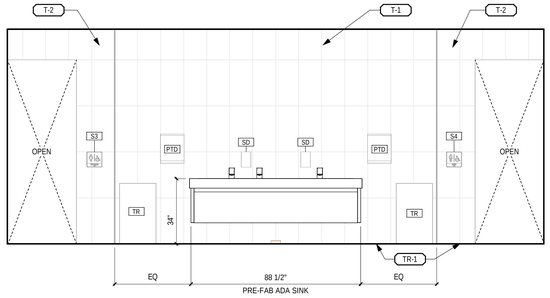
9 A-131 BOYS CHANGING- EAST WALL
3/8" = 1'-0"



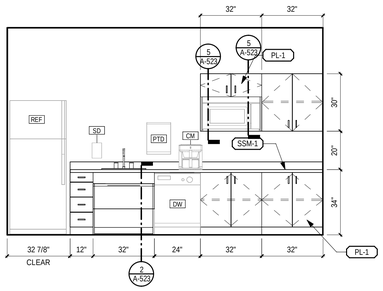
8 A-101A OFFICE WORK ROOM ISLAND
3/8" = 1'-0"



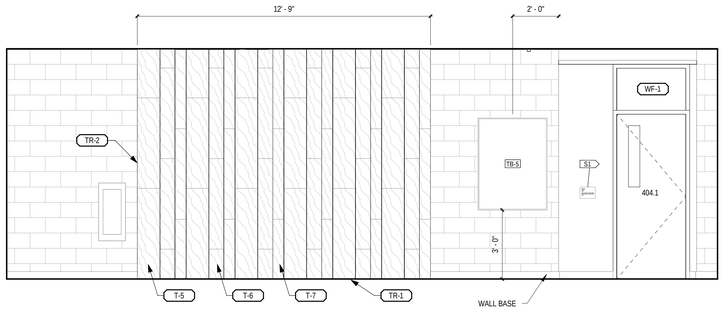
7 A-101A OFFICE WORK ROOM
3/8" = 1'-0"



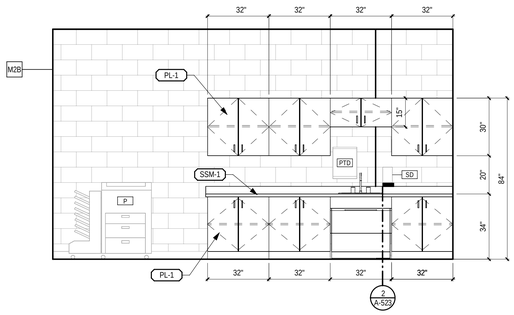
6 A-131 CORRIDOR GROUP TOILET SINK
3/8" = 1'-0"



5 A-101A OFFICE BREAKROOM
3/8" = 1'-0"



4 A-101A WOOD LOOK CORRIDOR TILE TYP.
3/8" = 1'-0"



3 A-101A TEACHER WORK ROOM
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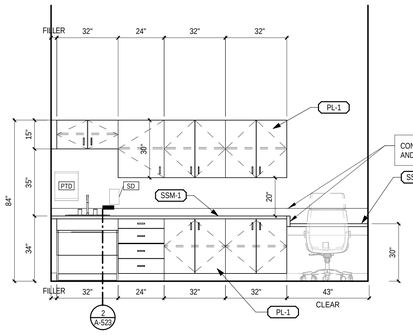

2 A-101A HEALTH CLINIC
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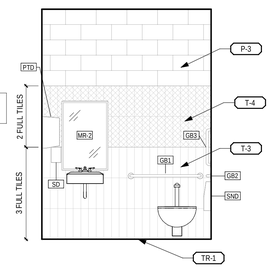

1 A-131 STAFF SINGLE RESTROOM
3/8" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/26/2023 8:44:52 AM
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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

INTERIOR ELEVATIONS - ANCILLARY SPACES

REVISIONS

REV	DESCRIPTION	DATE

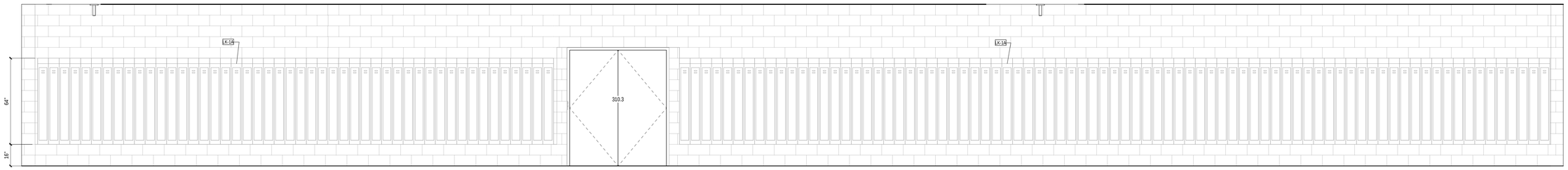
PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-407

100% CONSTRUCTION DOCUMENTS

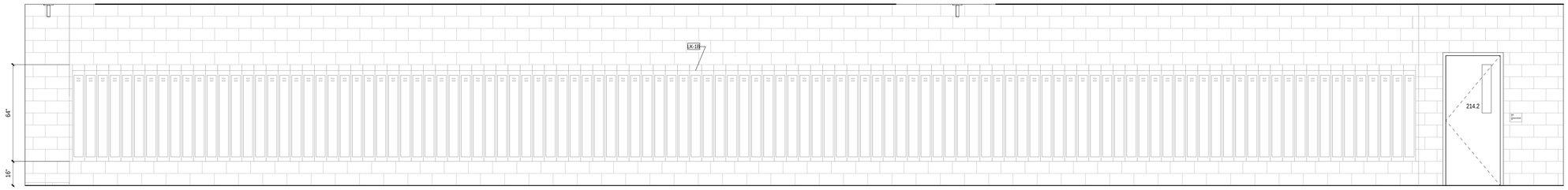
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
WHITE BLACK
WE RECYCLE

MILLWORK GENERAL NOTES:

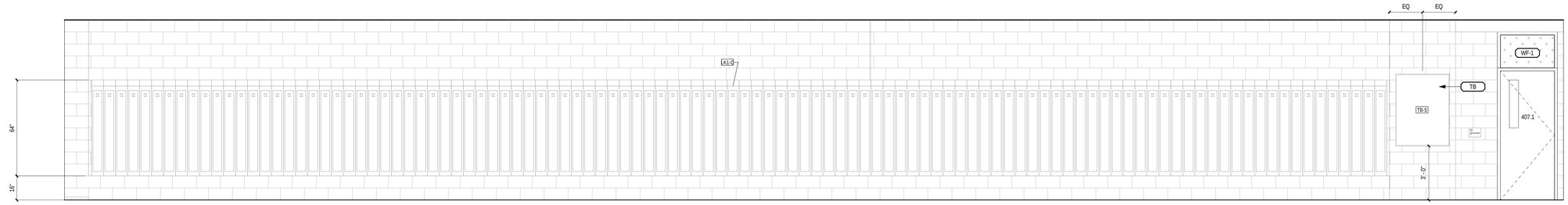
1. CONTRACTOR SHALL FIELD VERIFY ALL FINISHED DIMENSIONS PRIOR TO ORDERING / INSTALLATION.
2. ALL COUNTERTOP SUPPORTS SHALL BE SPACED 32" O.C. MAX. COORDINATE FINAL LOCATION W/ OWNER'S EQUIPMENT & FURNISHINGS PLACEMENT.
3. ALL EXPOSED SURFACES OF CABINETS ARE TO BE FINISHED TO MATCH CABINET FINISH, U.N.O.
4. GROMMETS SHALE BE SPACED 60" O.C. MAX. COORDINATE FINAL LOCATIONS WITH OWNER.
5. PROVIDE FILLER PIECE AT ALL LOCATIONS BETWEEN CABINET AND ADJACENT WALL OR CEILING. FILLER PIECE TO BE FLUSH WITH FACE OF CABINET AND SHALL MATCH MATERIAL AND FINISH OF CABINETS.
6. ALL COUNTERTOPS LOCATED ATOP BASE CABINETS TO HAVE 1" OVERHANG, U.N.O.
7. ALL BASE CABINETS SHALL BE 24"D, U.N.O.
8. ALL WALL CABINETS SHALL BE 12"D, U.N.O.
9. PROVIDE SEALANT AT ALL EDGES WHERE COUNTERTOP, SIDESPLASH OR BACKSPLASH ABUT ADJACENT SURFACES



4 A-101A NORTHWEST CORRIDOR
3/8" = 1'-0"



3 A-101B SOUTHWEST CORRIDOR
3/8" = 1'-0"



2 A-101A NORTHEAST CORRIDOR
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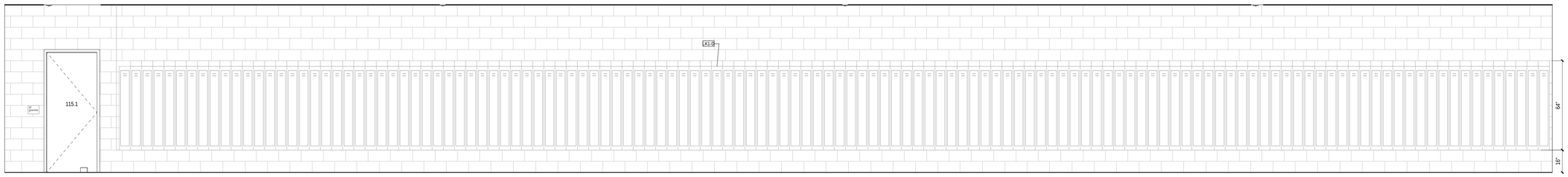

1 A-101B SOUTHEAST CORRIDOR
3/8" = 1'-0"

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INTERIOR ELEVATIONS - CORRIDORS

REVISIONS

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PROJ. #: 220116
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SHEET
A-408

100% CONSTRUCTION DOCUMENTS

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DESIGNED BY: Designer
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THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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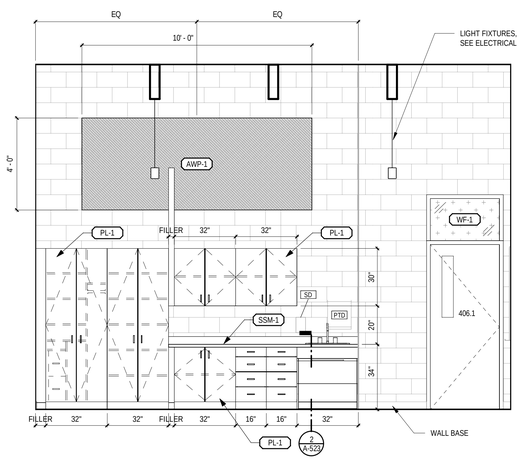
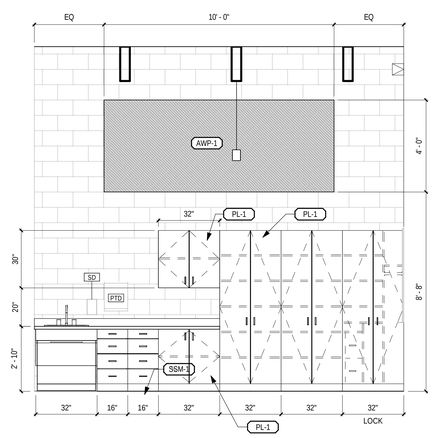
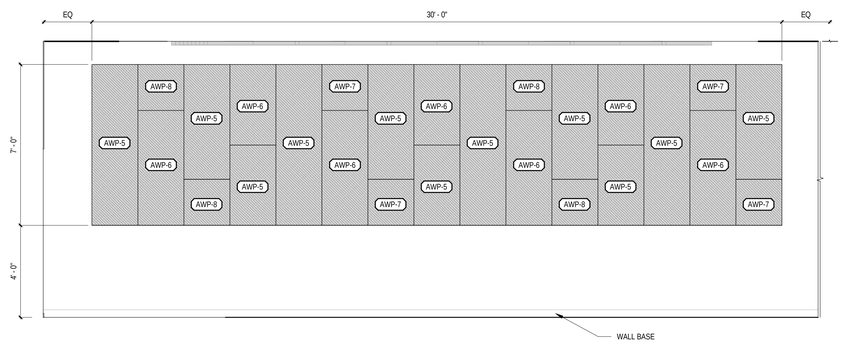


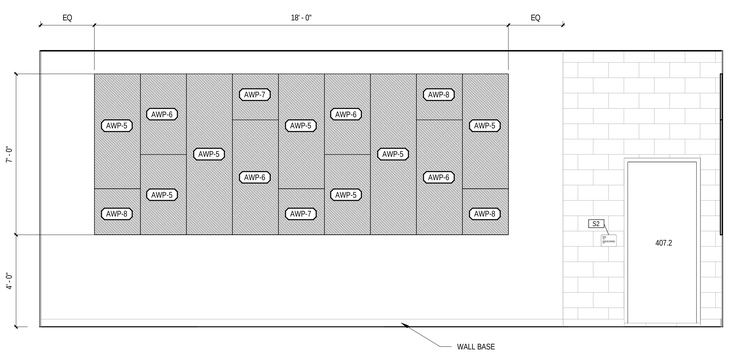
6 A-101A RESOURCE ROOM 406- EAST WALL
3/8" = 1'-0"



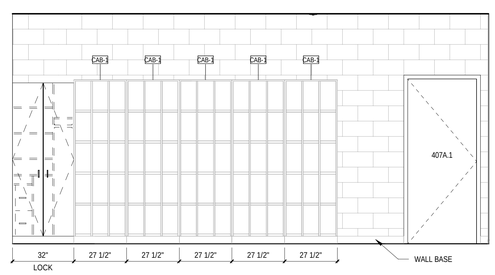
5 A-101A RESOURCE ROOM 210- EAST WALL
3/8" = 1'-0"



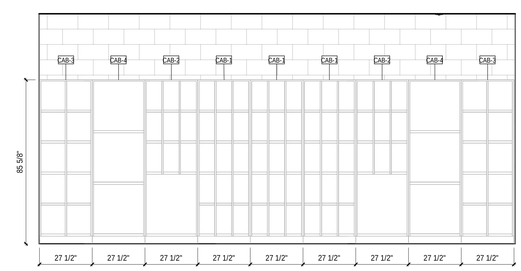
4 A-101A MUSIC ROOM SOUTH ACOUSTICAL WALL PANELS
3/8" = 1'-0"



3 A-101A MUSIC ROOM EAST ACOUSTICAL WALL PANELS
3/8" = 1'-0"



2 A-101A MUSIC ROOM SOUTH INSTRUMENT STORAGE
3/8" = 1'-0"



1 A-101A MUSIC ROOM NORTH INSTRUMENT STORAGE
3/8" = 1'-0"

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INTERIOR ELEVATIONS - CLASSROOMS SPECIFIC

REVISIONS

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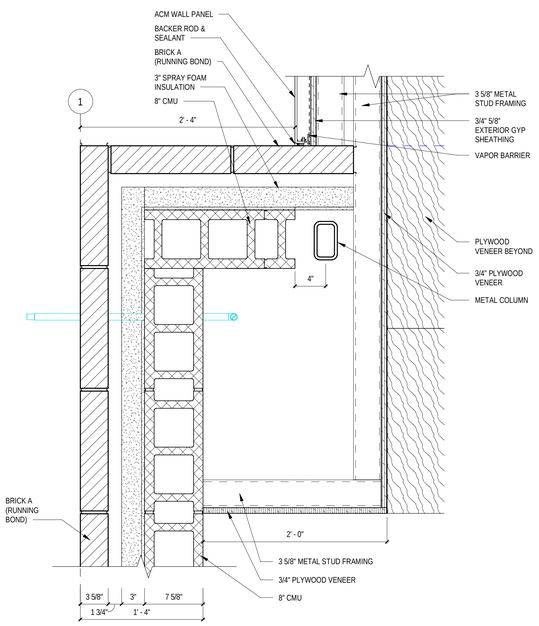
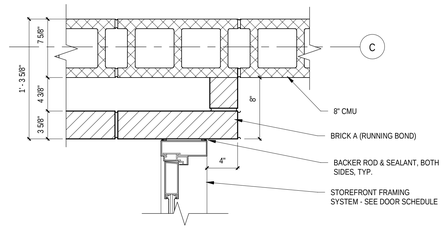
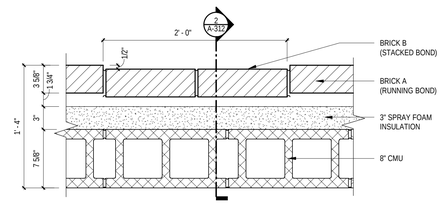


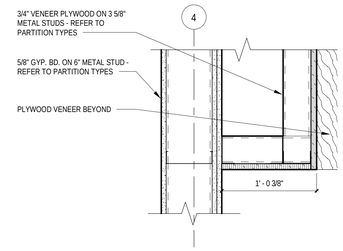
13 A-101A NOOK PLAN DETAIL
1 1/2" = 1'-0"



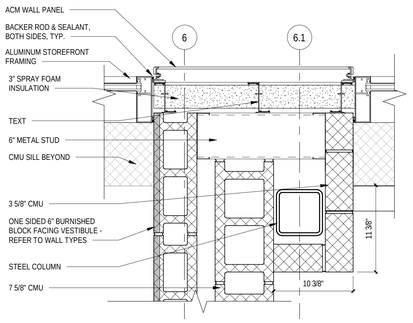
12 A-101A AREA A - TYPICAL ENTRY BRICK DETAIL 2
1 1/2" = 1'-0"



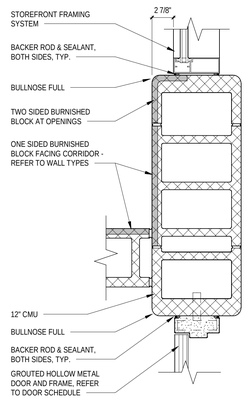
8 A-101A TYPICAL ACCENT BRICK DETAIL
1 1/2" = 1'-0"



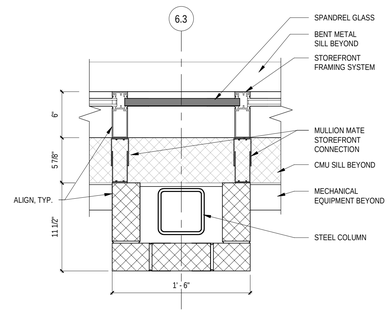
11 A-316 WALL AND NOOK PLAN DETAIL
1 1/2" = 1'-0"



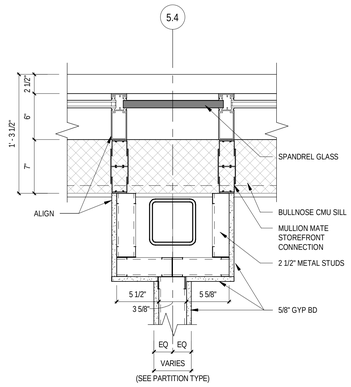
10 A-101A COLUMN ENCLOSURE 2
1 1/2" = 1'-0"



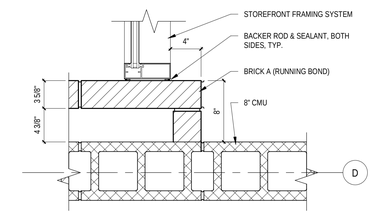
9 A-101A AREA A - GYMNASIUM BRICK DETAIL
1 1/2" = 1'-0"



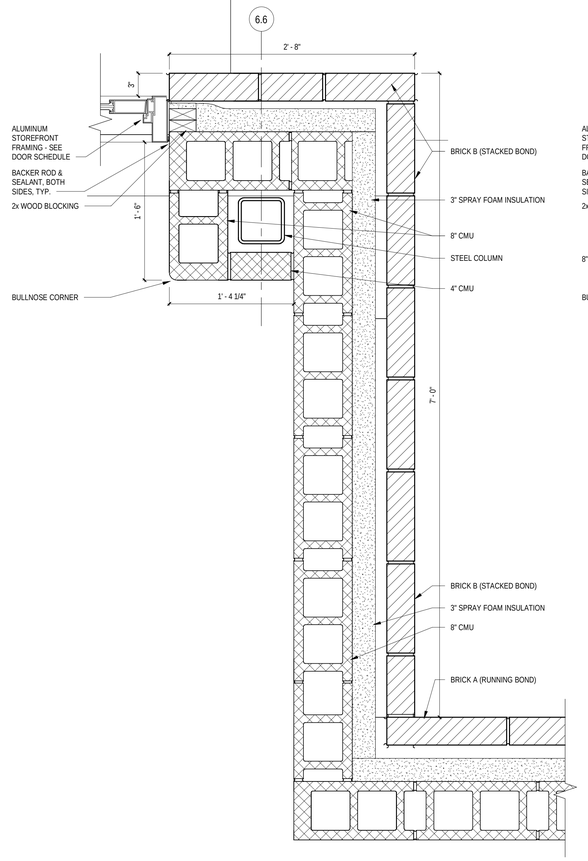
7 A-101B TYPICAL COLUMN ENCLOSURE
1 1/2" = 1'-0"



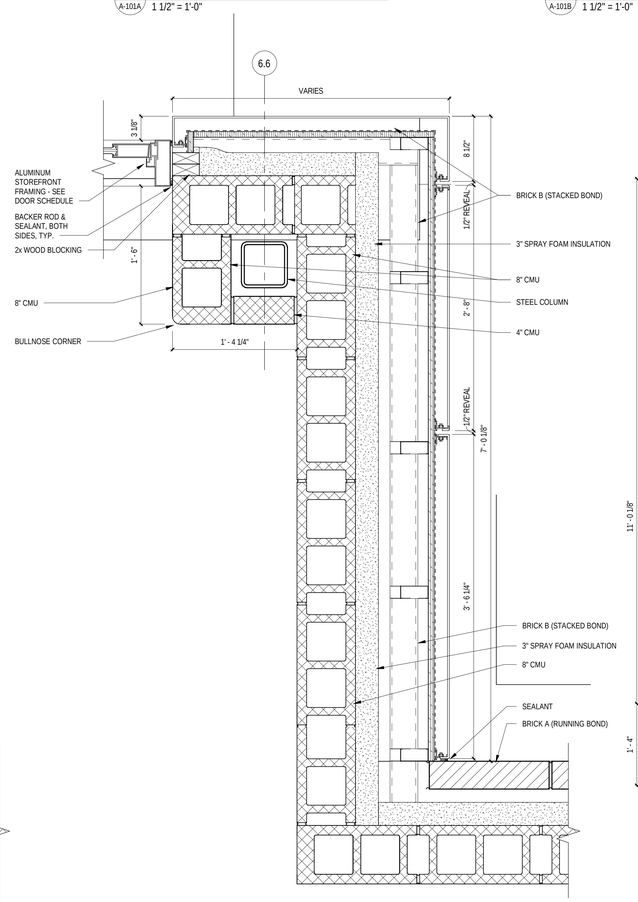
6 A-101A TYPICAL COLUMN ENCLOSURE W/ ADJACENT WALL
1 1/2" = 1'-0"



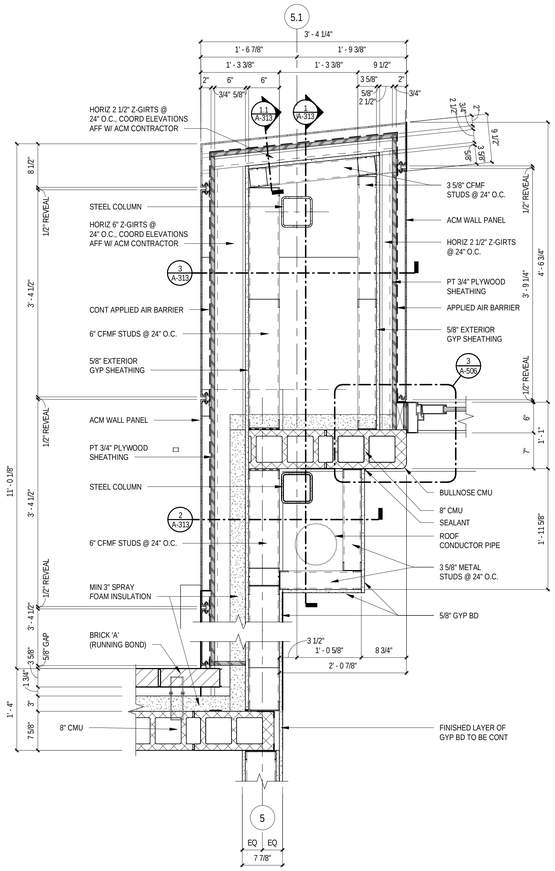
5 A-101A AREA A - TYPICAL ENTRY BRICK DETAIL
1 1/2" = 1'-0"



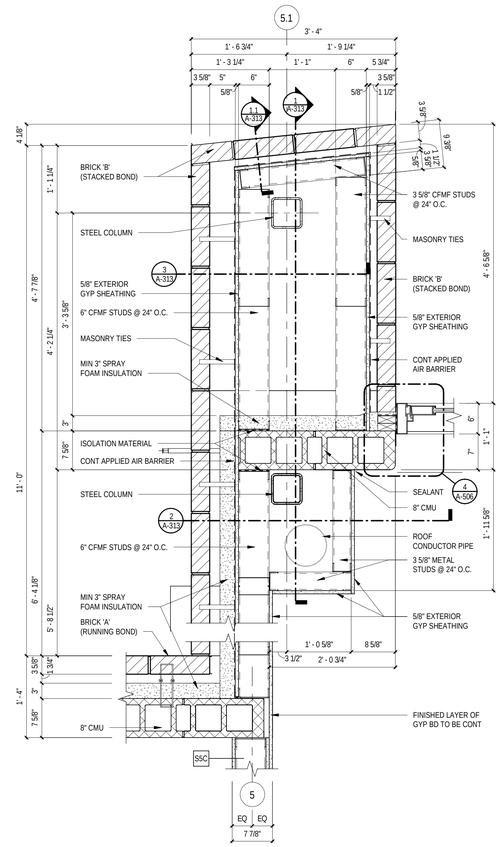
4 A-101B AREA B - ENTRY PAVILLION - LOWER
1 1/2" = 1'-0"



3 A-101B AREA B - ENTRY PAVILLION - UPPER
1 1/2" = 1'-0"



2 A-101A CANOPT NORTH WALL PLAN DETAIL @ ACM PANELS
1" = 1'-0"



1 A-101A CANOPY NORTH WALL PLAN DETAIL @ BRICK
1" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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PLAN DETAILS

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SHEET
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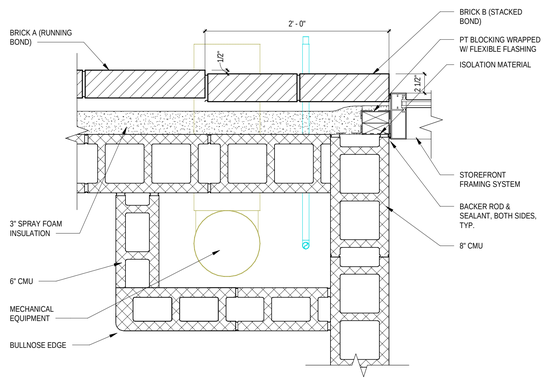
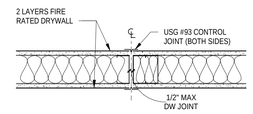
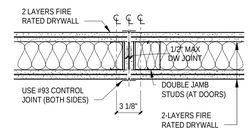


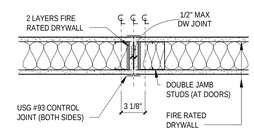
13 A-101B ACCENT BRICK AT DOOR PLAN DETAIL
1 1/2" = 1'-0"



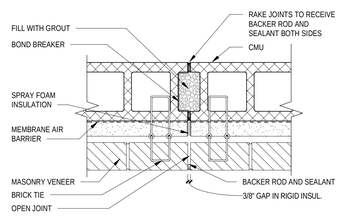
12 TYPICAL CONTROL JOINT @ NON-RATED WALLS
1 1/2" = 1'-0"



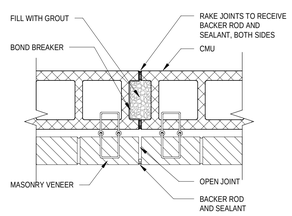
11 TYPICAL CONTROL JOINT @ 2-HR
1 1/2" = 1'-0"



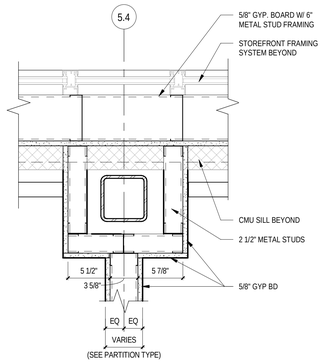
10 TYPICAL CONTROL JOINT @ 1-HR (INCLUDE SMOKE)
1 1/2" = 1'-0"



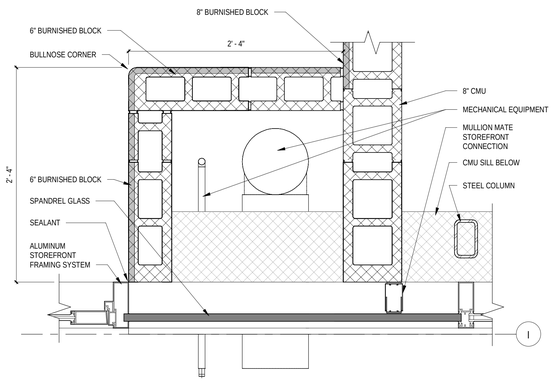
9 MASONRY CONTROL JOINT AT CMU, INSULATION, BRICK
1 1/2" = 1'-0"



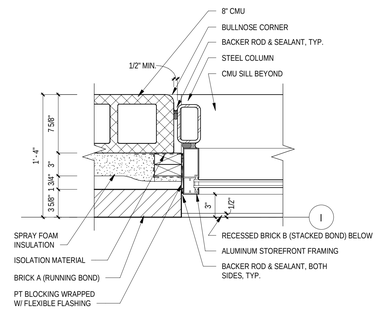
8 MASONRY CONTROL JOINT AT CMU, AIR SPACE, BRICK
1 1/2" = 1'-0"



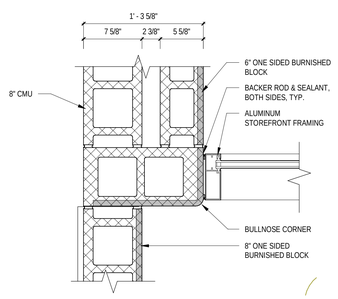
7 A-101A TYPICAL COLUMN ENCLOSURE DETAIL - ABOVE
1 1/2" = 1'-0"



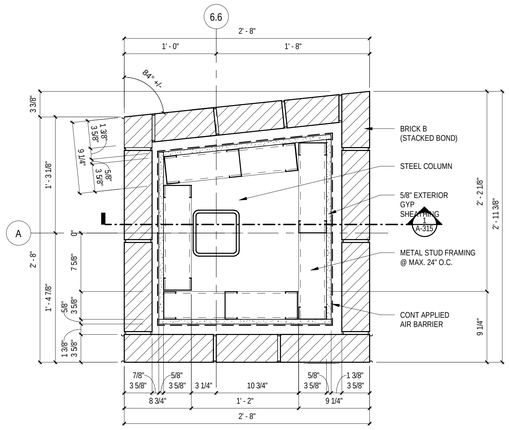
6 A-101A PLAN AREA B - SPANDREL GLASS & PIPE ENCLOSURE DETAIL
1 1/2" = 1'-0"



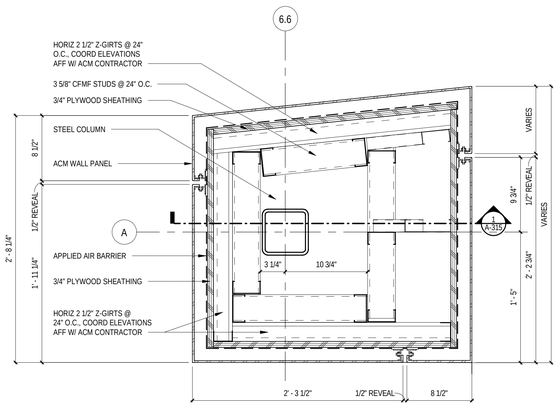
5 A-101A TYPICAL COLUMN WINDOW DETAIL
1 1/2" = 1'-0"



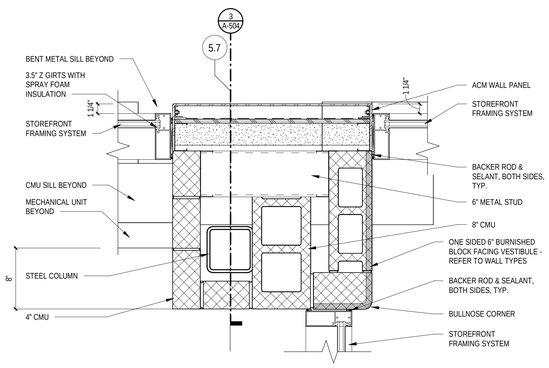
4 A-101A PLAN BURNISHED BLOCK DETAIL AT ENTRY
1 1/2" = 1'-0"



3 A-101B PLAN AREA B - ENTRY PAVILLION PIER - LOWER
1 1/2" = 1'-0"



2 A-101B PLAN AREA B - ENTRY PAVILLION PIER - UPPER
1 1/2" = 1'-0"



1 A-101A PLAN AREA A - ENTRY BRICK DETAIL
1 1/2" = 1'-0"

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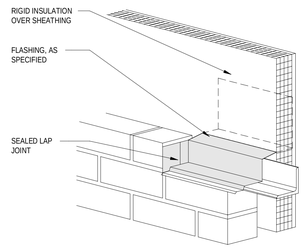
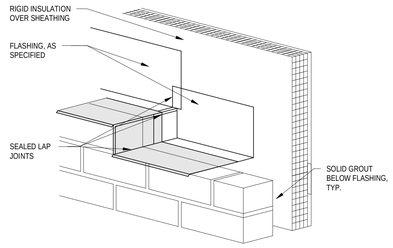
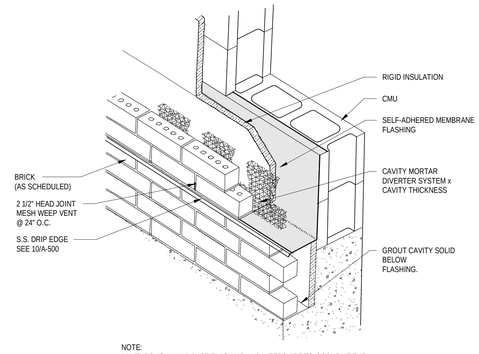


15 TYP. LINTEL FLASHING DETAIL @ EXTERIOR INSUL.
1 1/2" = 1'-0"

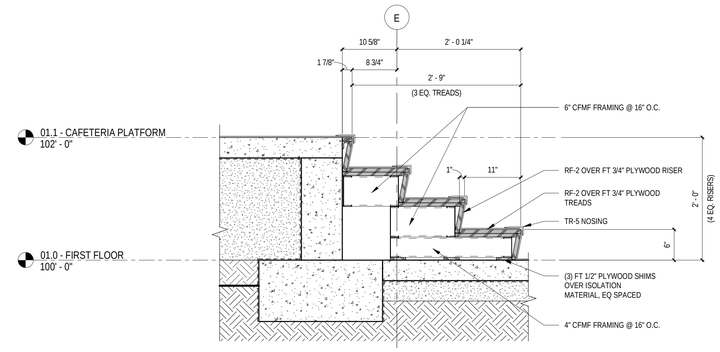


14 TYP. STEPPED FLASHING DETAIL @ EXTERIOR INSUL.
1 1/2" = 1'-0"

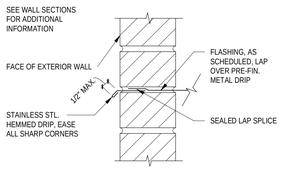


NOTE:
ALL THROUGH-WALL BASE FLASHING AND WEEPS ARE TO OCCUR AT THE SECOND MORTAR JOINT ABOVE GRADE, SOLID GROUT ANY CAVITY BELOW. STEP UP & DOWN PER GRADE

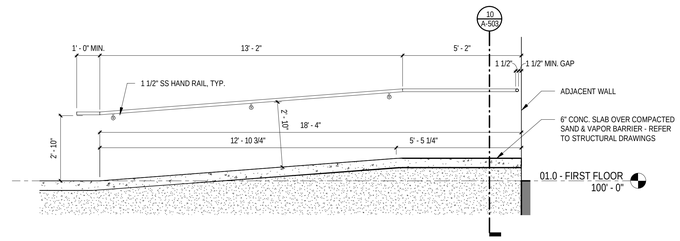
17 MASONRY VENEER (ON CMU) BASE FLASHING DETAIL
3/4" = 1'-0"



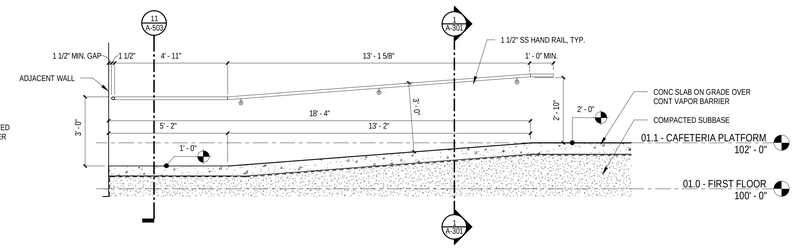
13 A-302 CAFETERIA PLATFORM STEPS
1" = 1'-0"



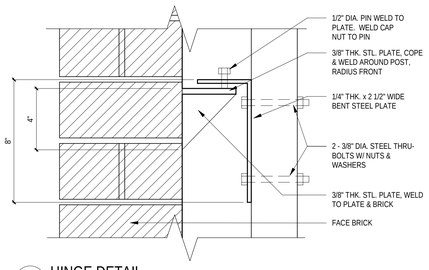
16 TYP. 2-PIECE FLASHING DETAIL
3" = 1'-0"



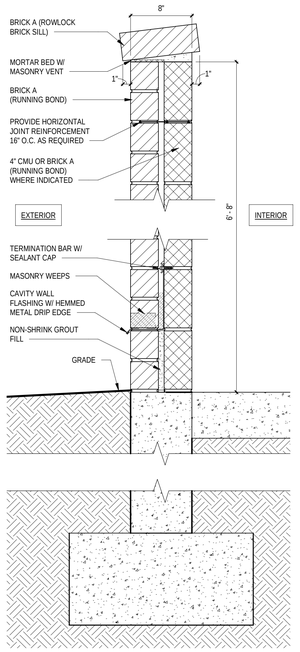
11 A-131 AREA A - TYPICAL RAMP DETAIL
3/8" = 1'-0"



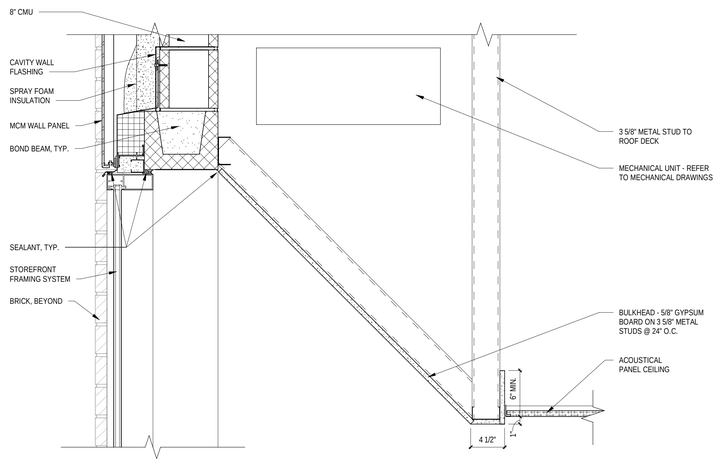
10 A-101A AREA A - TYPICAL RAMP DETAIL 2
3/8" = 1'-0"



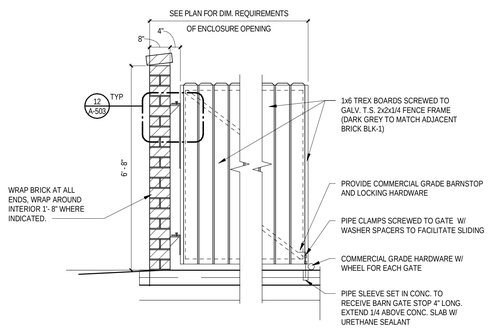
12 A-503 HINGE DETAIL
3" = 1'-0"



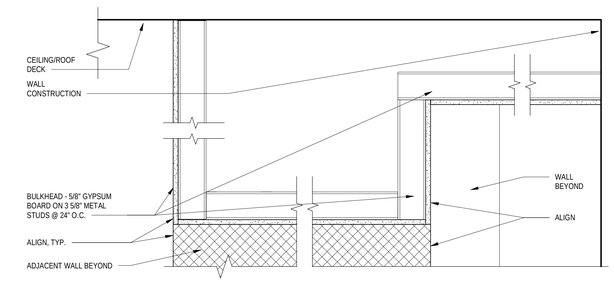
8 A-131 DUMPSTER ENCLOSURE WALL SECTION DETAIL
1 1/2" = 1'-0"



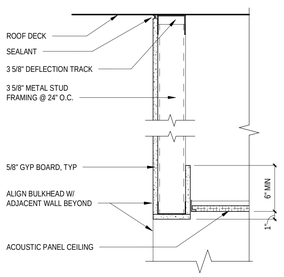
7 A-102B TYPICAL CEILING SLOPE DETAIL
1 1/2" = 1'-0"



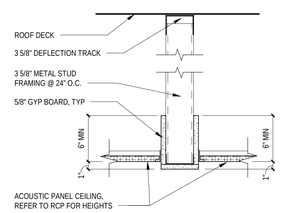
9 A-131 TRASH ENCLOSURE GATE
1/2" = 1'-0"



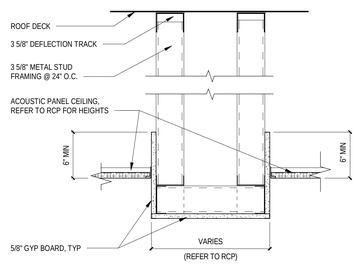
6 A-111A CEILING BULKHEAD DETAIL AT CAFETERIA PLATFORM
1 1/2" = 1'-0"



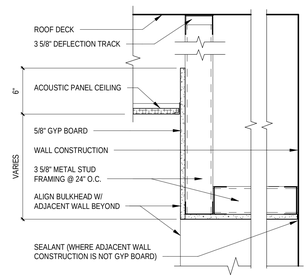
5 A-111A BULKHEAD DETAIL @ ACOUSTIC CEILING TERMINATION
1 1/2" = 1'-0"



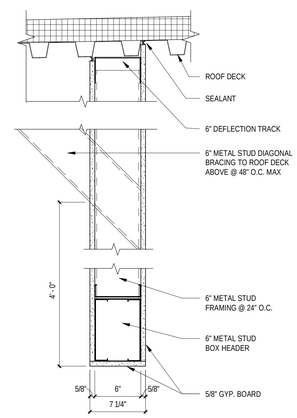
4 A-111A BULKHEAD DETAIL @ ACOUSTIC CEILING TRANS
1 1/2" = 1'-0"



3 A-111A BULKHEAD DETAIL @ WIDE BULKHEADS
1 1/2" = 1'-0"



2 A-111A BULKHEAD DETAIL @ GYP / ACOUSTIC CEILING TRANS
1 1/2" = 1'-0"



1 A-302 BULKHEAD DETAIL @ CAFETERIA PLATFORM
1 1/2" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/28/2023 6:45:06 AM
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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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REV	DESCRIPTION	DATE

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DATE: 23-JUN-2023
SHEET
A-503

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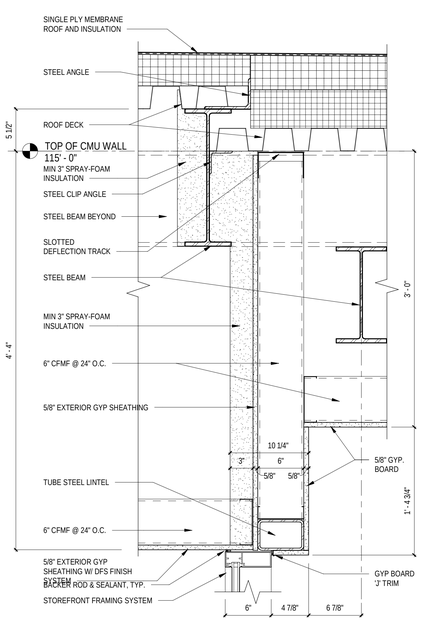
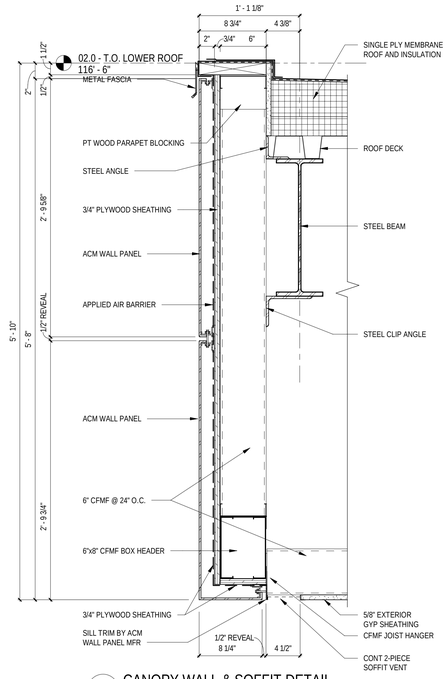
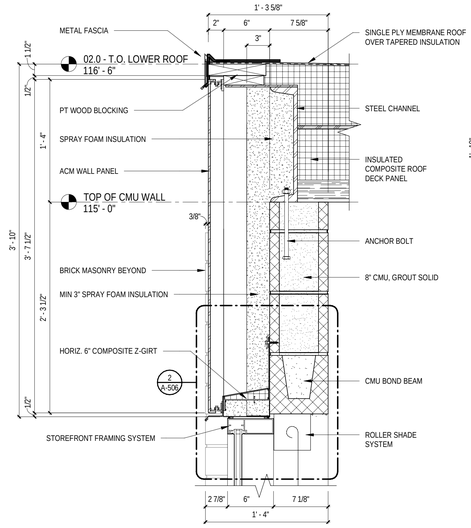


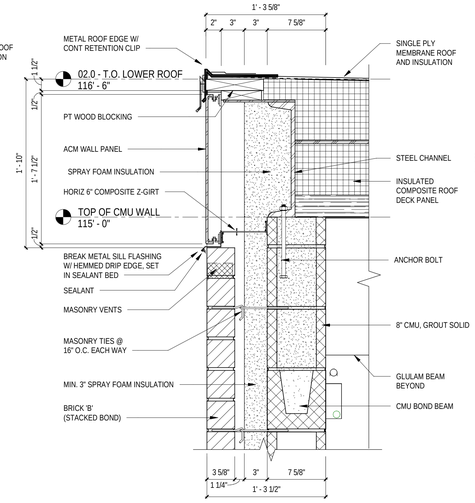
13 A-314 CANOPY STOREFRONT HEAD DETAIL
1 1/2" = 1'-0"



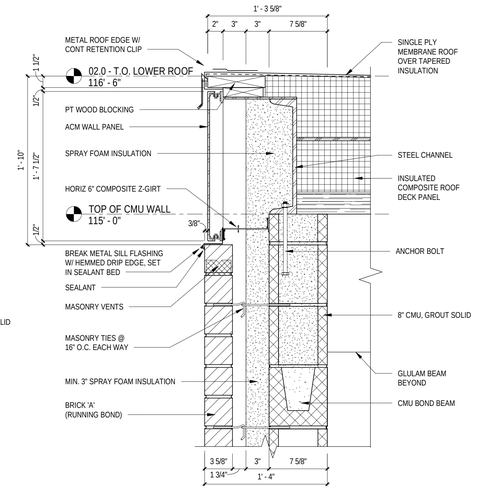
14 A-211 CANOPY WALL & SOFFIT DETAIL
1 1/2" = 1'-0"



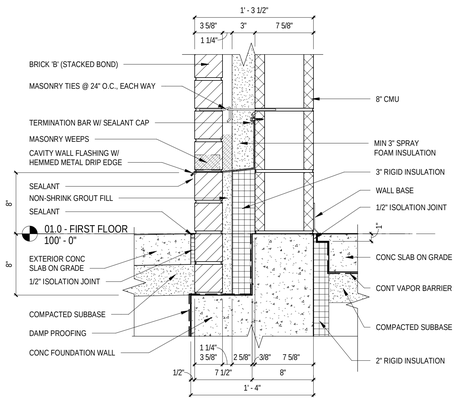
12 A-301 TYP. EXTERIOR WALL HEAD DETAIL @ STOREFRONT
1 1/2" = 1'-0"



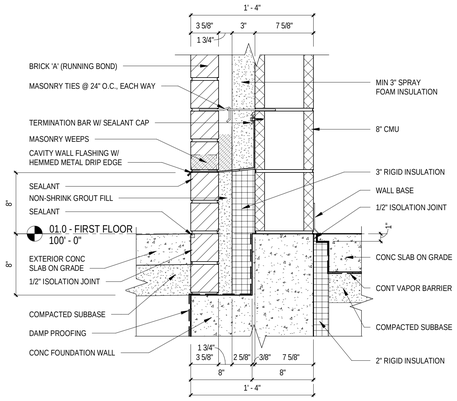
11 A-312 TYP. EXTERIOR WALL HEAD DETAIL @ BRICK 'B'
1 1/2" = 1'-0"



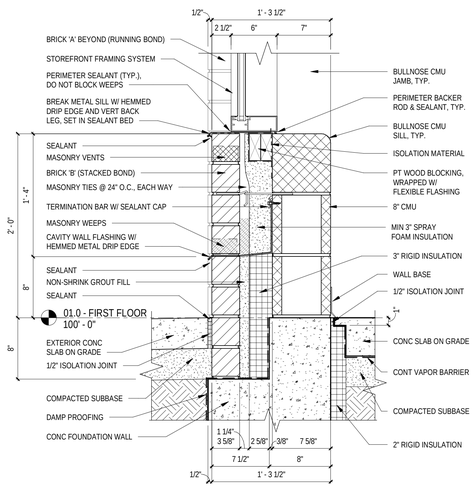
10 A-312 TYP. EXTERIOR WALL HEAD DETAIL @ BRICK 'A'
1 1/2" = 1'-0"



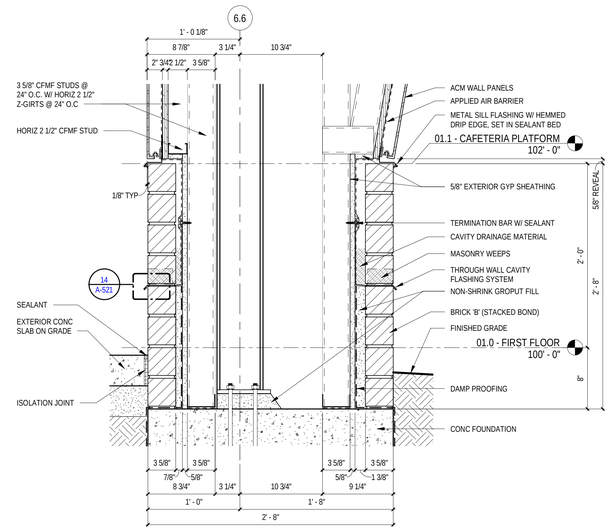
8 A-302 TYP. EXTERIOR WALL BASE @ BRICK 'B'
1 1/2" = 1'-0"



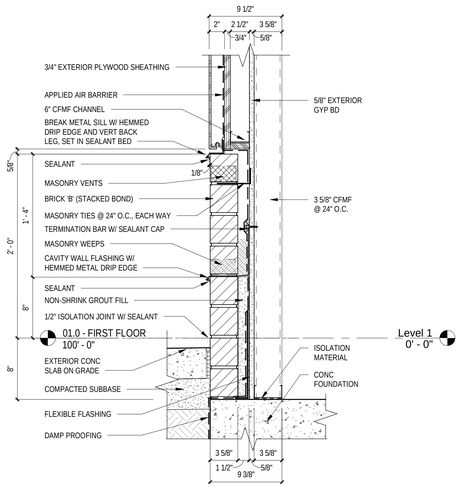
7 A-312 TYP EXTERIOR WALL BASE DETAIL @ BRICK 'A'
1 1/2" = 1'-0"



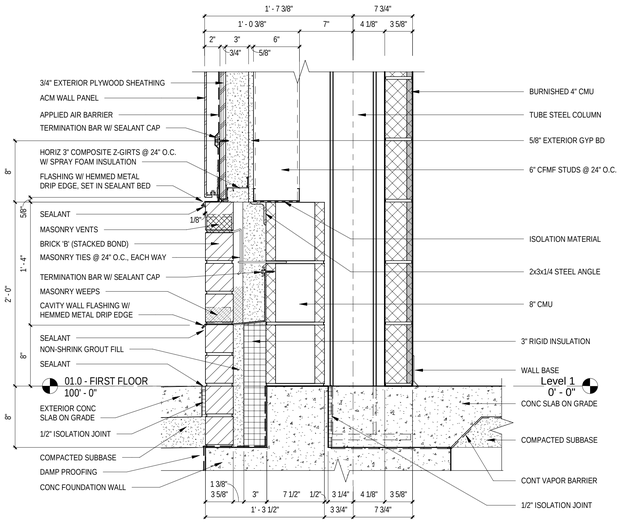
6 A-312 TYP. EXTERIOR WALL BASE DETAIL @ STOREFRONT
1 1/2" = 1'-0"



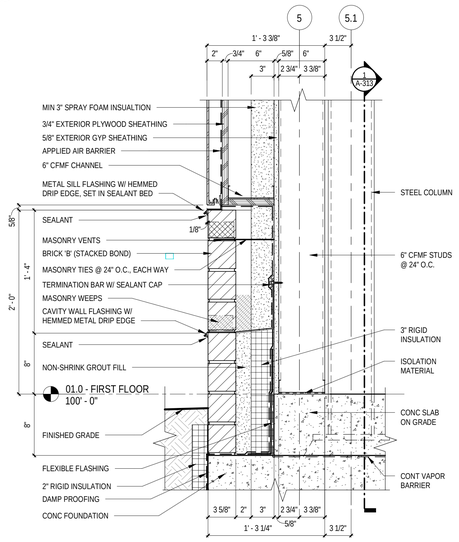
5 A-312 SOUTH CANOPY PIER BASE
1 1/2" = 1'-0"



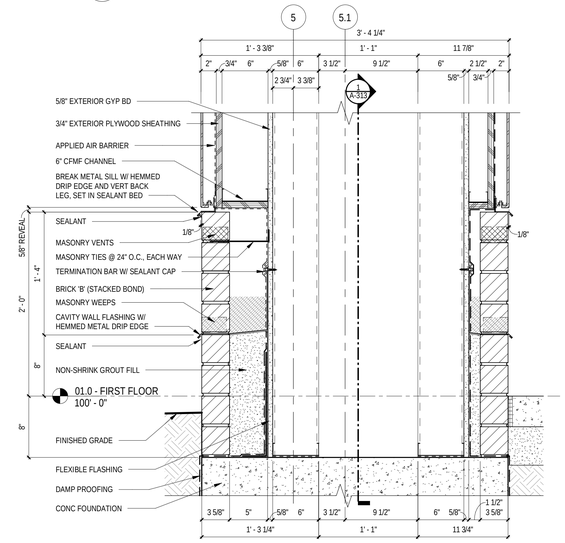
4 A-211 NORTH CANOPY WALL BASE DETAIL @ END
1 1/2" = 1'-0"



3 A-101A TYP. EXTERIOR WALL BASE @ BRICK / ACM
1 1/2" = 1'-0"



2 A-313 EXTERIOR WALL BASE DETAIL @ NORTH CLINIC WALL
1 1/2" = 1'-0"



1 A-313 NORTH CANOPY WALL BASE DETAIL (N/S)
1 1/2" = 1'-0"

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A-504

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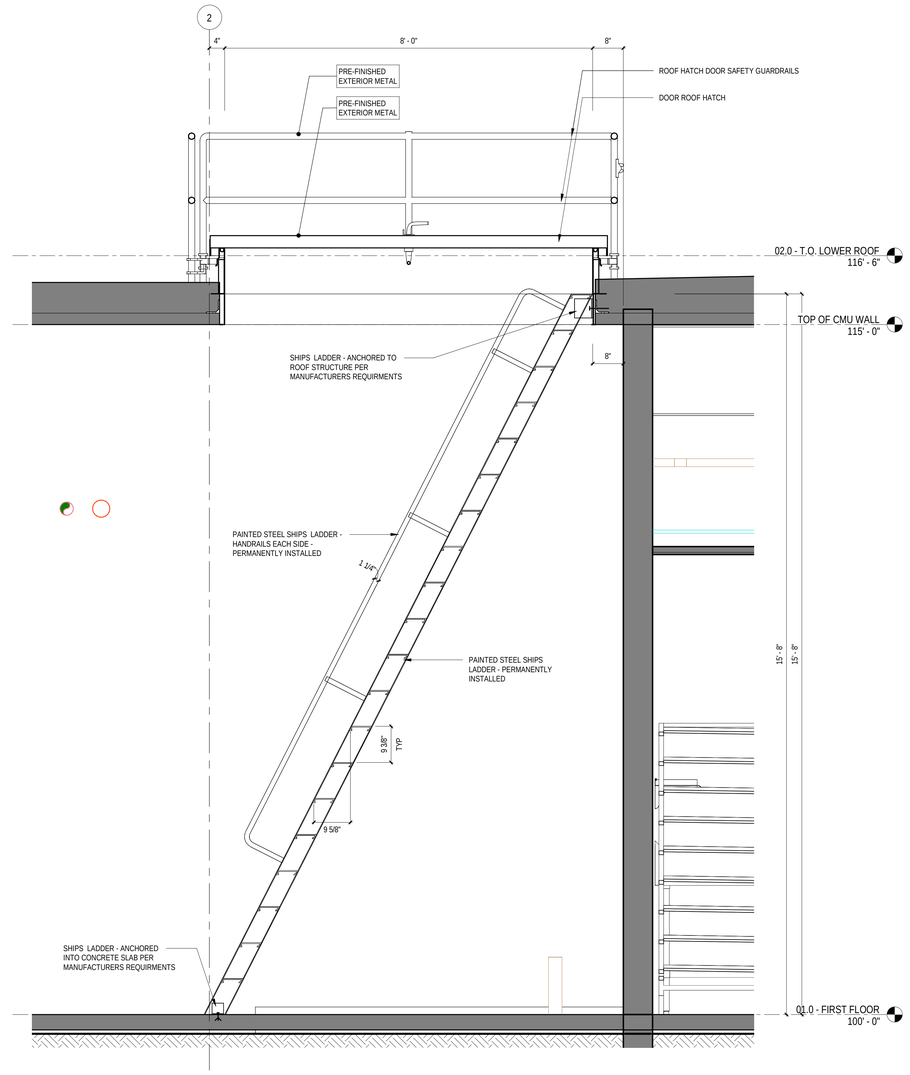
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE



1 A-101A SHIPS LADDER DETAIL
3/4" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

WE RECYCLE

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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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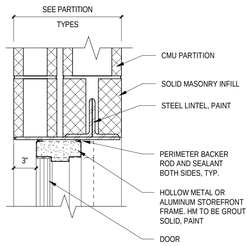
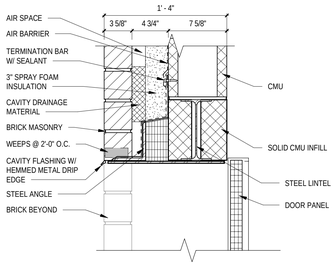
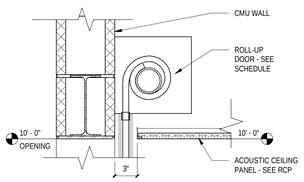


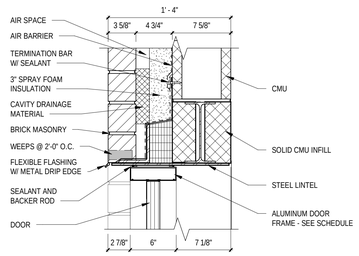
H6 HM INTERIOR DOOR AT CMU WALL HEAD 2
1 1/2" = 1'-0"



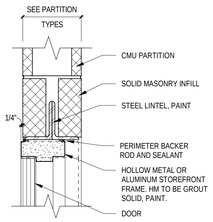
H5 SECTIONAL OVERHEAD DOOR HEAD
1 1/2" = 1'-0"



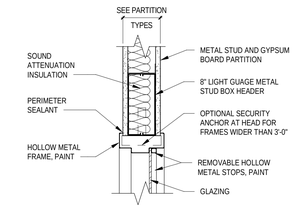
H4 ROLL UP DOOR AT CMU HEAD
1 1/2" = 1'-0"



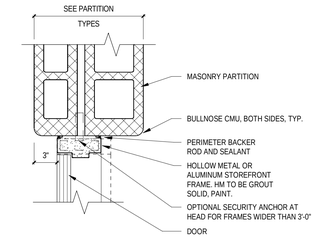
H3 EXTERIOR DOOR AT CMU WITH BRICK HEAD
1 1/2" = 1'-0"



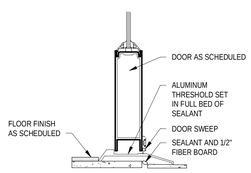
H2 HM INTERIOR DOOR AT CMU WALL HEAD
1 1/2" = 1'-0"



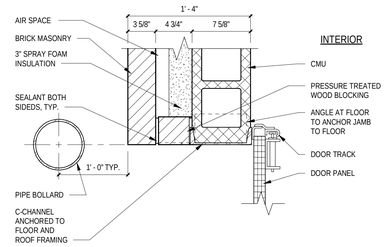
H1 HM BORROWED LITE AT METAL STUDS HEAD
1 1/2" = 1'-0"



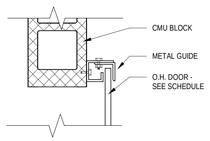
J6 HM INTERIOR DOOR AT CMU WALL JAMB 2
1 1/2" = 1'-0"



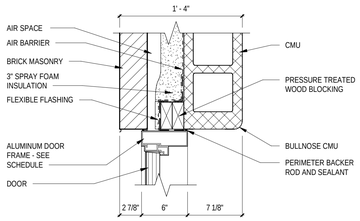
S1 ALUMINUM DOOR THRESHOLD DETAIL
3" = 1'-0"



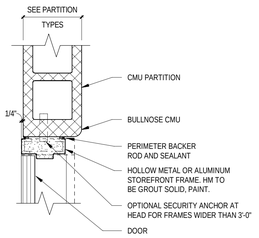
J5 SECTIONAL OVERHEAD DOOR JAMB
1 1/2" = 1'-0"



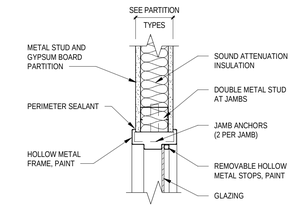
J4 ROLL UP DOOR AT CMU JAMB
1 1/2" = 1'-0"



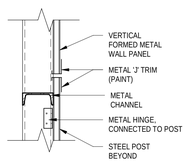
J3 EXTERIOR DOOR AT CMU WITH BRICK JAMB
1 1/2" = 1'-0"



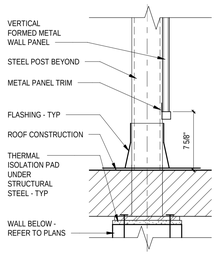
J2 HM INTERIOR DOOR AT CMU WALL JAMB
1 1/2" = 1'-0"



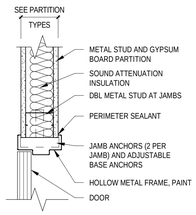
J1 HM BORROWED LITE AT METAL STUDS JAMB
1 1/2" = 1'-0"



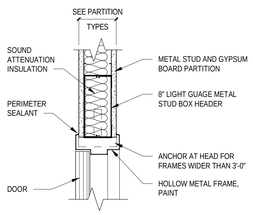
8 A-314 TYP SWING GATE HEAD
1 1/2" = 1'-0"



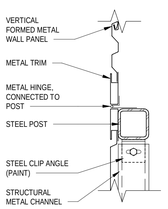
7 A-314 TYP SWING GATE BOTTOM
1 1/2" = 1'-0"



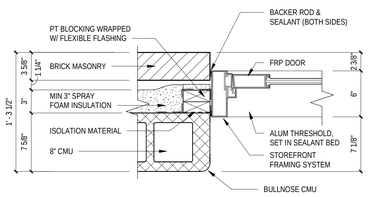
6 HM INTERIOR DOOR AT METAL STUDS JAMB
1 1/2" = 1'-0"



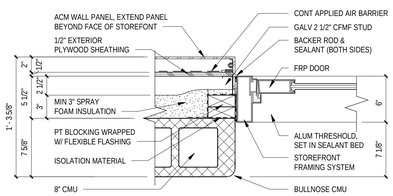
5 HM INTERIOR DOOR AT METAL STUDS HEAD
1 1/2" = 1'-0"



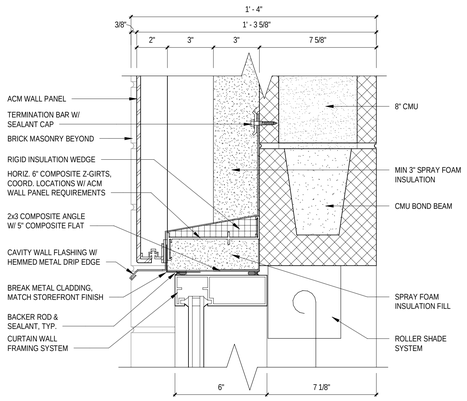
9 A-314 TYP SWING GATE JAMB
1 1/2" = 1'-0"



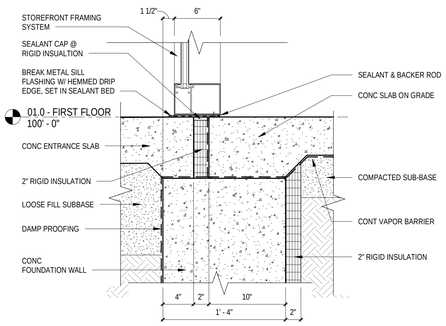
4 A-501 TYP. STOREFRONT DOOR JAMB @ BRICK / CMU
1 1/2" = 1'-0"



3 A-501 TYP. STOREFRONT DOOR JAMB @ ACM / CMU
1 1/2" = 1'-0"



2 A-504 TYP. STOREFRONT HEAD FLASHING
3" = 1'-0"



1 A-314 STOREFRONT SILL @ ENTRANCE SLAB
1 1/2" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/28/2023 12:29:09 PM
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CHECKED BY: Checker APPROVED BY: Approver

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DOOR & WINDOW DETAILS

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DATE: 23-JUN-2023
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A-506

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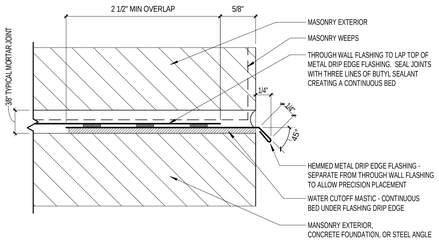
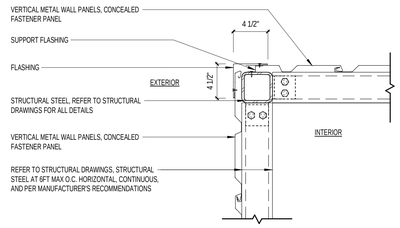
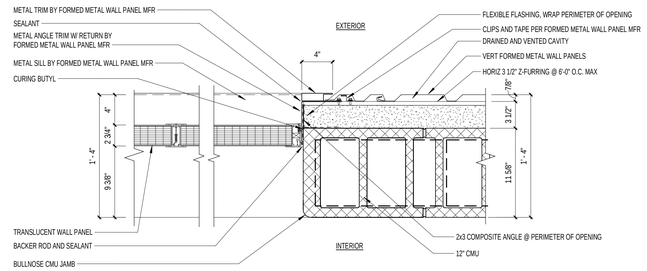


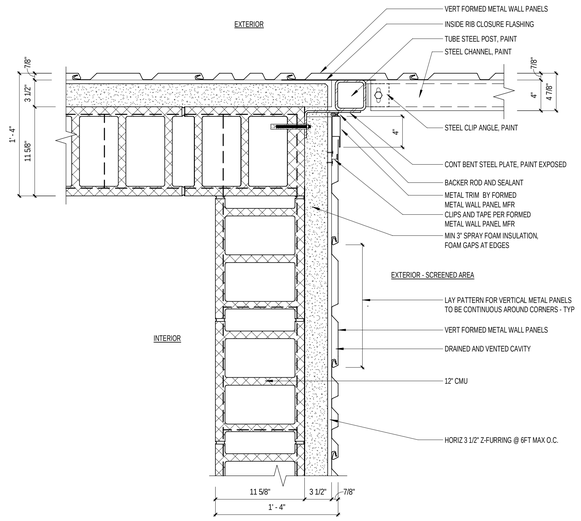
14 A-123 TYPICAL PROJECTED HEMMED DRIP EDGE DETAIL
12" = 1'-0"



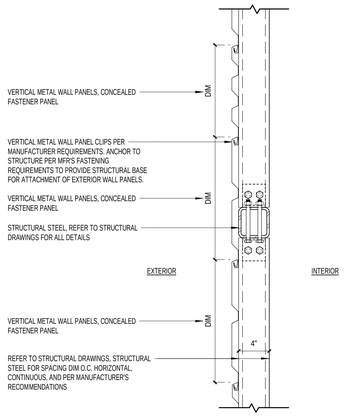
11 A-102 EXTERIOR WALL - PLAN DETAIL - MECH SCREEN OUTSIDE CORNER
1 1/2" = 1'-0"



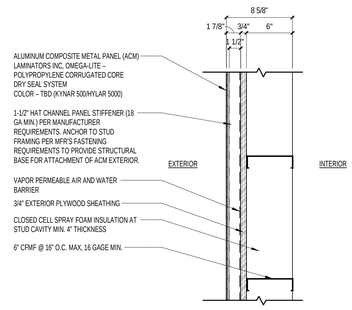
10 A-102 EXTERIOR WALL - PLAN DETAIL - TRANSLUCENT WALL PANEL
1 1/2" = 1'-0"



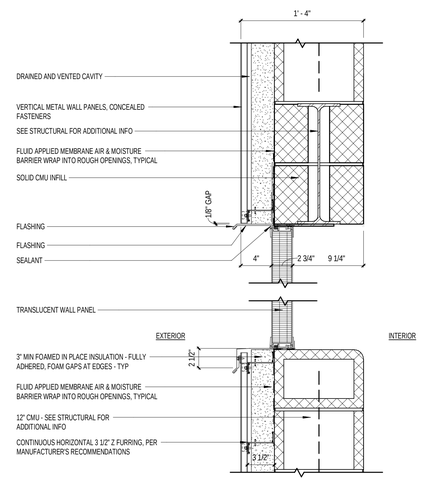
9 A-102 EXTERIOR WALL - PLAN CORNER DETAIL - VERTICAL METAL PANEL SCREEN
1 1/2" = 1'-0"



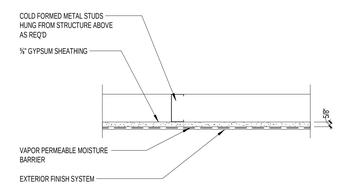
8 A-102 TYPICAL EXTERIOR WALL CONSTRUCTION - PLAN - METAL PANEL SCREEN
1 1/2" = 1'-0"



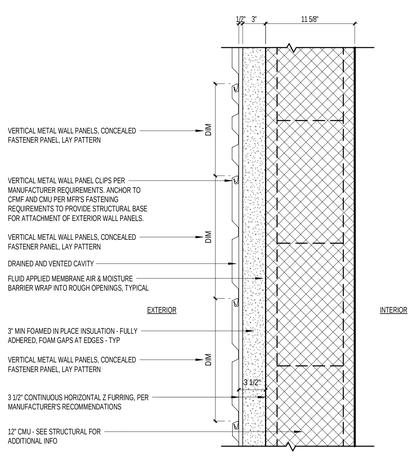
7 TYPICAL EXTERIOR WALL CONSTRUCTION - PLAN - ACM ENTRANCE CANOPY
1 1/2" = 1'-0"



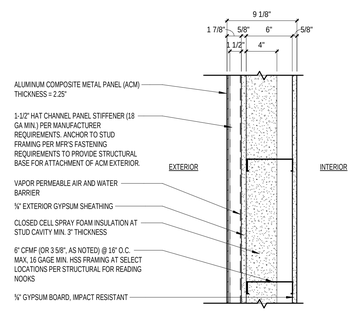
6 A-102 EXTERIOR WALL - SECTION DETAIL - TRANSLUCENT WALL PANEL
1 1/2" = 1'-0"



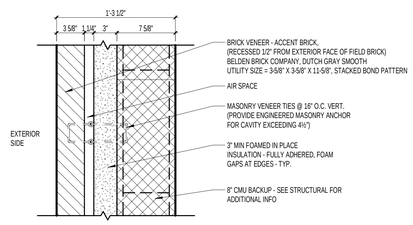
5 COMPOSITE PANEL SOFFIT ASSEMBLY
1 1/2" = 1'-0"



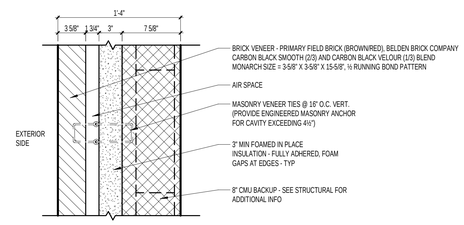
4 TYPICAL EXTERIOR WALL CONSTRUCTION - PLAN - METAL PANEL / CMU
1 1/2" = 1'-0"



3 TYPICAL EXTERIOR WALL CONSTRUCTION - PLAN - ACM READING NOOKS
1 1/2" = 1'-0"



2 TYP EXTERIOR WALL CONSTRUCTION - PLAN - ACCENT BRICK VENEER / CMU
1 1/2" = 1'-0"



1 TYP EXTERIOR WALL CONSTRUCTION - PLAN - PRIMARY BRICK VENEER / CMU
1 1/2" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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TYPICAL EXTERIOR ASSEMBLIES, DETAILS

REVISIONS

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A-521

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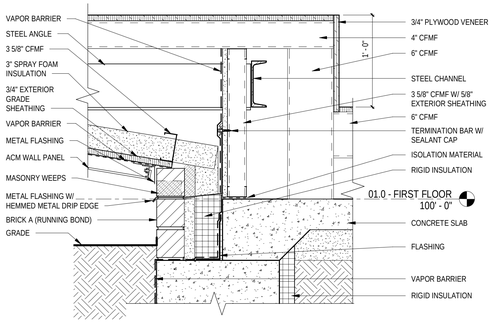
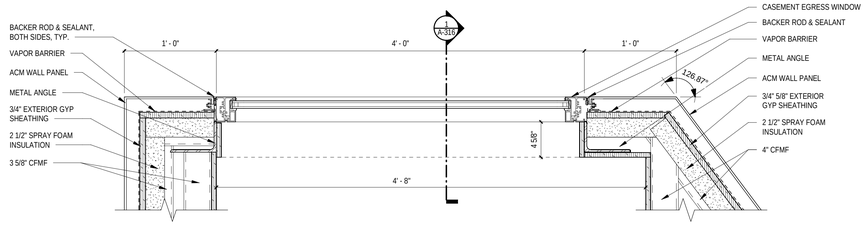
NOTE:

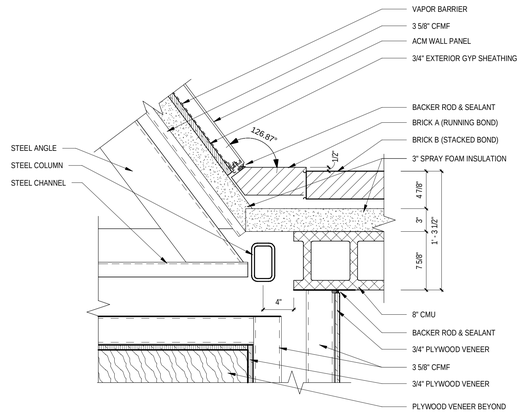
DETAILING BELOW IS PROVIDED TO CLARIFY DESIGN INTENT. ACTUAL CONNECTIONS, ASSEMBLY, AND MAKEUP IS THE RESPONSIBILITY OF THE CONTRACTOR. CONTRACTOR TO PROVIDE FULLY ASSEMBLED AND WEATHER TIGHT CONSTRUCTION.



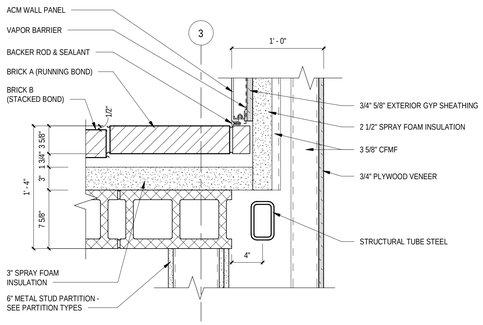
13 A-316 TYPICAL NOOK A SILL DETAIL
1 1/2" = 1'-0"



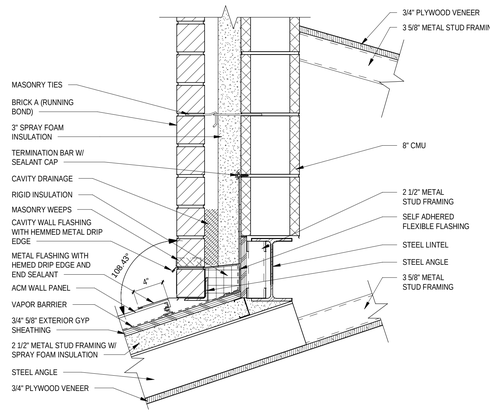
12 A-316 TYPICAL NOOK A WINDOW DETAIL
1 1/2" = 1'-0"



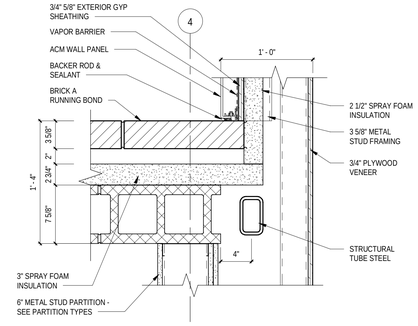
11 A-316 TYPIAL NOOK A PLAN DETAIL
1 1/2" = 1'-0"



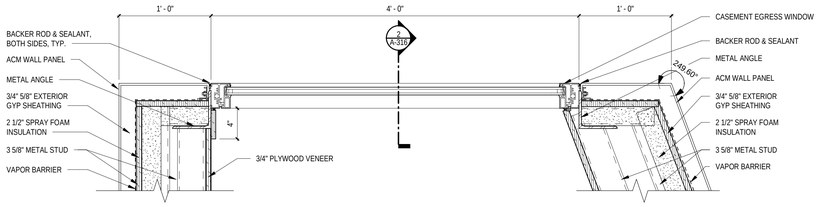
9 A-316 TYPICAL NOOK A PLAN DETAIL
1 1/2" = 1'-0"



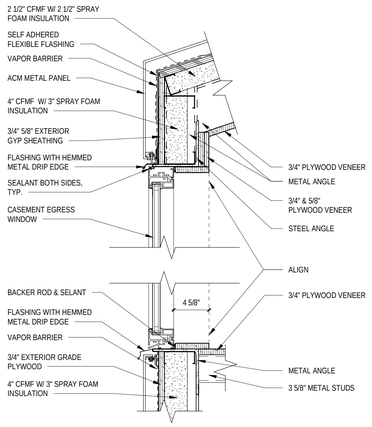
8 A-316 TYPICAL NOOK A CMU HEAD DETAIL
1 1/2" = 1'-0"



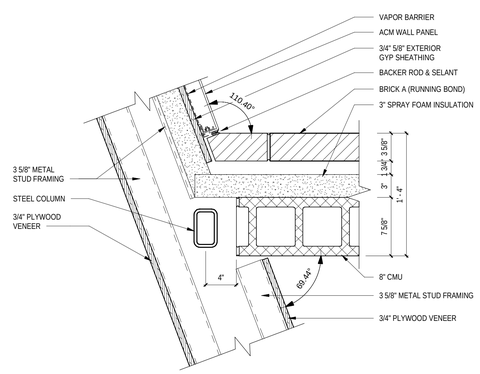
7 A-316 TYPICAL NOOK B PLAN DETAIL
1 1/2" = 1'-0"



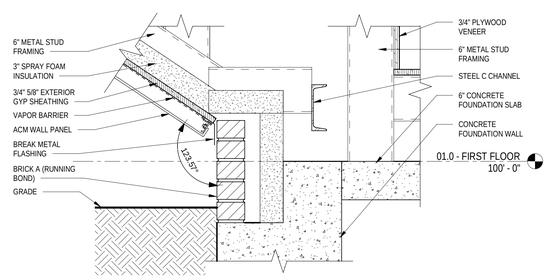
6 A-316 TYPICAL NOOK B WINDOW DETAIL
1 1/2" = 1'-0"



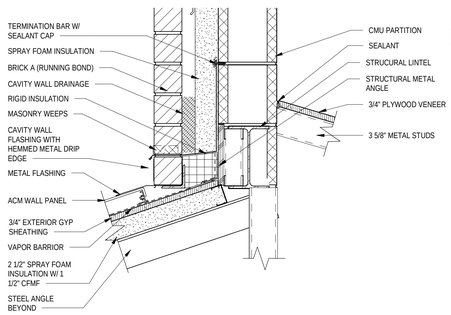
5 A-316 TYPICAL NOOK A WINDOW HEAD & SILL
1 1/2" = 1'-0"



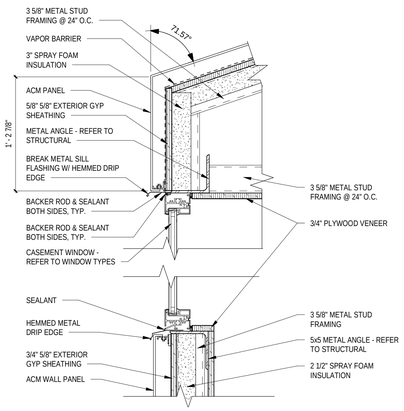
4 A-316 TYPICAL READING NOOK B PLAN DETAIL
1 1/2" = 1'-0"



3 A-316 TYPICAL NOOK B SILL DETAIL
1 1/2" = 1'-0"



2 A-316 TYPICAL NOOK B CMU HEAD DETAIL
1 1/2" = 1'-0"



1 A-316 TYPICAL NOOK B WINDOW HEAD & SILL
1 1/2" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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READING NOOK DETAILS

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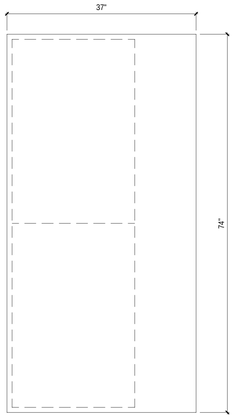
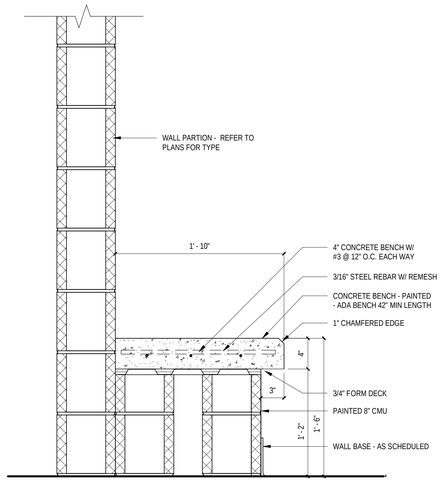
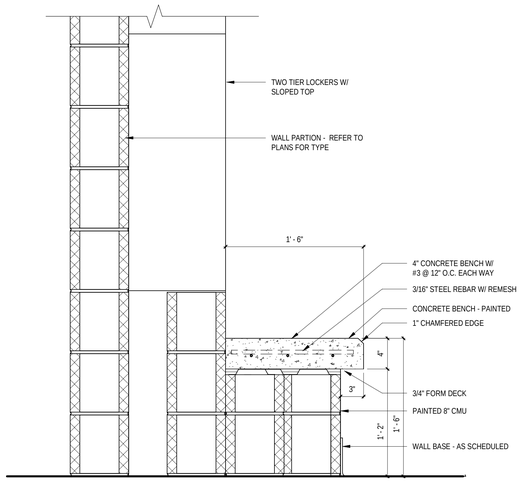


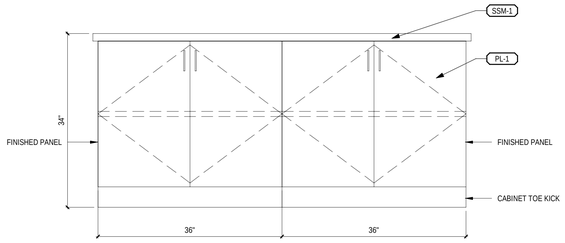
8 OFFICE WORKROOM ISLAND PLAN DETAIL
1" = 1'-0"



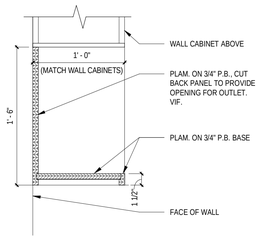
10 A-131 BENCH DETAILS - ADA
1 1/2" = 1'-0"



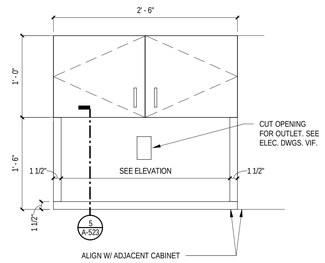
9 A-131 BENCH DETAILS
1 1/2" = 1'-0"



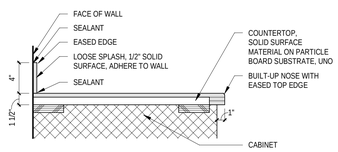
7 A-101A OFFICE WORKROOM ISLAND DETAIL
1" = 1'-0"



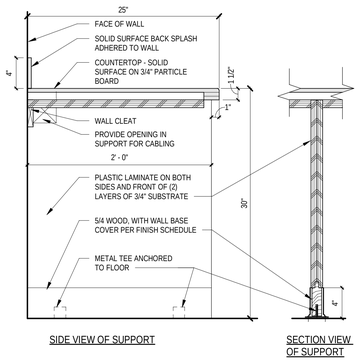
5 A-407 MICROWAVE SHELF 2
1 1/2" = 1'-0"



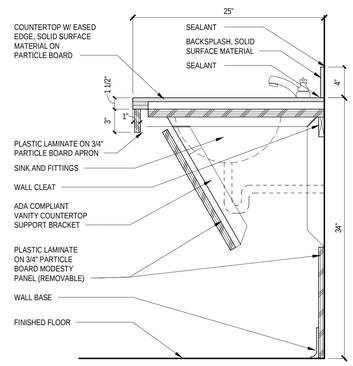
6 MICROWAVE SHELF 1
1" = 1'-0"



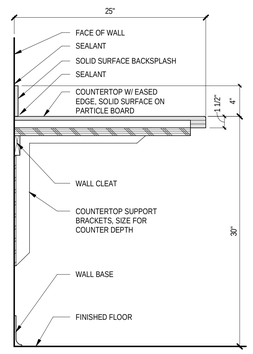
4 SOLID SURFACE COUNTERTOP
1 1/2" = 1'-0"



3 COUNTER SOLID SURFACE WITH VERTICAL SUPPORT
1 1/2" = 1'-0"



2 A-402 TYPICAL ADA SINK APRON - SOLID SURFACE
1 1/2" = 1'-0"



1 COUNTER DETAIL - SOLID SURFACE
1 1/2" = 1'-0"

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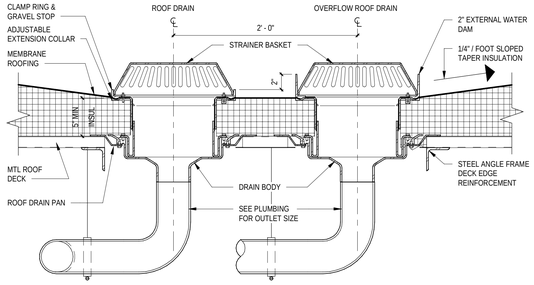
A-523

100% CONSTRUCTION DOCUMENTS

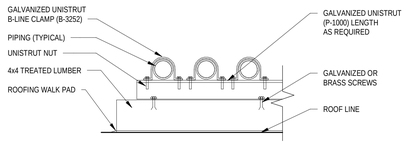
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/26/2023 8:45:39 AM
Autodesk Docs://220116_LSD_Mt HOPE/220116_A.rvt

DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

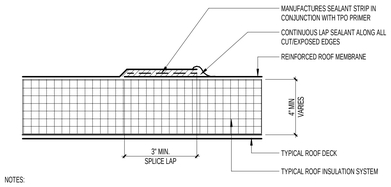


11 ROOF DRAIN AND OVERFLOW DRAIN - MEMBRANE ROOFING ON MTL DECK
1 1/2" = 1'-0"



INSTALLATION NOTES:
1. LEAVE PIPE CLAMPS SLIGHTLY LOOSE TO ALLOW FOR EXPANSION
2. SEE SPECIFICATIONS FOR PIPE SUPPORT SPACING.
3. ALL FASTENERS TO BE BRASS, GALVANIZED OR STAINLESS STEEL.

10 PIPE SUPPORT DETAIL
1 1/2" = 1'-0"



NOTES:

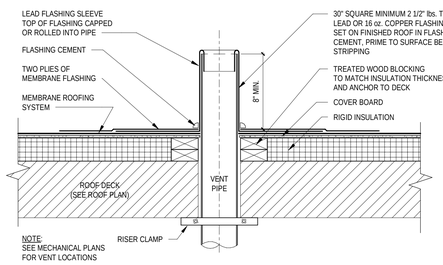
1. MEMBRANE SPLICE PROCEDURE IS FOR SPLICES BETWEEN CURED TPO SECTIONS.

2. APPLY TPO PRIMER TO MEMBRANE SURFACES PRIOR TO INSTALLING PRESSURE-SENSITIVE FLASHINGS AND/OR FACTORY APPLIED SEALANT STRIP/TAPE

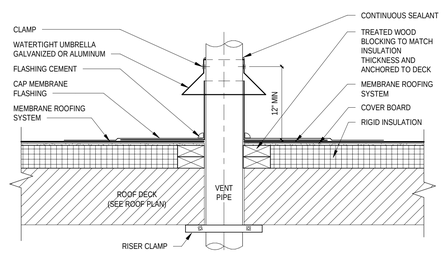
3. APPLY LAP SEALANT ALONG EDGE OF MEMBRANE SPLICE

4. ALL EDGES OF CUT ROOFING MEMBRANE TO BE SEALED PER MANUFACTURES RECOMMENDATIONS PROCEDURES TO COMPLY WITH SPECIFIED SYSTEM WARRANTY.

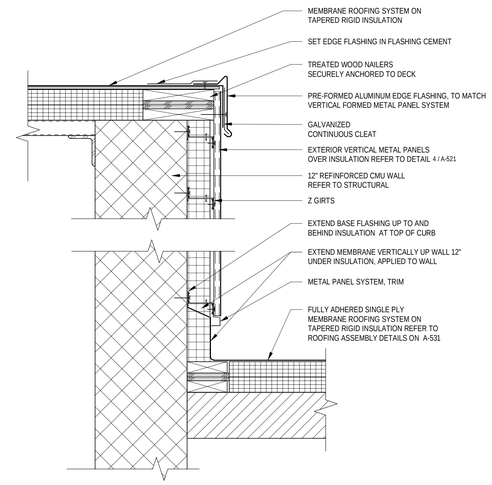
9 TYP - FULLY ADHEARED TPO ROOF MEMBRANE SPLICE DETAIL
3" = 1'-0"



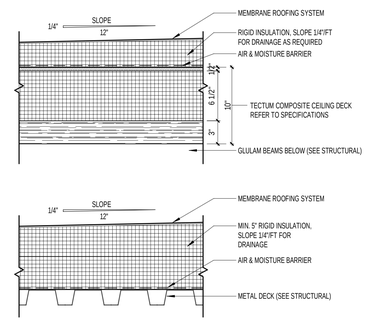
8 ROOF PENETRATION AT VENT PIPE
1 1/2" = 1'-0"



7 ROOF PENETRATION AT METAL FLASHING
1 1/2" = 1'-0"

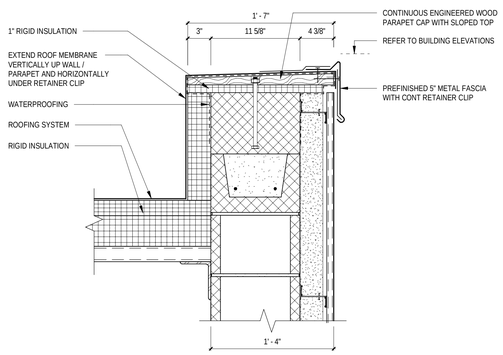


6 A-102 WALL SECTION DETAIL AT DRIP EDGE
1 1/2" = 1'-0"

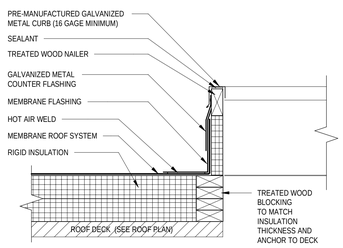


TYPICAL ROOF ASSEMBLIES

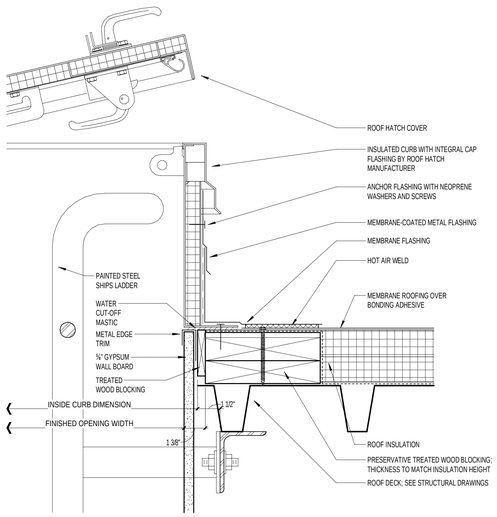
5 TYP - LOW SLOPE ROOF CONSTRUCTION
1 1/2" = 1'-0"



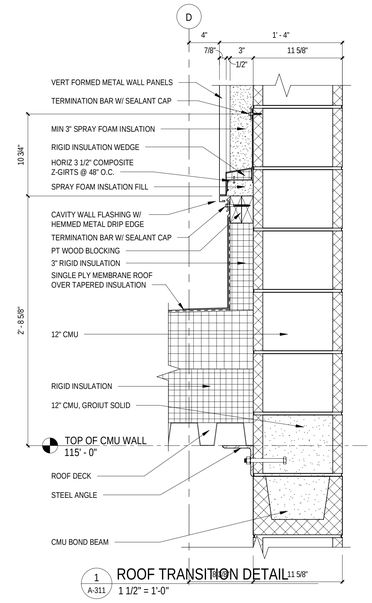
4 A-102 PARAPET WALL
1 1/2" = 1'-0"



3 A-102A ROOF CURB DETAIL
1 1/2" = 1'-0"



2 ROOF HATCH CURB - TPO ROOFING SYSTEM
3" = 1'-0"



1 A-311 ROOF TRANSITION DETAIL
1 1/2" = 1'-0"

Stantec
c2ae architecture · engineering
www.c2ae.com

LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

ROOF DETAILS

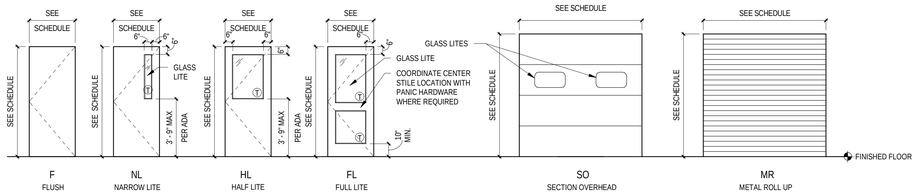
REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-531

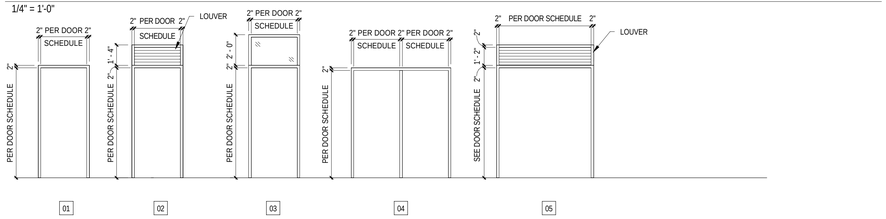
100% CONSTRUCTION DOCUMENTS

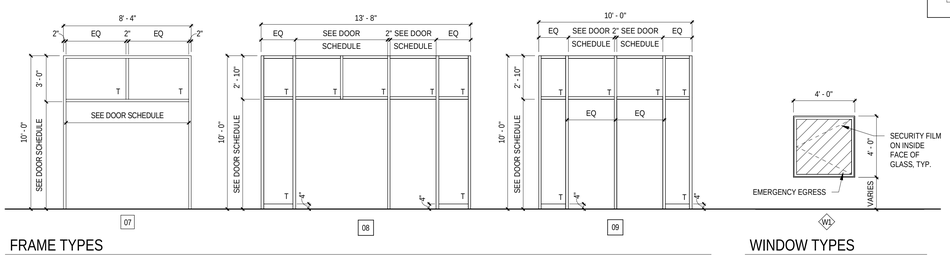
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE
6/26/2023 6:45:42 AM
AutoDesk Docs://220116_LSD - Mt HOPE/220116_A-v4
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



DOOR TYPES

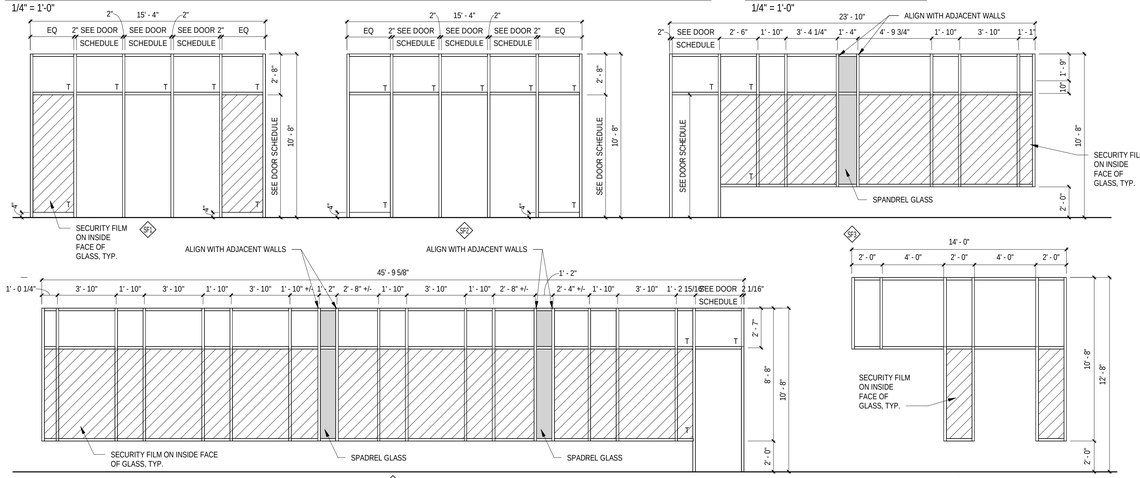
1/4" = 1'-0"





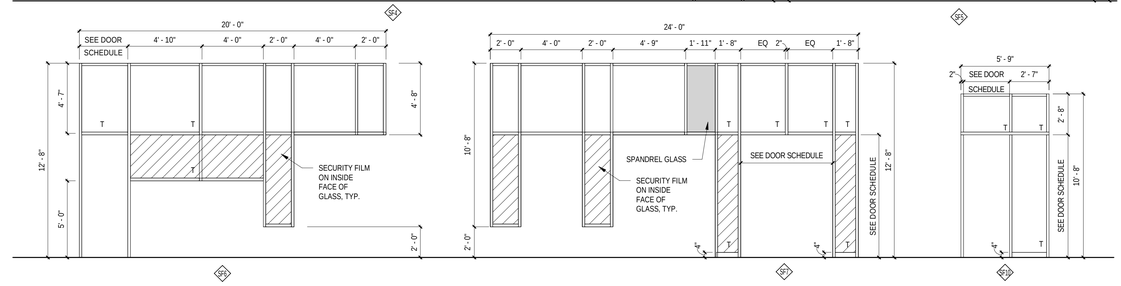
FRAME TYPES

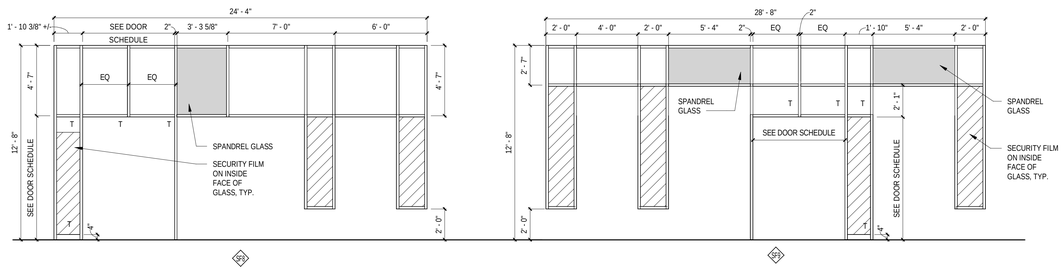
1/4" = 1'-0"



WINDOW TYPES

1/4" = 1'-0"





CURTAIN WALL/STOREFRONT ELEVATIONS

1/4" = 1'-0"

DOOR & FRAME GENERAL NOTES

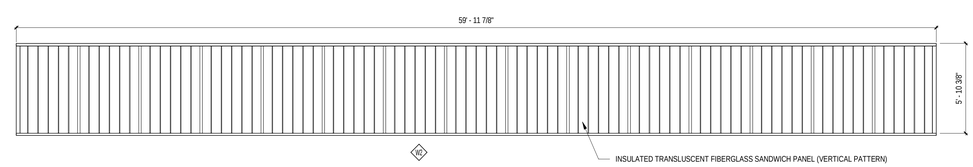
1. PROVIDE THRESHOLD SET IN A BED OF SEALANT AT ALL EXTERIOR DOORS. DO NOT BLOCK WEEP HOLES.
2. ALL EXTERIOR HOLLOW METAL DOORS & FRAMES SHALL BE GALVANIZED, U.N.O.
3. ALL DOOR AND WINDOW FRAMES SHALL HAVE SEALANT & BACKER ROD AT ENTIRE PERIMETER (BOTH SIDES,) U.N.O.
4. REFER TO SPECIFICATIONS FOR HARDWARE SETS.
5. ALL OUTSIDE DIMENSIONS OF FRAME TYPES ARE ROUGH OPENING SIZES.
6. MAINTAIN 4" MIN BETWEEN EDGE OF DOOR JAMB (HINGE SIDE) AND NEAREST PERPENDICULAR SURFACE.
7. STYLES & DIMENSIONS FOR DOOR TYPES & LITES ARE REFLECTING DESIGN INTENT. DOOR MANUFACTURER TO SUBMIT THEIR STANDARD TYPES, U.N.O., PER SPECIFICATIONS.
8. ST = SMOKE-TIGHT PER CODE TO RESIST THE PASSAGE OF SMOKE.
9. T = TEMPERED GLASS
10. S = SPANDREL GLASS
11. HM = HOLLOW METAL
12. WD = WOOD
13. AL = ALUMINUM
14. GL = GLASS
15. RO = ROUGH OPENING
16. FG = FROSTED GLASS (ETCHING ON ENTIRE INSIDE OF GLAZING TO OBSCURE SIGHT)
17. X-(MATERIAL) = DENOTES EXISTING MATERIAL REFERENCED
18. VERIFY EXISTING DOORS AND FRAMES SCHEDULED FOR USE IN RATED WALLS ARE RATED FOR SUCH USE. PROVIDE NEW WHERE REQUIRED.
19. PROVIDE ALL FIRE RATED DOORS WITH FIRE RATED GLASS WHERE REQUIRED.

WINDOW GLAZING LEGEND:

- REGULAR GLAZING
- SPANDREL GLASS
- SECURITY FILM (ON INSIDE FACE OF GLASS ONLY)

DOOR AND FRAME SCHEDULE

DOOR			DOOR				FRAME							
			SIZE						DETAIL					
DOOR NO.	ROOM NO.	ROOM NAME	WD.	HGT	MATL	TYPE	MATL	TYPE	HEAD	JAMB	SILL	FIRE RATING	HARDWARE SET NO.	NOTES
01.0 - FIRST FLOOR														
100.1	100	VESTIBULE	3' - 0"	8' - 0"	FRP	FL	AL	-	-	-	S1		40	
100.2	100	VESTIBULE	3' - 0"	8' - 0"	FRP	FL	AL	-	-	-	S1		41	
100.3	100	VESTIBULE	3' - 0"	8' - 0"	FRP	FL	AL	-	-	-	S1		41	
100.4	100	VESTIBULE	3' - 0"	8' - 0"	FRP	FL	AL	-	H1	-			38	
100.5	100	VESTIBULE	3' - 0"	8' - 0"	FRP	FL	AL	-	H1	-			39	
100.6	100	VESTIBULE	3' - 0"	8' - 0"	FRP	FL	AL	-	H1	-			39	
101.1	101	CORRIDOR	8' - 0"	7' - 2"	WD	NL	HM	07	H2	J2			33	
101.2	101	CORRIDOR	8' - 0"	7' - 2"	WD	NL	HM	07	H2	J2			33	
101.3	101	CORRIDOR	6' - 0"	8' - 0"	FRP	FL	AL	-	7 / A-503	J3	S1		44	
101.4	101	CORRIDOR	8' - 0"	7' - 2"	WD	NL	HM	07	H2	J2			33	
101.5	101	CORRIDOR	8' - 0"	7' - 2"	WD	NL	HM	07	H2	J2			33	
102.1	102	RECEPTION	3' - 0"	8' - 0"	FRP	HL	AL	-	H6	J6			25	
102.2	102	RECEPTION	3' - 0"	8' - 0"	WOOD	HL	AL	-	H2	J2			26	
103.1	103	PRINCIPAL OFFICE	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			09	
105.1	105	HEALTH CLINIC	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			09	
105.2	105	HEALTH CLINIC	3' - 0"	8' - 0"	FRP	FL	FRP	-	SIM 13 / A-504	-	S1		05	
106.1	106	TOILET	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			07	
107.1	107	WORK ROOM	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			27	
108.1	108	MEETING ROOM	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			02	
109.1	109	RECORDS STORAGE	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			15	
110.1	110	MEDIA CENTER	3' - 0"	8' - 0"	WOOD	HL	AL	-	H2	J2			36	
110.2	110	MEDIA CENTER	3' - 0"	8' - 0"	FRP	FL	AL	-	SIM 13 / A-504	-	S1		45	
111.1	111	TOILET	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			07	
112.1	112	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
113.1	113	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
114.1	114	RESOURCE ROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
115.1	115	MDF	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			15	
201.1	201	CORRIDOR	6' - 0"	8' - 0"	FRP	FL	AL	-	7 / A-503	J3	S1		44	
202.1	202	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
203.1	203	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
204.1	204	PROJECT ROOM A	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			34	
204.2	204	PROJECT ROOM A	3' - 0"	7' - 2"	WD	F	HM	03	H2	J2			30	
204A.1	204A	PROJECT STORAGE A	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			02	
205.1	205	PROJECT ROOM B	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			34	
205.2	205	PROJECT ROOM B	3' - 0"	8' - 0"	FRP	F	FRP	-	2 / A-506	4 / A-506	S1		45	
205A.1	205A	PROJECT STORAGE B	3' - 0"	7' - 2"	WD	F	HM	01	H1	J1			03	
206.1	206	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
207.1	207	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
208.1	208	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
209.1	209	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
210.1	210	RESOURCE ROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
213.1	213	JANITOR	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			16	
214.1	214	PE OFFICE	3' - 0"	7' - 2"	WD	HL	HM	01	H2	J2			09	
214.2	214	PE OFFICE	3' - 0"	7' - 2"	WD	173	HM	01	H2	J2			21	
215.1	215	GYMNASIUM	6' - 0"	7' - 2"	WD	FL	HM	08	H2	J2			32	
215.2	215	GYMNASIUM	3' - 0"	7' - 2"	WD	FL	HM	08	H2	J2			35	
215.3	215	GYMNASIUM	6' - 0"	7' - 2"	WD	FL	HM	08	H6	J6			32	
215.4	215	GYMNASIUM	3' - 0"	7' - 2"	WD	FL	HM	08	H6	J6			35	
216.1	216	BOYS CHANGING	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			14	
216A.1	216A	SHOWER	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			08	
217.1	217	GIRLS CHANGING	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			14	
217A.1	217A	SHOWER	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			08	
218.1	218	PE STORAGE	6' - 0"	7' - 2"	WD	F	HM	01	H2	J2			13	
219.1	219	SPEC OFFICE	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			21	
220.1	220	SPEC OFFICE	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			21	
221.1	221	TOILET	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			07	
301.1	301	CORRIDOR	6' - 0"	8' - 0"	FRP	FL	AL	-	7 / A-503	J3	S1		44	
302.1	302	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
303.1	303	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
304.1	304	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
305.1	305	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
306.1	306	MECHANICAL	6' - 0"	7' - 2"	WD	F	HM	01	H2	J2		1 HR RATED	18	
306.2	306	MECHANICAL	6' - 0"	7' - 2"	FRP	F	AL	05	H3	J3	S1		06	
307.1	307	RECEIVING / STORAGE	6' - 0"	7' - 2"	WD	F	HM	01	H2	J2		1 HR RATED	19	
307.2	307	RECEIVING / STORAGE	3' - 0"	7' - 2"	FRP	F	AL	02	H3	J3	S1		43	
307.3	307	RECEIVING / STORAGE	10' - 0"	8' - 0"	STL	OH	STL	-	H5	J5			47	
307A.1	307A	JANITOR OFFICE	3' - 0"	7' - 2"	WD	HL	HM	01	H2	J2			09	
308.1	308	ELECTRICAL	6' - 0"	7' - 2"	WD	F	HM	01	H2	J2		1 HR RATED	17	
308.2	308	ELECTRICAL	6' - 0"	7' - 2"	FRP	F	AL	05	H3	J3	S1		46	
309.1	309	ATS ROOM	6' - 0"	7' - 2"	FRP	F	AL	05	H3	J3	S1		28	
310.1	310	CAFETERIA	3' - 0"	7' - 2"	WD	FL	HM	09	H2	J2			35	
310.2	310	CAFETERIA	3' - 0"	7' - 2"	WD	FL	HM	09	H2	J2			31	
310.3	310	CAFETERIA	6' - 0"	7' - 2"	WD	F	HM	01	H2	J2			37	
310.4	310	CAFETERIA	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			04	
310B.1	310B	TABLE STORAGE	6' - 0"	7' - 2"	WD	F	HM	01	H1	J1			11	
310C.1	310C	CHAIR STORAGE	6' - 0"	7' - 2"	WD	F	HM	01	H1	J1			11	
311.1	311	SERVERY	6' - 8"	10' - 8"	STL	OCD	STL	-	H4	J4		1 HR RATED	47	
311.2	311	SERVERY	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2		1 HR RATED	20	
311.3	311	SERVERY	6' - 8"	10' - 8"	STL	OCD	STL	-	H4	J4		1 HR RATED	47	
312.1	312	KITCHEN	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			01	
312.2	312	KITCHEN	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			01	
312.3	312	KITCHEN	4' - 0"	7' - 2"	FRP	F	AL	01	H3	J3	S1		43	
312A.1	312A	KITCHEN OFFICE	3' - 0"	7' - 2"	WD	HL	HM	01	H2	J2			09	
312B.1	312B	PANTRY	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			10	
315.1	315	JANITOR	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			16	
316.1	316	TOILET	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			07	
317.1	317	SPEC OFFICE	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			21	
318.1	318	TEACHER STAFF	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			21	
318.2	318	TEACHER STAFF	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			09	
318A.1	318A	TOILET	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			07	
318B.1	318B	STORAGE	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			12	
319.1	319	STAFF DINING	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			21	
320.1	320	IDF	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			15	
321.1	321	ELECTRICAL	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			15	
322.1	322	JANITOR	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			16	
402.1	402	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
403.1	403	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
404.1	404	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
405.1	405	CLASSROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
406.1	406	RESOURCE ROOM	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			23	
407.1	407	MUSIC STUDIO	3' - 0"	7' - 2"	WD	NL	HM	03	H2	J2			24	
407.2	407	MUSIC STUDIO	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			22	
407A.1	407A	MUSIC STORAGE	3' - 0"	7' - 2"	WD	F	HM	01	H2	J2			12	
408.1	408	VESTIBULE	6' - 0"	8' - 0"	FRP	FL	AL	-	7 / A-503	J3	S1		42	
408.2	408	VESTIBULE	6' - 2"	8' - 0"	FRP	FL	AL	-	H6	-			29	



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SCHEDULES & DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
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A-601

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WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

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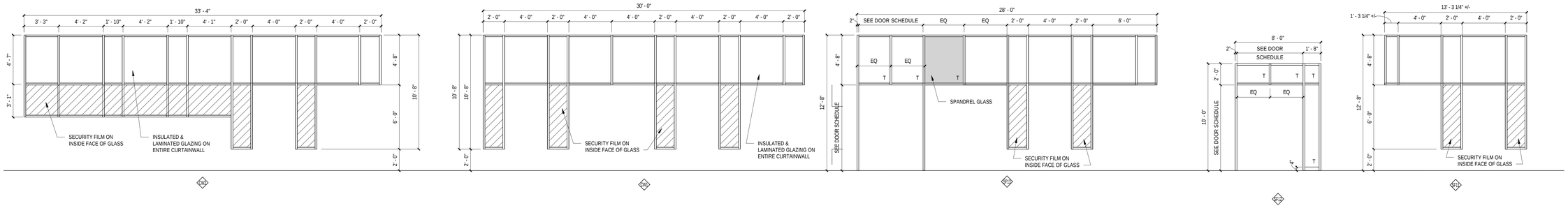
DOOR & FRAME GENERAL NOTES

1. PROVIDE THRESHOLD SET IN A BED OF SEALANT AT ALL EXTERIOR DOORS. DO NOT BLOCK WEEP HOLES.
2. ALL EXTERIOR HOLLOW METAL DOORS & FRAMES SHALL BE GALVANIZED, U.N.O.
3. ALL DOOR AND WINDOW FRAMES SHALL HAVE SEALANT & BACKER ROD AT ENTIRE PERIMETER (BOTH SIDES.) U.N.O.
4. REFER TO SPECIFICATIONS FOR HARDWARE SETS.
5. ALL OUTSIDE DIMENSIONS OF FRAME TYPES ARE ROUGH OPENING SIZES.
6. MAINTAIN 4" MIN BETWEEN EDGE OF DOOR JAMB (HINGE SIDE) AND NEAREST PERPENDICULAR SURFACE.
7. STYLES & DIMENSIONS FOR DOOR TYPES & LITES ARE REFLECTING DESIGN INTENT. DOOR MANUFACTURER TO SUBMIT THEIR STANDARD TYPES, U.N.O., PER SPECIFICATIONS.
8. ST = SMOKE-TIGHT PER CODE TO RESIST THE PASSAGE OF SMOKE.
9. T = TEMPERED GLASS
10. S = SPANDREL GLASS
11. HM = HOLLOW METAL
12. WD = WOOD
13. AL = ALUMINUM
14. GL = GLASS
15. RO = ROUGH OPENING
16. FG = FROSTED GLASS (ETCHING ON ENTIRE INSIDE OF GLAZING TO OBSCURE SIGHT)
17. X-(MATERIAL) = DENOTES EXISTING MATERIAL REFERENCED
18. VERIFY EXISTING DOORS AND FRAMES SCHEDULED FOR USE IN RATED WALLS ARE RATED FOR SUCH USE. PROVIDE NEW WHERE REQUIRED.
19. PROVIDE ALL FIRE RATED DOORS WITH FIRE RATED GLASS WHERE REQUIRED.

WINDOW GLAZING LEGEND:

- REGULAR GLAZING
- SPANDREL GLASS
- SECURITY FILM (ON INSIDE FACE OF GLASS ONLY)



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CURTAIN WALL & STOREFRONT ELEVATIONS

REVISIONS

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THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

WHITE

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ROOM FINISH GENERAL NOTES:

1. DOOR FRAME COLOR CHANGES SHALL OCCUR ON STOP AS IF DOOR IS IN CLOSED POSITION WITH THE DOOR AND FRAME SHOWING AS ONE COLOR.
2. FLOORING TRANSITIONS SHALL BE CENTERED UNDER DOOR WHILE IN CLOSED POSITION. PROVIDE TRANSITION STRIP BETWEEN ALL FLOORING MATERIAL TRANSITIONS.
3. ALL AREAS EXPOSED TO VIEW ABOVE THE CEILINGS ARE TO BE PAINTED. REFER TO INTERIORS DOCUMENTS FOR COLOR .
4. ALL EXPOSED STRUCTURAL, PLUMBING, MECHANICAL & ELECTRICAL ELEMENTS ARE TO BE PAINTED. REFER TO INTERIORS DOCUMENTS FOR COLOR.

INTERIORS ABBREVIATIONS

ABBREVIATION	FULL TEXT
ACD	ACOUSTICAL CEILING DIFFUSER
ACP	ACOUSTICAL CEILING PANEL
AWP	ACOUSTICAL WALL PANEL
CPT	CARPET TILE
EP	EPOXY PAINT
GT	GROUT
P	PAINT
PL	PLASTIC LAMINATE
POL	POLISHED CONCRETE
RB	RUBBER BASE
RF	RESILIENT FLOORING
RS	ROLLER SHADE
SLR	SEALED CONCRETE
STN	STAIN
T	TILE
TB	TACKBOARD
TP	TOILET PARTITION
TR	TRANSITION TRIM
WD	WOOD
WF	WINDOW FILM
WM	WALK OFF MAT

MATERIALS SCHEDULE

CODE	USE	MANUFACTURER	STYLE	PATTERN & COLOR	SIZE	INSTALLATION PATTERN	FINISH NOTES
ACOUSTICAL CEILING PANEL							
ACD-1	ACOUSTICAL CEILING DIFFUSER PANEL- MUSIC ROOM	KINETICS	RADIUS DIFFUSERS	WHITE DIFFUSER, WHITE GRID	24" X 24', 15/16" GRID	--	--
ACP-1	ACOUSTICAL CEILING PANEL	ARMSTRONG	SCHOOLZONE, FINE FISSURED, SQUARE EDGE	WHITE PANEL, WHITE GRID	24" X 24', 15/16" GRID	--	--
ACP-2	WASHABLE ACOUSTICAL CEILING PANEL	ARMSTRONG	KITCHENZONE	WHITE PANEL, WHITE GRID	24" X 24', 15/16" GRID	--	--
BASE							
RB-1	RUBBER BASE	FLEXCO	RUBBER BASE, COVE	024 STONE	4"H	--	--
TB	TILE BASE	VIRGINIA TILE, CROSSVILLE	COLOR BLOX 2.0	SLINKY	6" X 12" COVE	--	--
CARPET							
CPT-1	CLASSROOM TEXTILE COMPOSITE FLOORING TILE	EF CONTRACT	KINETEX, IMPRINT	RAVEN IMP56	--	--	--
CPT-2	WALK OFF CARPET TILE	MILLIKEN	OBEX, CUT/DRIFT	DTC5-27-173 GREY	20" X 20" MONOLITHIC	--	--
CPT-3	ADMINISTRATION OFFICES / OTHER OFFICES TEXTILE COMPOSITE FLOORING TILE	EF CONTRACT	KINETEX, IMPRINT	CADET IMP47	--	--	--
RESILIENT							
RF-1	CAFETERIA RESILIENT FLOORING	FORBO	MARMOLEUM, SHEET, REAL	DOVE GREY 2621	--	--	--
RF-2	CAFETERIA STAGE, PROJECT ROOM A/B, BAND ROOMS RESILIENT FLOORING	FORBO	MARMOLEUM, SHEET, CONCRETE	BLACK HOLE 3707	--	--	--
RF-3	RESILIENT KITCHEN FLOORING	PROTECT-ALL FLOORING	PROTECT-ALL FLOORING	DARK GRAY	--	--	INTEGRAL BASE
RF-4	GYMNASIUM FLOOR	GERFLOR	TARAFLEX SPORTS M PLUS	6375 OAK	--	--	--
RF-5	GYMNASIUM ACCENT FLOOR	GERFLOR	TARAFLEX SPORTS M PLUS	6430 BLUE	--	--	--
TILE							
T-1	SINK WET WALL & DRINKING FOUNTAIN NICHE TILE	VIRGINIA TILE, ISLA TILES	SHIBUSA	BEIGE	MOSAICO BACCHETTE RETT	INSTALLED IN VERTICAL ORIENTATION WITH 24"L RUNNING NORTH/SOUTH	--
T-2	TOILET WET WALL AND SIDE WALLS TILE	VIRGINIA TILE, ISLA TILES	SHIBUSA	BEIGE	24"L X 12"W	INSTALLED IN VERTICAL ORIENTATION WITH 24"L RUNNING NORTH / SOUTH	--
T-3	FIELD WALL TILE	VIRGINIA TILE COMPANY	MELROSE	WALL TILE, NAVY, GLOSSY	4" X 16"	VERTICAL STACK	--
T-4	ACCENT WALL TILE	VIRGINIA TILE COMPANY	MELROSE	CURVE DECORATIVE TILE, NAVY, MATTE	4" X 16"	VERTICAL STACK	--
T-5	CORRIDOR TILE WIDE	VIRGINIA TILE, CAESAR CERAMICHE	LIFE	OAK	30 CM X 120 CM	VERTICAL STACK	--
T-6	CORRIDOR TILE MEDIUM	VIRGINIA TILE, CAESAR CERAMICHE	LIFE	OAK	20 CM X 120 CM	VERTICAL STACK	--
T-7	CORRIDOR TILE SMALL	VIRGINIA TILE, CAESAR CERAMICHE	LIFE	OAK	14.7 CM X 120 CM	VERTICAL STACK	--
T-8	SHOWER FLOOR TILE	VIRGINIA TILE, AMERICAN OLEAN	UNGLAZED MOSAICS	SNOW LEOPARD, STRAIGHT JOINT, 0A68	1" X 1" MOSAIC	MONOLITHIC	--
T-9	SHOWER WALL TILE	VIRGINIA TILE, AMERICAN OLEAN	UNGLAZED MOSAICS	SALT & PEPPER, STRAIGHT JOINT, 0A12	1" X 1" MOSAIC	MONOLITHIC	--
T-10	FLOOR TILE	VIRGINIA TILE, CROSSVILLE	COLOR BLOX 2.0	SLINKY	12" X 12"	MONOLITHIC	--
PAINT							
P-1	GYPSUM BOARD / BULKHEAD CEILINGS - WHITE	SHERWIN-WILLIAMS	FLAT	SW 7004 SNOWBOUND	--	--	--
P-2	HOLLOW METAL DOOR AND WINDOW FRAME	SHERWIN-WILLIAMS	SEMI-GLOSS	SW 7019 GAUNTLET GRAY	--	--	--
P-3	FIELD NEUTRAL	SHERWIN-WILLIAMS	EGGSHELL	SW 7014 EIDER WHITE	--	--	--
P-4	ACCENT PAINT - GOLD	SHERWIN-WILLIAMS	EGGSHELL	SW 6361 AUTUMNAL	--	--	--
P-5	ACCENT PAINT - TEAL	SHERWIN-WILLIAMS	EGGSHELL	SW 7620 SEAWORTHY	--	--	--
P-6	ACCENT PAINT - BLUE	SHERWIN-WILLIAMS	EGGSHELL	SW 9178 IN THE NAVY	--	--	--
P-7	ACCENT PAINT - PURPLE	SHERWIN-WILLIAMS	EGGSHELL	SW 6286 MATURE GRAPE	--	--	--
P-8	INFRASTRUCTURE PAINT - FIRE SUPRESSION	SHERWIN-WILLIAMS	EGGSHELL	SW 7600 BOLERO	--	--	--
P-9	INFRASTRUCTURE PAINT - ELECTRICAL CONDUIT	SHERWIN-WILLIAMS	EGGSHELL	SW 6286 MATURE GRAPE	--	--	--
P-10	INFRASTRUCTURE PAINT - HVAC	SHERWIN-WILLIAMS	EGGSHELL	SW 9047 AFTER THE RAIN	--	--	--
P-11	INFRASTRUCTURE PAINT - WATERLINE	SHERWIN-WILLIAMS	EGGSHELL	SW 6775 BRINY	--	--	--
P-12	GYPSUM BOARD / BULKHEAD CEILINGS - BLACK	SHERWIN-WILLIAMS	FLAT	SW 6258 TRICORN BLACK	--	--	--
P-13	CAFETERIA DUCTWORK ACCENT COLOR	SHERWIN-WILLIAMS	FLAT	SW 9059 SILKEN PEACOCK	--	--	--
P-14	GYMNASIUM DUCTWORK ACCENT COLOR	SHERWIN-WILLIAMS	FLAT	SW 6531 INDIGO	--	--	--
P-15	TECTUM ACOUSTIC WALL PANEL AND CEILING DECK COLOR	SHERWIN-WILLIAMS	FLAT	SW 9110 MALABAR	--	--	--
P-16	CHANGING ROOM CONCRETE BENCH PAINT	SHERWIN-WILLIAMS	EPOXY SEMI-GLOSS	SW7019 GAUNTLET GRAY			
STN-1	STAIN FOR CLASSROOM LAM-BEAMS	MINWAX	SEMI-TRANSPARENT, SATIN	HABITAT 427			
CASEWORK							
PL-1	WOODGRAIN PLASTIC LAMINATE	LAMINART	--	983 WG GOLDEN OAK	--	VERTICAL GRAIN	--
SSM-1	SOLID SURFACE COUNTERTOPS	WILSONART	SOLID SURFACE	AVALANCHE MELANGE, 9175ML	--	--	--
MISCELLANEOUS							
AWP-1	ACOUSTIC WALL PANEL	MPS ACOUSTICS	COLIGO RECTANGLE FELT ACOUSTIC WALL PANEL	51 BIRCH BARK	48" x 120", 1" THICK	--	MOUNTING TO ACCMODATE 3/8" PET ACOUSTIC ENHANCER
AWP-2	TECTUM ACOUSTIC WALL PANEL	TECTUM	DESIGNART SHAPES & LINES	90° SQUARE, BAND IN COLOR NATURAL	24" X 24"	--	TO BE PAINTED P-15 ON SITE
AWP-3	TECTUM ACOUSTIC WALL PANEL	TECTUM	DESIGNART SHAPES & LINES	90° SQUARE, RING IN COLOR NATURAL	24" X 24"	--	TO BE PAINTED P-15 ON SITE
AWP-4	TECTUM ACOUSTIC WALL PANEL	TECTUM	DESIGNART SHAPES & LINES	CIRCLE IN COLOR NATURAL	24" X 24"	--	TO BE PAINTED P-15 ON SITE
AWP-5	SOUND SEAL S-2000 WALL PANEL	SOUND SEAL	--	GUILFORD OF MAINE FR701 2100: SILVER NEUTRAL 406	2" THICK	--	EC-CLIP MOUNTED
AWP-6	SOUND SEAL S-2000 WALL PANEL	SOUND SEAL	--	GUIILFORD OF MAINE FR701 2100: BALTIO 153	2" THICK	--	EC-CLIP MOUNTED
AWP-7	SOUND SEAL S-2000 WALL PANEL	SOUND SEAL	--	GUILFORD OF MAINE FR701 2100: TEAL 742	2" THICK	--	EC-CLIP MOUNTED
AWP-8	SOUND SEAL S-2000 WALL PANEL	SOUND SEAL	--	GUILFORD OF MAINE FR701 2100: ORANGE 746	2" THICK	--	EC-CLIP MOUNTED
FRP-1	FIBERGLASS REINFORCED PANEL	MARLITE FRP	--	PEBBLED MEDIUM GRAY	4' X 8'	INSTALLED IN VERTICAL ORIENTATION WITH 8' RUNNING NORTH/ SOUTH	--
POL-1	POLISHED CONCRETE	--	--	NATURAL	--		
RS-1	WINDOW ROLLER SHADES	DRAPER	SHEERWEAVE BASIC	3% V22 CHARCOAL/GRAY WITH CLEAR ANODIZED VALANCE	VARIES, CONTRACTOR V.I.F.	--	--
SLR-1	SEALED CONCRETE	--	--	NATURAL	--	--	COORDINATE WITH STRUCTURAL
TB	TACKBOARD FINISH	FORBO	OYSTER SHELL	--	--	--	--
TP-1	TOILET PARTITIONS	SCRANTON PRODUCTS	ARIA PARTITIONS	HAMMERED, NICKEL	FULL HEIGHT PARTITIONS	--	--
WD-1	WOOD DOOR FINISH	--	WHITE OAK, PLAIN SLICED	CLEAR STAIN	--	--	--
WD-2	NICHE WOOD	--	WHITE OAK	--	--	--	--
WF-1	WINDOW FILM	ORGANOID	SELF-ADHESIVE TRANSLUCENT	SKELETTBLATTLA MEDIUM, SKL0000045SKTRW	--	--	--
TRIM							
TR-1	SCHLUTER DILEX-AHKA FLOOR TRANSITION TRIM	SCHLUTER	--	SATIN ANODIZED	--	--	--
TR-2	SCHLUTER JOLLY EDGE TRIM	SCHLUTER	--	SATIN ANODIZED	--	--	--
TR-3	SCHLUTER QUADEC CORNER TRIM	SCHLUTER	--	SATIN ANODIZED	--	--	--
TR-4	SCHLUTER RENO RAMP	SCHLUTER		SATIN ANODIZED			
TR-5	CAFETERIA STAGE NOSING	TARKETT	STAIR NOSING SLIM NOSING	48 GREY			
TR-6	TRANSITION CARPET TO CONCRETE	TARKETT	RUBBER EDGE GUARD	48 GREY			
TR-7	TRANSITION RESILIENT TO CONCRETE	TARKETT	SLIM LINE	38 PEWTER			

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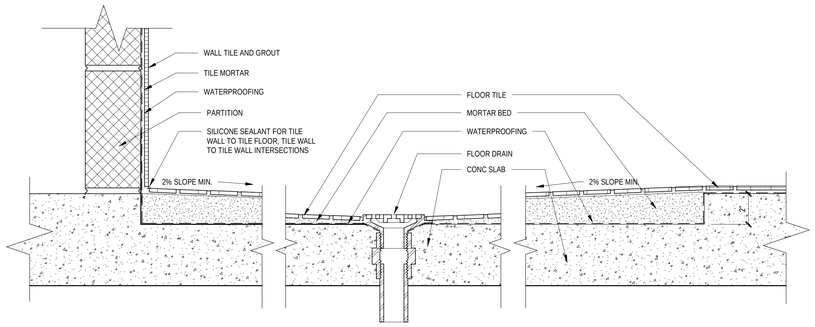
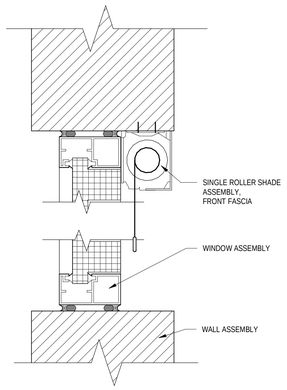
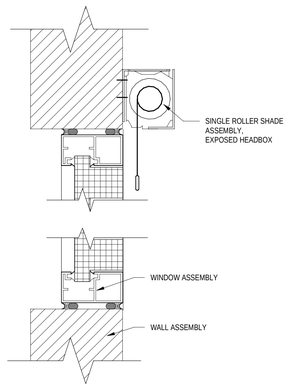


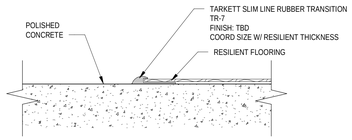
11 SHOWER PAN (TILE AND GROUT) DETAIL
3" = 1'-0"



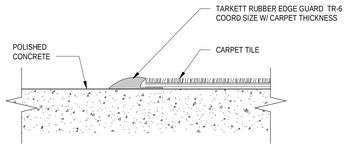
10 SINGLE ROLLER SHADE INSIDE JAMB
3" = 1'-0"



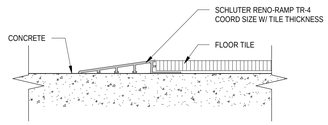
9 SINGLE ROLLER SHADE OUTSIDE JAMB WALL MOUNTED
3" = 1'-0"



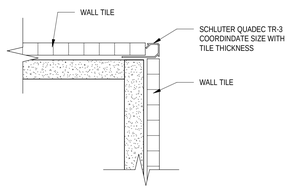
8 TRANSITION RESILIENT TO CONCRETE
6" = 1'-0"



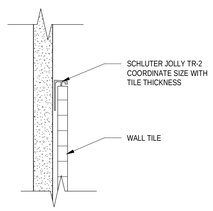
7 TRANSITION CARPET TO CONCRETE
6" = 1'-0"



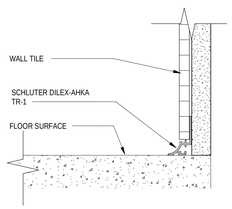
6 TRANSITION CONCRETE TO FLOOR TILE
6" = 1'-0"



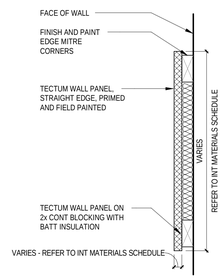
5 WALL TILE OUTSIDE CORNER DETAIL
6" = 1'-0"



4 WALL TILE EXPOSED EDGE DETAIL
6" = 1'-0"

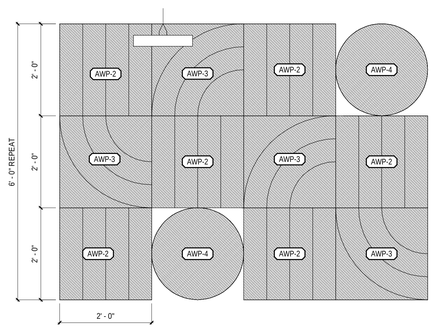


3 TRANSITION DETAIL TILE TO CONCRETE
6" = 1'-0"



ACOUSTIC WALL PANEL WALL - TECTUM MOUNTING

2 ACOUSTIC PANEL WALL MOUNTING
1 1/2" = 1'-0"



1 TECTUM PANEL REPEAT
3/4" = 1'-0"

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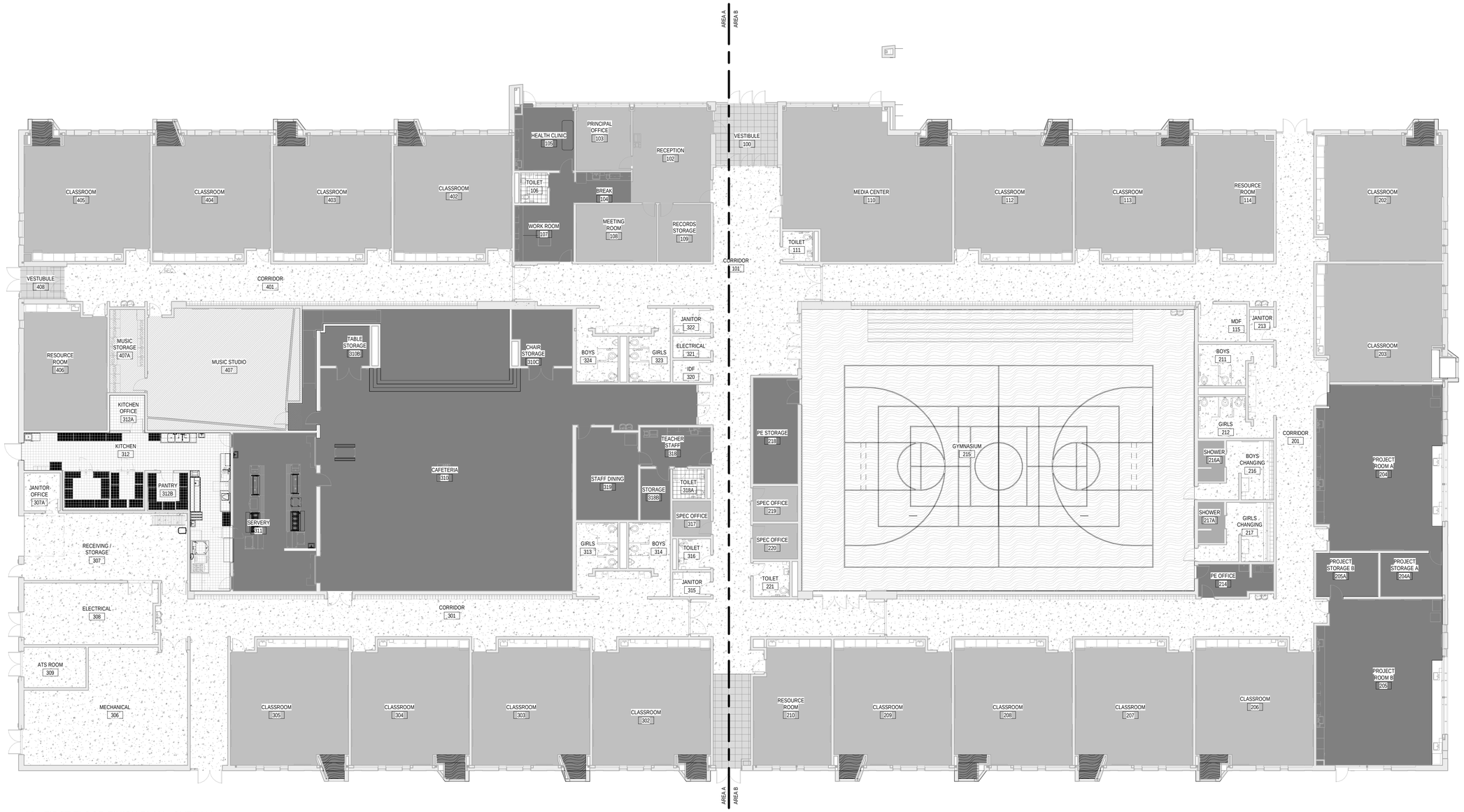
MATERIALS LEGEND:

- POL-1
- SLR-1
- RF-1
- RF-2
- RF-3
- RF-4
- RF-5
- CPT-1
- CPT-2
- CPT-3

ACCENT FINISH

FIELD WALL FINISH
FIELD BASE FINISH
FIELD FLOOR FINISH



FIRST FLOOR FINISH PLAN - OVERALL
3/32" = 1'-0"

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FINISH PLAN - OVERALL

REVISIONS

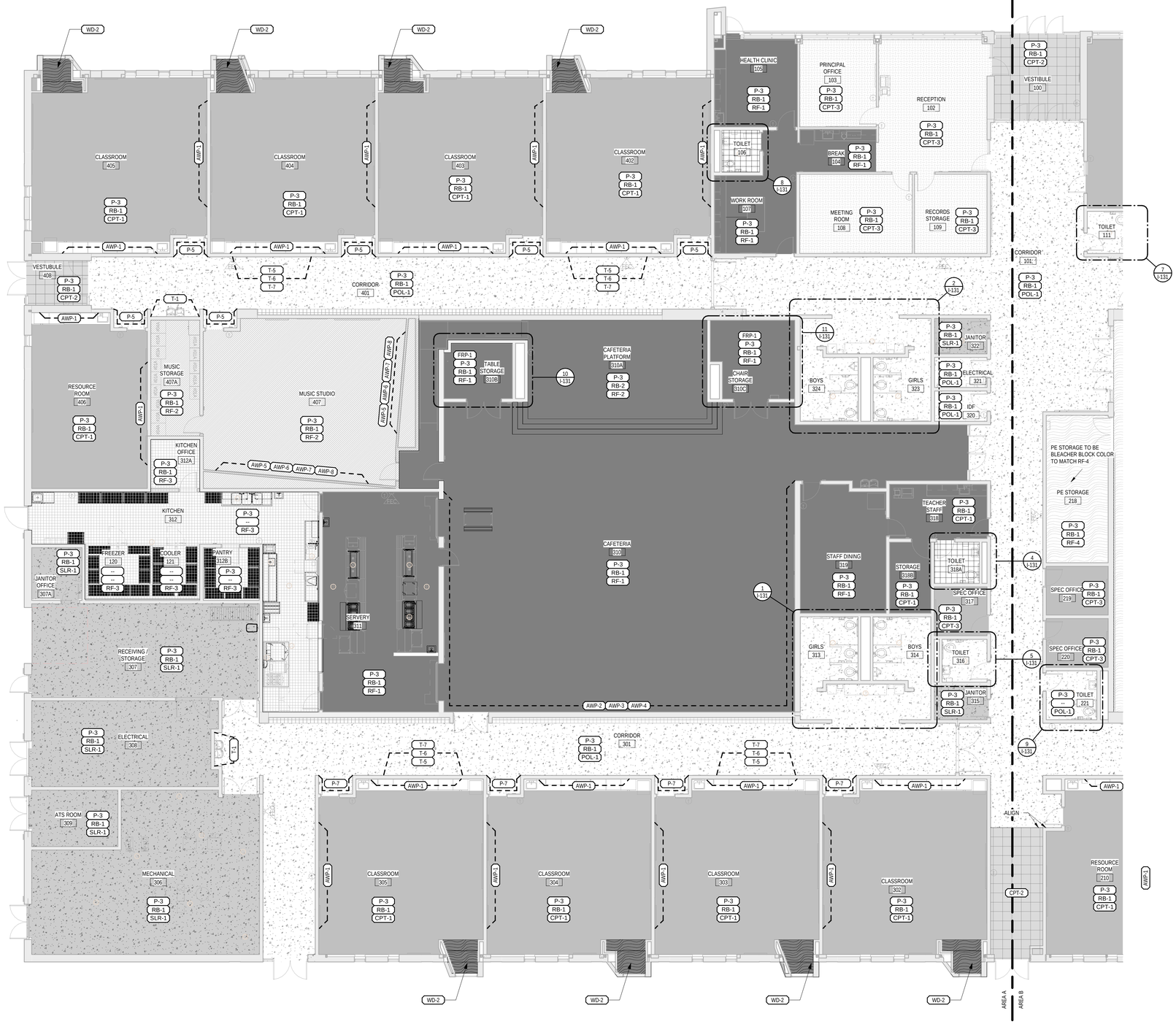
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
I-101

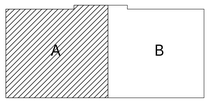
100% CONSTRUCTION DOCUMENTS

MATERIALS LEGEND:

- POL-1
- SLR-1
- RF-1
- RF-2
- RF-3
- RF-4
- RF-5
- CPT-1
- CPT-2
- CPT-3
- ACCENT FINISH
- FIELD WALL FINISH
- FIELD BASE FINISH
- FIELD FLOOR FINISH



FIRST FLOOR FINISH PLAN - AREA A
1/8" = 1'-0"



KEY PLAN
NOT TO SCALE

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FINISH PLAN - AREA A

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THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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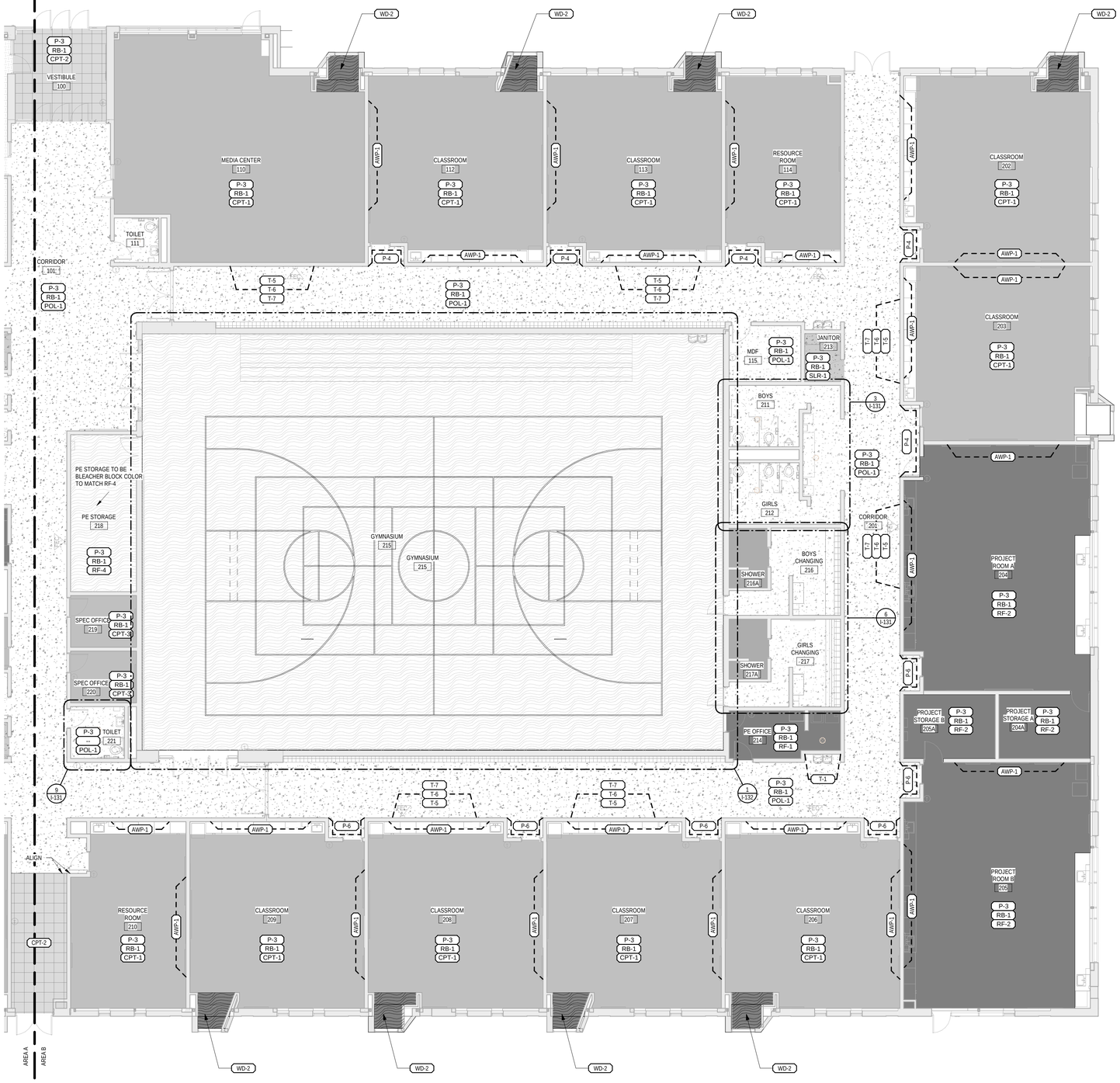

FIRST FLOOR FINISH PLAN - AREA B
1/8" = 1'-0"

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FINISH PLAN - AREA B

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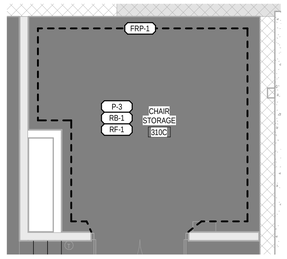
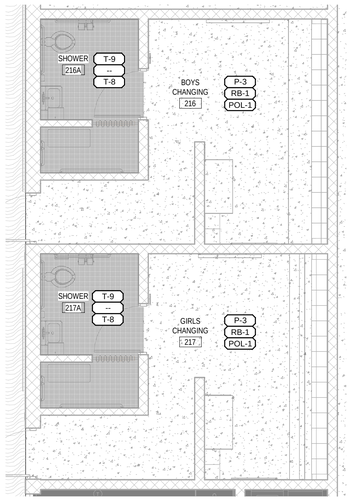
- CPT-2
- CPT-3

ACCENT FINISH

FIELD WALL FINISH
FIELD BASE FINISH
FIELD FLOOR FINISH



11 CHAIR STORAGE FINISH PLAN
1/4" = 1'-0"



6 I-101B AREA B - LOCKER ROOMS FINISH PLAN
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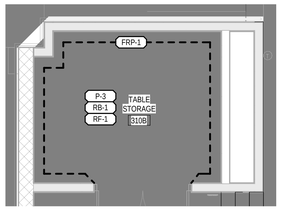

10 I-101A TABLE STORE FINISH PLAN
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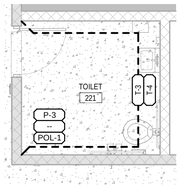
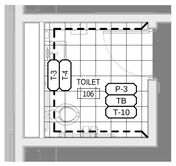
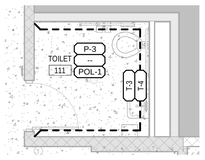


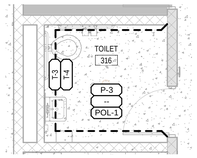
9 I-101A AREA A SINGLE RESTROOM FINISH PLAN- EAST
1/4" = 1'-0"



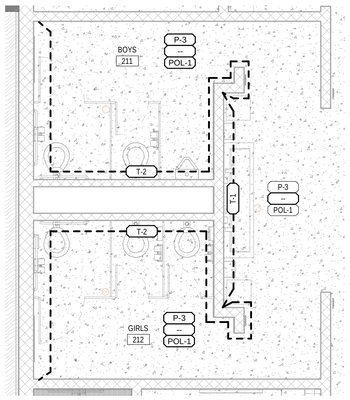
8 I-101A AREA A - TOILET ROOM FINISH PLAN
1/4" = 1'-0"



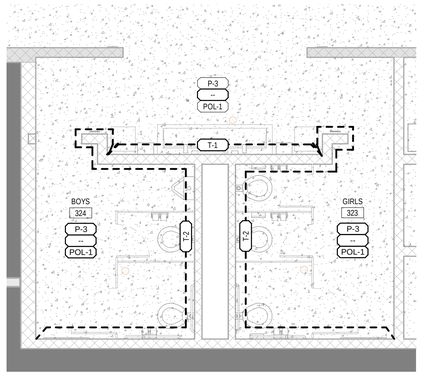
7 I-101A AREA B - TOILET ROOM FINISH PLAN
1/4" = 1'-0"



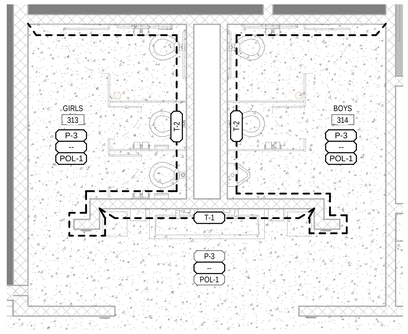
5 I-101A AREA A - SINGLE RESTROOM FINISH PLAN- WEST
1/4" = 1'-0"



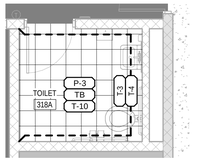
3 I-101B AREA B - GROUP TOILET ROOMS FINISH PLAN
1/4" = 1'-0"



2 I-101A AREA A - ENTRY GROUP TOILET ROOMS FINISH PLAN
1/4" = 1'-0"



1 I-101A AREA A - GROUP TOILET ROOMS FINISH PLAN
1/4" = 1'-0"



4 I-101A STAFF SINGLE RESTROOM FINISH PLAN
1/4" = 1'-0"

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ENLARGED PLANS

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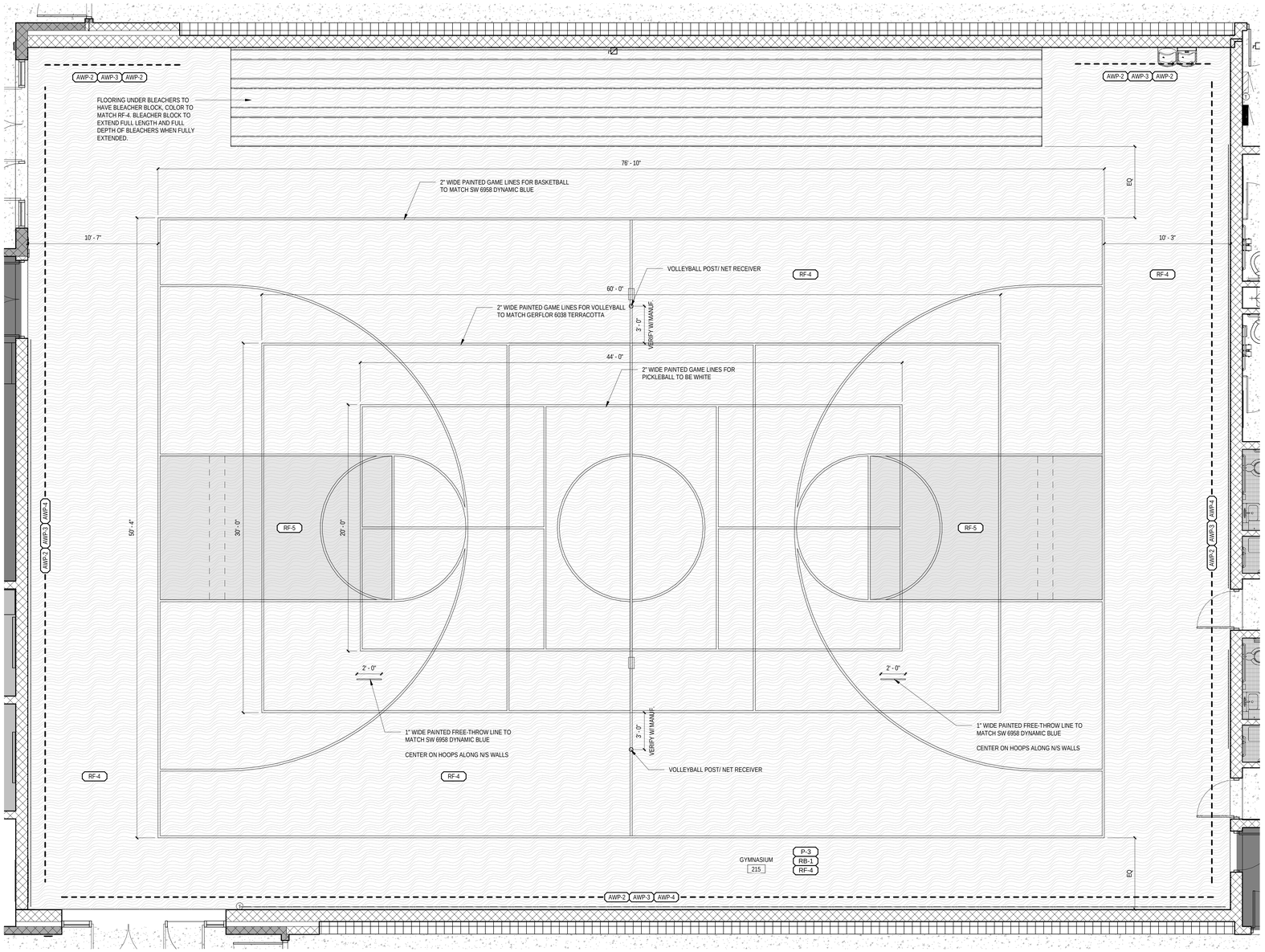
- CPT-3

ACCENT FINISH

FIELD WALL FINISH
FIELD BASE FINISH
FIELD FLOOR FINISH



1 / I-101B GYM FLOOR FINISH PLAN AND GAME LINES
1/4" = 1'-0"

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ENLARGED PLAN - GYMNASIUM

REVISIONS

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FIRE PROTECTION SYMBOLS

SYMBOL	DESCRIPTION
	GLOBE VALVE
	GENERIC VALVE
	FULL PORT BALL VALVE
	CHECK VALVE
	BALANCING VALVE
	BALANCE VALVE W/ TEST PORTS
S	SOLENOID VALVE
M	MOTOR OPERATED VALVE
	PLUG VALVE
	THREE WAY CONTROL VALVE
	TWO WAY CONTROL VALVE
	BUTTERFLY VALVE
	PRESSURE REGULATOR VALVE
	PRESSURE RELIEF VALVE
	THERMOMETER
	STRAINER w/HOSE END CONNECTION
	UNION
	PRESSURE GAGE WITH COCK
	FLEXIBLE CONNECTOR
	PIPE TURNED UP
	PIPE TURNED DOWN
	PIPE OUT TOP
	PIPE OUT BOTTOM
AW	ACID WASTE
AV	ACID VENT
DCW	DOMESTIC COLD WATER PIPING
DHW	DOMESTIC HOT WATER PIPING
DHWR	DOMESTIC HOT WATER RETURN PIPING
V	VENT PIPING
FP	FIRE PROTECTION PIPING
FP (DRY)	DRY SYSTEM FP PIPING
G	NATURAL GAS PIPING
SAN	SANITARY PIPING
ST	STORM PIPING
SST	SECONDARY STORM PIPING
SSD	SUB-SOIL DRAIN
	AUTOMATIC AIR VENT (PIPE TO NEAREST DRAIN)
	MANUAL AIR VENT (PIPE TO NEAREST DRAIN)

NOTE: ALL SYMBOLS MAY NOT BE USED ON THIS PROJECT.

FIRE PROTECTION ABBREVIATIONS

AC	AIR CONDITIONING
ACCU	AIR COOLED CONDENSING UNIT
ACU	AIR CONDITIONING UNIT
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
ALT	ALTERNATIVE
AMB	AMBIENT
AP	ACCESS PANEL / DOOR
APPROX	APPROXIMATE
AR	ACID RESISTANT
ARCH	ARCHITECT(URAL)
ARV	AIR RELIEF VALVE
AUTO	AUTOMATIC
AV	ACID VENT
AVTR	ACID VENT THROUGH ROOF
AW	ACID WASTE
B-#	BOILER
BD	BAROMETRIC DAMPER
BDD	BACKDRAFT DAMPER
BFP	BACKFLOW PREVENTER
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BOD	BOTTOM OF DUCT
BOT	BOTTOM
CA	COMPRESSED AIR
CAB	CABINET
CFH	CUBIC FEET PER HOUR
CFS	CUBIC FEET PER SECOND
CL	CENTERLINE
CLG	CEILING
COL	COLUMN
CONC	CONCRETE
COND	CONDENSER / CONDENSATE
COTG	CLEAN OUT TO GRADE
CP	CIRCULATION PUMP
CPD	CONDENSATE PUMP DISCHARGE
CPRSR	COMPRESSOR
CT-#	COOLING TOWER
CUH-#	CABINET UNIT HEATER
D	DEPTH/DEEP
DB	DRY BULB TEMEPRATURE
DCW	DOMESTIC COLD WATER
DEG	DEGREE
DF	DRINKING FOUNTAIN
DFU	DRAIN FIXTURE UNIT
DHW	DOMESTIC HOT WATER
DHWR	DOMESTIC HOT WATER RETURN
DIA / Ø	DIAMETER
DSCH	DISCHARGE
DT	DRAIN TILE
DTC	DRAIN TILE CONNECTION
DWG	DRAWING
DWH-#	WATER HEATER
ECS	EMERGENCY COMBINATION SHOWER
EEW	EMERGENCY EYEWASH
EF	EXHAUST FAN
EFF	EFFICIENCY
ELEC	ELECTRIC(AL)
ELEV	ELEVATOR
EMER	EMERGENCY
EQUIP	EQUIPMENT
ERC	ENERGY RECOVERY COIL
ESH	EMERGENCY SHOWER
ET	EXPANSION TANK
EXH	EXHAUST
EXIST / (E)	EXISTING
EXP	EXPANSION
EXT	EXTERIOR
EWC	ELECTRIC WATER COOLER
FCU-#	FAN COIL UNIT
FD-#	FLOOR DRAIN
FDC	FIRE DEPARTMENT CONNECTION
FEV	FLUE EXHAUST VENT
FIN FLR / FF	FINISH FLOOR
FLR	FLOOR
FP	FIRE PROTECTION
FPM	FEET PER MINUTE
FUR-#	FURNACE
G	NATURAL GAS
GA	GAUGE
GAL	GALLON
GALV	GALVANIZE(D)
GPM	GALLONS PER MINUTE
GV	NATURAL GAS VENT
GVTR	NATURAL GAS VENT THROUGH ROOF
H	HEIGHT/HIGH
HB	HOSE BIBB
HC-#	HEATING COIL
HP	HORSEPOWER
HRU	HEAT RECOVERY UNIT
HVAC	HEATING / VENTILATING / AIR CONDITIONING
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
INSUL	INSULATION / INSULATE
IW	INDIRECT WASTE
JC	JANITOR CLOSET
KW	KILOWATT
L	LENGTH / LONG
LAV-#	LAVATORY
LP	LIQUID PETROLEUM
LVR	LOUVER
M	METER
MAU	MAKEUP AIR UNIT
MAX	MAXIMUM
MECH	MECHANICAL
MFR	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
MTD	MOUNTED
NIC	NOT IN CONTRACT
NO / #	NUMBER
NPCW	NON-POTABLE COLD WATER
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OC	ON CENTER
OD	OUTSIDE DIAMETER
PC	PUMPED CONDENSATE
PREFAB	PREFABRICATED
PRV	PRESSURE REDUCING VALVE
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
R / RAD	RADIUS
RD-#	ROOF DRAIN
REQ'D	REQUIRED
RF-#	RETURN FAN
RM	ROOM
RPM	REVOLUTIONS PER MINUTE
RTU	ROOFTOP UNIT
SAN	SANITARY
SCHED	SCHEDULE
SCW	SOFT COLD WATER (DOMESTIC)
SH	SHOWER
SK	SINK
SP	STATIC PRESSURE
SPEC(S)	SPECIFICATON(S)
SQFT	SQUARE FEET
SRD-#	SECONDARY ROOF DRAIN
SS	SERVICE SINK
SST	SECONDARY STORM
ST	STORM
STD	STANDARD
TC	TEMPERATURE CONTROL
TEMP	TEMPERATURE
TYP	TYPICAL
UH-#	UNIT HEATER
UR	URINAL
UV	UNIT VENTILATOR
V	VENT
VA	VALVE
VAC	VACUUM
VB	VACUUM BREAKER
VEL	VELOCITY
VIF	VERIFY IN FIELD
VTR	VENT-THRU-ROOF
W	WIDE / WIDTH
W /	WITH
W / O	WITHOUT
WB	WET BULB TEMPERATURE
WC-#	WATER CLOSET
WCC	WATER COOLED CHILLER
WCO	WALL CLEAN OUT
WG	WATER GAUGE
WH	WALL HYDRANT
WSFU	WATER SUPPLY FIXTURE UNIT

DRAWING NOTATIONS

MECHANICAL SYSTEM INDICATION

HEAVY LINE- WEIGHT INDICATES NEW WORK

LIGHT LINE WEIGHT- INDICATES EXISTING EQUIPMENT OR REFERENCED INFORMATION

HATCH MARKS - EQUIPMENT OR MATERIALS TO BE DISCONNECTED AND REMOVED

DASHED LINES- PIPING ROUTED BELOW SLAB OR GRADE

DRAWING/ DETAIL TITLE

NOTE: DRAWING TITLE MAY NOT APPEAR ON LARGE SCALE DETAIL DRAWINGS

DETAIL NUMBER
A10 P100 DRAWING TITLE
##" = 1'-0"
P200
REFER TO THIS DRAWING FOR DETAIL
ADDITIONAL DRAWING WHERE DETAIL IS REFERENCED

NEW / EXISTING CONNECTIONS

POINT OF NEW CONNECTION
EXISTING SYSTEM COMPONENT TO REMAIN
NEW SYSTEM COMPONENT

SECTION CUT SYMBOL

SECTION NUMBER
1 M101
SHEET WHERE SECTION IS DRAWN

EXISTING POINT OF DISCONNECT

POINT OF DISCONNECT
EXISTING SYSTEM COMPONENT TO REMAIN
EXISTING SYSTEM COMPONENT TO BE REMOVED

NORTH ARROW

N
PROJECT NORTH
TRUE NORTH

ENLARGED PLAN DETAIL

ENLARGED PLAN NUMBER
1 M101
REFER TO THIS SHEET FOR ENLARGED PLAN

TEXT LEADER

INFORMATION TEXT

EXISTING CONNECTIONS

CAP OFF EXISTING
EXISTING SYSTEM COMPONENT TO REMAIN

DRAWING REVISION SYMBOL

1
DRAWING REVISION NUMBER

KEYNOTE

X
KEYNOTE NOTE NUMBER

FIRE AIR COMPRESSOR SCHEDULE

UNIT IDENTIFICATION						MAX DIMENSIONS				ELECTRICAL					
MARK	NUMBER	AREA SERVED	TYPE	CFM AT 40 PSI	TANK CAPACITY (GAL)	HEIGHT (PO)	WIDTH (PO)	LENGTH (PO)	WEIGHT (LBS)	TOTAL HP	VOLTS	PHASE	MANUFACTURER	MODEL NUMBER	NOTES
FAC	1	EXTERIOR ENTRY CANOPY	RISER MOUNT	1.46	120	18	10	8	30	1/6	115	1	GENERAL AIR PRODUCTS	OLR12016AC	1

NOTES:
1. PROVIDE SYSTEM COMPLETE WITH PRESSURE GAUGE, PRESSURE SWITCH, SHUT OFF VALVE, DRAIN VALVE, CHECK VALVE, AND SAFETY VALVES.

FIRE PROTECTION PIPING SYSTEM APPLICATION SCHEDULE

SYSTEM	ABBREVIATION	PIPE SIZE (IN)	PIPING MATERIAL						JOINTS						CONSTRUCTION				
			STAINLESS STEEL	SCH 5 STEEL	SCH 10 BLACK STEEL	SCH 30 BLACK STEEL	SCH 30 GALVANIZED STEEL	SCH 40 BLACK STEEL	SCH 40 GALVANIZED STEEL	SOLDERED	BRAZED	WELDED	PRESSURE SEAL FITTINGS	ROLL GROOVED	THREADED	OPERATING TEMPERATURE (°F)	MINIMUM WORKING PRESSURE (PSI)	TEST PRESSURE (PSI)	TEST DURATION (HRS)	ACCEPTANCE LEVEL
WET-PIPE SPRINKLER SYSTEM, STANDARD PRESSURE	FP	NPS 2 AND SMALLER						X							X	40 - 100	175	225	2 1/2	ZERO LOSS/LEAKS
WET-PIPE SPRINKLER SYSTEM, STANDARD PRESSURE	FP	NPS 2 1/2 TO NPS 4						X				X		X		40 - 100	175	225	2 1/2	ZERO LOSS/LEAKS
WET-PIPE SPRINKLER SYSTEM, STANDARD PRESSURE	FP	NPS 5 AND LARGER						X				X		X		40 - 100	175	225	2 1/2	ZERO LOSS/LEAKS
DRY-PIPE SPRINKLER SYSTEM	DFP/PFP	NPS 4 AND SMALLER							X						X	40 - 100	175	225	2 1/2	ZERO LOSS/LEAKS
PIPING BETWEEN FIRE DEPARTMENT CONNECTION AND CHECK VALVES	FP	ALL SIZES							X					X	X	40 - 100	250	250	2 1/2	ZERO LOSS/LEAKS

NOTES:

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FIRE PROTECTION SYMBOLS, SCHEDULES AND ABBREVIATIONS

REVISIONS

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FP-001

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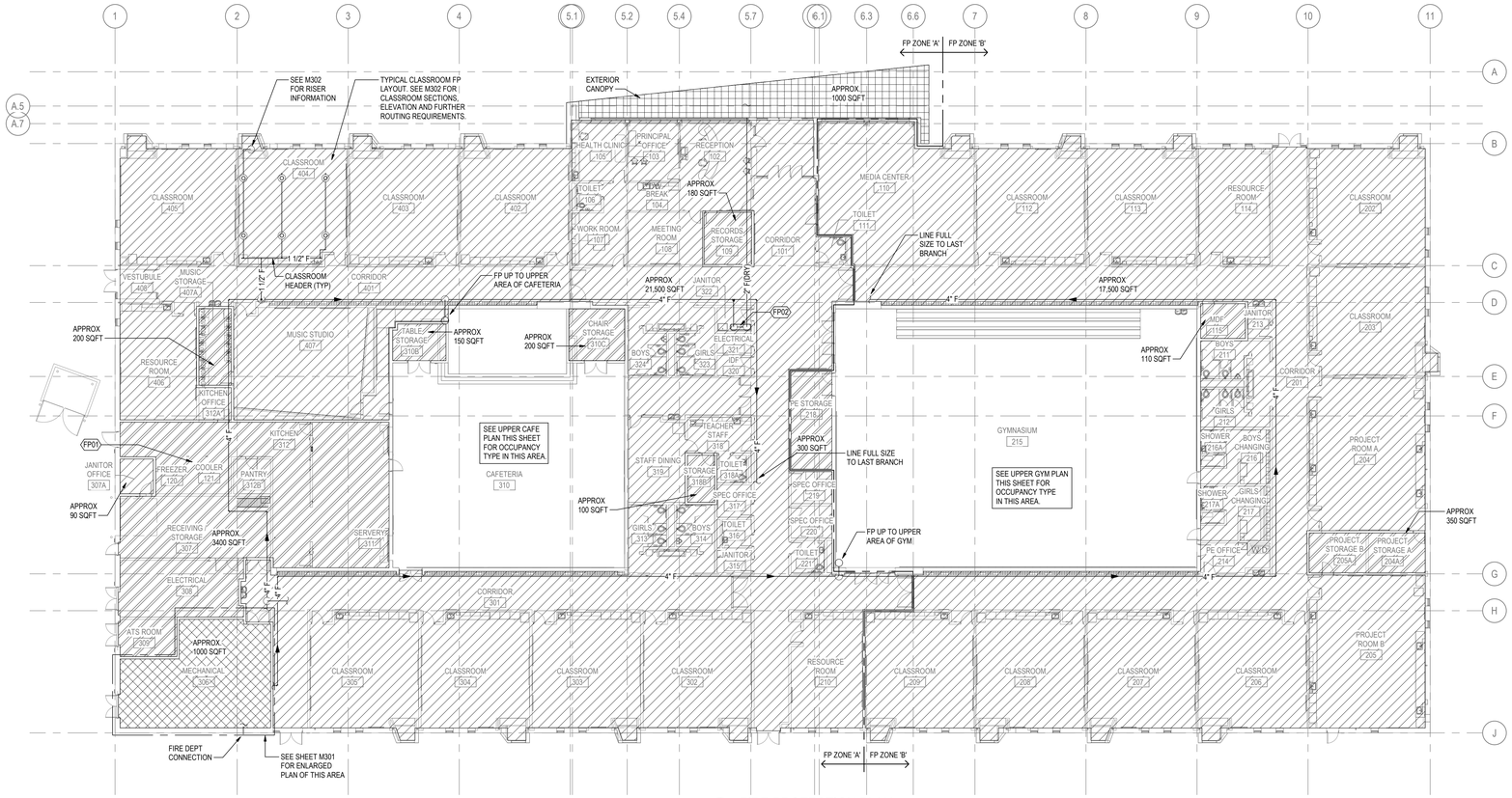
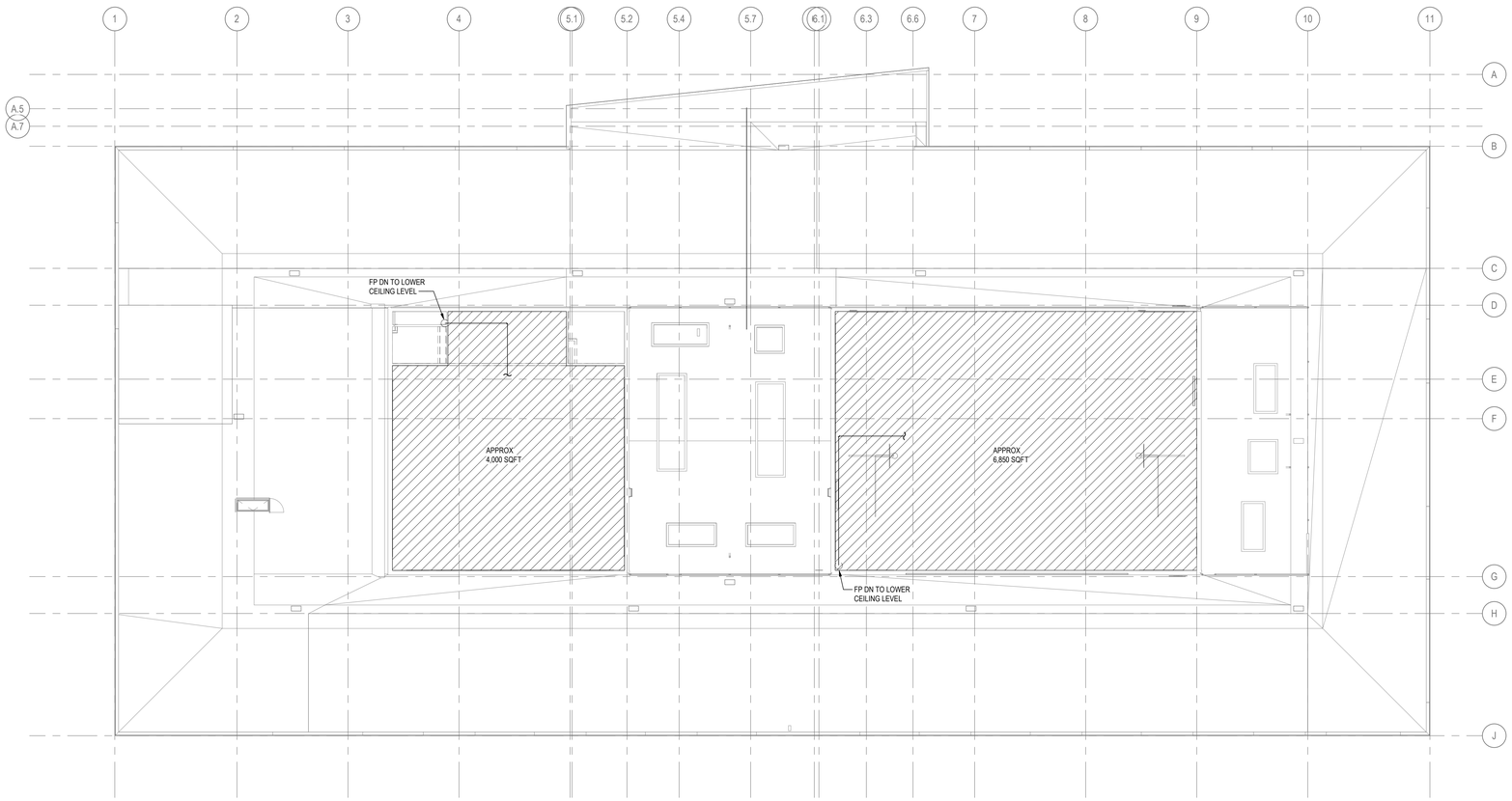


FIRE PROTECTION PLAN
1/16" = 1'-0"



FIRE PROTECTION PLAN - UPPER CAFE AND GYMNASIUM
1/16" = 1'-0"

FIRE PROTECTION GENERAL NOTES

1 THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE FIRE PROTECTION SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, AND TRANSITIONS, ETC. AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.

2 THE AUTOMATIC SPRINKLER AND STAND PIPE SYSTEM SHALL SERVE THE ENTIRE BUILDING AND SHALL BE DESIGNED AND INSTALLED IN ACCORDANCE WITH THE PROVISIONS OF THE BUILDING CODE, FIRE CODE, NFPA 13 AND OTHER APPLICABLE CODES.

3 ALL EQUIPMENT SHALL BE UL LISTED.

4 PIPES SHALL BE SUPPORTED AND BRACED PER NFPA 13.

5 APPROVED SHOP DRAWINGS SHALL BE REVIEWED BY THE STATE FIRE MARSHAL AND LOCAL AUTHORITY HAVING JURISDICTION.

6 APPROVAL BY LOCAL AUTHORITY HAVING JURISDICTION MUST BE RECEIVED PRIOR TO PROCEEDING WITH THE WORK.

7 INSPECT AND REPLACE ALL EQUIPMENT AND PIPING THAT IS DAMAGED OR BENT. HEADS THAT ARE PAINTED OTHER THAN THE ORIGINAL PAINT SHALL BE REPLACED.

8 PROVIDE 1" INSPECTOR'S TEST CONNECTION WITH UNION WITH SMOOTH BORE CORROSION RESISTANT ORIFICE GIVING A FLOW EQUIVALENT TO THE SMALLEST SPRINKLER ORIFICE IN THE SYSTEM FOR EACH SPRINKLER ZONE. TERMINATE DISCHARGE TO DRAIN.

9 COORDINATE LOCATIONS OF ALL ROOF OPENINGS WITH OTHER TRADES PRIOR TO ANY INSTALLATION.

10 PROVIDE CONCRETE PADS, CURBS, AND ACCESSORIES FOR FIRE PROTECTION EQUIPMENT. COORDINATE EXACT SIZES OF REQUIRED OPENINGS AND SUPPORTS FOR FURNISHED EQUIPMENT.

11 ALL EQUIPMENT SHALL BE INSTALLED IN STRICT ACCORDANCE WITH THE EQUIPMENT MANUFACTURER'S RECOMMENDATIONS AND APPLICABLE CODES. PROVIDE ALL FITTINGS, TRANSITIONS, VALVES, AND OTHER DEVICES REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.

12 MAINTENANCE LABEL SHALL BE AFFIXED TO ALL FIRE PROTECTION EQUIPMENT AND MAINTENANCE MANUAL SHALL BE PROVIDED TO OWNER.

13 COORDINATE LOCATIONS OF ALL SPRINKLER HEADS WITH ARCHITECTURAL REFLECTED CEILING PLANS AND ELECTRICAL LIGHTING LAYOUT. SUBMIT LAYOUT DRAWINGS FOR ARCHITECTURAL APPROVAL.

14 ALL SPRINKLER HEADS SHALL BE CENTERED BOTH WAYS IN ACOUSTICAL CEILING TILES UNLESS NOTED OTHERWISE.

15 PROVIDE A 1" MINIMUM BRANCH TO SPRINKLER HEADS.

16 EXPOSED PIPING TO FOLLOW BUILDING ELEMENTS.

FIRE WATER CALCULATIONS NOTES

1 DESIGN PRESSURE FLOW TEST WAS PERFORMED BY LBWL. THE HYDRANT ALONG SHUBEL MEASURED 63.4# STATIC AND 20# RESIDUAL. THE HYDRANT ALONG SHUBEL MEASURED A FLOW OF 1200 GPM.

2 CONTRACTOR SHALL MAKE PRESSURE FLOW TEST PRIOR TO SYSTEM DESIGN.

3 FP MAIN PIPING SIZE WITHIN THE BUILDING TO BE VERIFIED BY FIRE PROTECTION CONTRACTOR AFTER COMPLETION OF UPDATED FLOW TEST AND HYDRAULIC CALCULATIONS.

(X) FIRE PROTECTION KEYNOTES

FP01 PROVIDE DRY TYPE SPRINKLER HEADS TO SERVE FREEZER COMPARTMENTS.

FP02 DRY FIRE PROTECTION VALVE ASSEMBLY REFER TO PIPING DIAGRAM ON FP501 FOR REQUIREMENTS. PROVIDE MOUNTED COMPRESSOR. DRAIN TO SERVICE SINK.

FIRE PROTECTION HAZARD CLASSIFICATIONS

PROVIDE AN AUTOMATIC WET PIPE SPRINKLER SYSTEM IN ACCORDANCE WITH NFPA 13 LIGHT HAZARD OCCUPANCY

PROVIDE AN AUTOMATIC WET PIPE SPRINKLER SYSTEM IN ACCORDANCE WITH NFPA 13 ORDINARY HAZARD GROUP 1 OCCUPANCY

PROVIDE AN AUTOMATIC WET PIPE SPRINKLER SYSTEM IN ACCORDANCE WITH NFPA 13 ORDINARY HAZARD GROUP 2 OCCUPANCY

PROVIDE A DRY TYPE FIRE PROTECTION SYSTEM IN ACCORDANCE WITH NFPA 13.

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FIRE PROTECTION PLANS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
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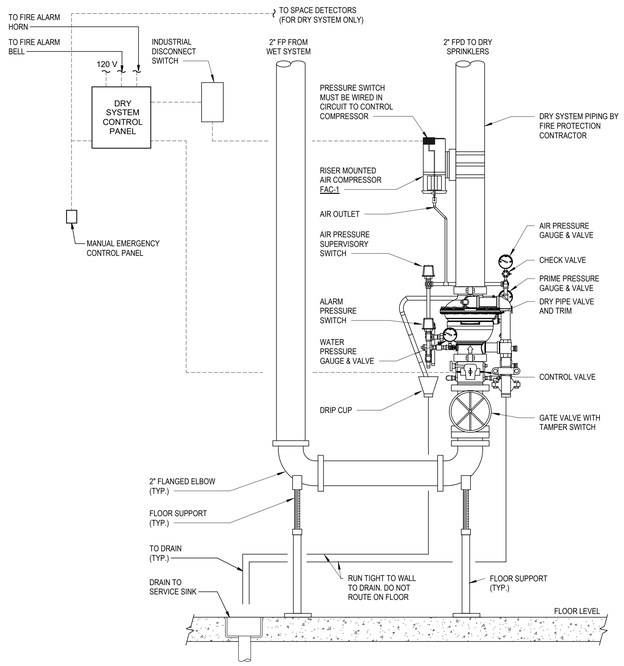
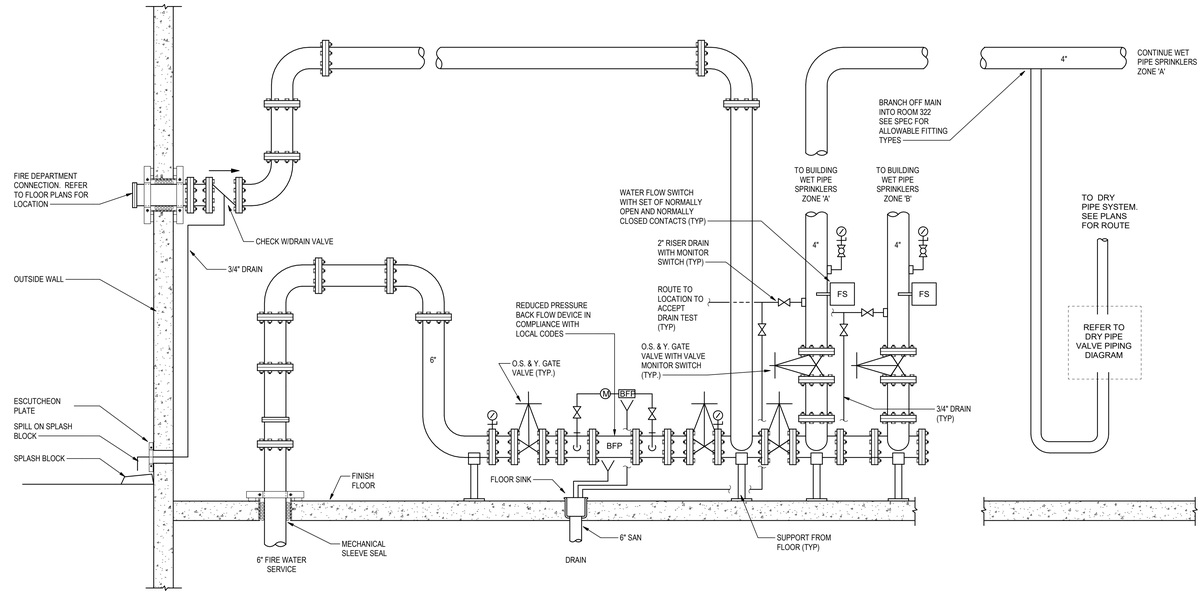


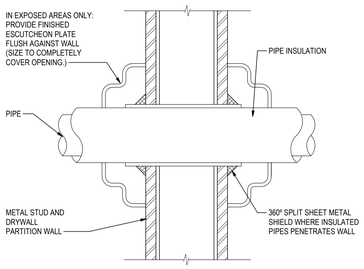
DRY VALVE PIPING DIAGRAM

SCALE: NONE



AUTOMATIC SPRINKLER RISER PIPING DIAGRAM

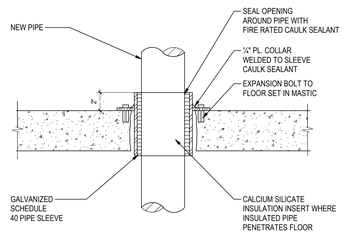
SCALE: NONE



NOTES:
1. PIPE PENETRATION DETAIL SIMILAR FOR UNINSULATED PIPING.

NON-FIRE RATED STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL

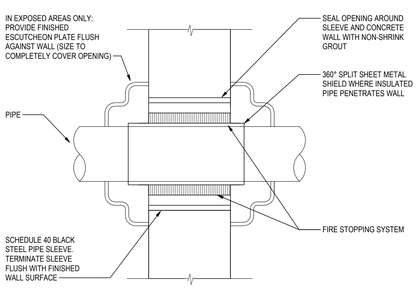
SCALE: NONE



PIPE PENETRATION THROUGH FLOOR DETAIL

SCALE: NONE

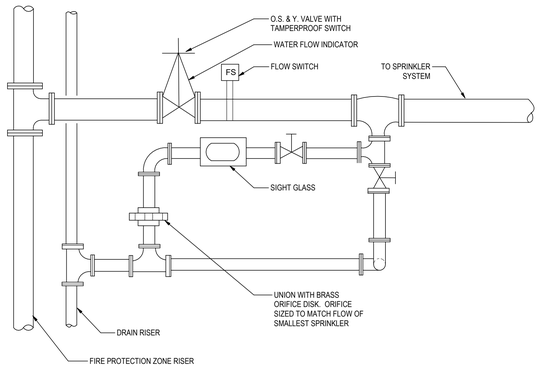
EXPOSED SPRINKLER HEAD DETAIL



NOTES:
1. DETAIL INDICATES THE INSULATION REQUIREMENTS FOR A FIRE RATED ASSEMBLY. FOR A NON-FIRE RATED ASSEMBLY PACK SLEEVED OPENING WITH INSULATION MATERIAL AND CAULK WITH NON-HARDENING SEALANT.

FIRE RATED AND NON-FIRE RATED POURED CONCRETE OR BLOCK WALL PIPE PENETRATION DETAIL

SCALE: NONE



TYPICAL DRAIN INSPECTOR'S TEST ASSEMBLY DETAIL

SCALE: NONE

CONCEALED SPRINKLER HEAD DETAIL

SCALE: NONE

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FIRE PROTECTION DETAILS

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PLUMBING SYMBOLS

SYMBOL	DESCRIPTION
	GLOBE VALVE
	GENERIC VALVE
	FULL PORT BALL VALVE
	CHECK VALVE
	BALANCING VALVE
	BALANCE VALVE W/ TEST PORTS
S	SOLENOID VALVE
M	MOTOR OPERATED VALVE
	PLUG VALVE
	THREE WAY CONTROL VALVE
	TWO WAY CONTROL VALVE
	BUTTERFLY VALVE
	PRESSURE REGULATOR VALVE
	PRESSURE RELIEF VALVE
	THERMOMETER
	STRAINER w/HOSE END CONNECTION
	UNION
	PRESSURE GAGE WITH COCK
	FLEXIBLE CONNECTOR
	PIPE TURNED UP
	PIPE TURNED DOWN
	PIPE OUT TOP
	PIPE OUT BOTTOM
AW	ACID WASTE
AV	ACID VENT
DCW	DOMESTIC COLD WATER PIPING
DHW	DOMESTIC HOT WATER PIPING
DHWR	DOMESTIC HOT WATER RETURN PIPING
V	VENT PIPING
FP	FIRE PROTECTION PIPING
G	NATURAL GAS PIPING
SAN	SANITARY PIPING
ST	STORM PIPING
SST	SECONDARY STORM PIPING
SSD	SUB-SOIL DRAIN
	AUTOMATIC AIR VENT (PIPE TO NEAREST DRAIN)
	MANUAL AIR VENT (PIPE TO NEAREST DRAIN)

NOTE: ALL SYMBOLS MAY NOT BE USED ON THIS PROJECT.

PLUMBING ABBREVIATIONS

AC	AIR CONDITIONING
ACCU	AIR COOLED CONDENSING UNIT
ACU	AIR CONDITIONING UNIT
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
ALT	ALTERNATIVE
AMB	AMBIENT
AP	ACCESS PANEL / DOOR
APPROX	APPROXIMATE
AR	ACID RESISTANT
ARCH	ARCHITECT(URAL)
ARV	AIR RELIEF VALVE
AUTO	AUTOMATIC
AV	ACID VENT
AVTR	ACID VENT THROUGH ROOF
AW	ACID WASTE
B-#	BOILER
BD	BAROMETRIC DAMPER
BDD	BACKDRAFT DAMPER
BFP	BACKFLOW PREVENTER
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BOD	BOTTOM OF DUCT
BOT	BOTTOM
CA	COMPRESSED AIR
CAB	CABINET
CFH	CUBIC FEET PER HOUR
CFS	CUBIC FEET PER SECOND
CL	CENTERLINE
CLG	CEILING
COL	COLUMN
CONC	CONCRETE
COND	CONDENSER / CONDENSATE
COTG	CLEAN OUT TO GRADE
CP	CIRCULATION PUMP
CPD	CONDENSATE PUMP DISCHARGE
CPRSR	COMPRESSOR
CT-#	COOLING TOWER
CUH-#	CABINET UNIT HEATER
D	DEPTH/DEEP
DB	DRY BULB TEMEPRATURE
DCW	DOMESTIC COLD WATER
DEG	DEGREE
DF	DRINKING FOUNTAIN
DFU	DRAIN FIXTURE UNIT
DHW	DOMESTIC HOT WATER
DHWR	DOMESTIC HOT WATER RETURN
DIA / Ø	DIAMETER
DSCH	DISCHARGE
DT	DRAIN TILE
DTC	DRAIN TILE CONNECTION
DWG	DRAWING
DWH-#	WATER HEATER
ECS	EMERGENCY COMBINATION SHOWER
EEW	EMERGENCY EYEWASH
EF	EXHAUST FAN
EFF	EFFICIENCY
ELEC	ELECTRIC(AL)
ELEV	ELEVATOR
EMER	EMERGENCY
EQUIP	EQUIPMENT
ERC	ENERGY RECOVERY COIL
ESH	EMERGENCY SHOWER
ET	EXPANSION TANK
EXH	EXHAUST
EXIST / (E)	EXISTING
EXP	EXPANSION
EXT	EXTERIOR
EWC	ELECTRIC WATER COOLER
FCU-#	FAN COIL UNIT
FD-#	FLOOR DRAIN
FDC	FIRE DEPARTMENT CONNECTION
FEV	FLUE EXHAUST VENT
FIN FLR / FF	FINISH FLOOR
FLR	FLOOR
FP	FIRE PROTECTION
FPM	FEET PER MINUTE
FUR-#	FURNACE
G	NATURAL GAS
GA	GAUGE
GAL	GALLON
GALV	GALVANIZE(D)
GPM	GALLONS PER MINUTE
GV	NATURAL GAS VENT
GVTR	NATURAL GAS VENT THROUGH ROOF
H	HEIGHT/HIGH
HB	HOSE BIBB
HC-#	HEATING COIL
HP	HORSEPOWER
HRU	HEAT RECOVERY UNIT
HVAC	HEATING / VENTILATING / AIR CONDITIONING
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
INSUL	INSULATION / INSULATE
IW	INDIRECT WASTE
JC	JANITOR CLOSET
KW	KILOWATT
L	LENGTH / LONG
LAV-#	LAVATORY
LP	LIQUID PETROLEUM
LVR	LOUVER
M	METER
MAU	MAKEUP AIR UNIT
MAX	MAXIMUM
MECH	MECHANICAL
MFR	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
MTD	MOUNTED
NIC	NOT IN CONTRACT
NO / #	NUMBER
NPCW	NON-POTABLE COLD WATER
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OC	ON CENTER
OD	OUTSIDE DIAMETER
PC	PUMPED CONDENSATE
PREFAB	PREFABRICATED
PRV	PRESSURE REDUCING VALVE
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
R / RAD	RADIUS
RD-#	ROOF DRAIN
REQ'D	REQUIRED
RF-#	RETURN FAN
RM	ROOM
RPM	REVOLUTIONS PER MINUTE
RTU	ROOFTOP UNIT
SAN	SANITARY
SCHED	SCHEDULE
SCW	SOFT COLD WATER (DOMESTIC)
SH	SHOWER
SK	SINK
SP	STATIC PRESSURE
SPEC(S)	SPECIFICATON(S)
SQFT	SQUARE FEET
SRD-#	SECONDARY ROOF DRAIN
SS	SERVICE SINK
SST	SECONDARY STORM
ST	STORM
STD	STANDARD
TC	TEMPERATURE CONTROL
TEMP	TEMPERATURE
TYP	TYPICAL
UH-#	UNIT HEATER
UR	URINAL
UV	UNIT VENTILATOR
V	VENT
VA	VALVE
VAC	VACUUM
VB	VACUUM BREAKER
VEL	VELOCITY
VIF	VERIFY IN FIELD
VTR	VENT-THRU-ROOF
W	WIDE / WIDTH
W /	WITH
W / O	WITHOUT
WB	WET BULB TEMPERATURE
WC-#	WATER CLOSET
WCC	WATER COOLED CHILLER
WCO	WALL CLEAN OUT
WG	WATER GAUGE
WH	WALL HYDRANT
WSFU	WATER SUPPLY FIXTURE UNIT

DRAWING NOTATIONS

MECHANICAL SYSTEM INDICATION

HEAVY LINE-WEIGHT INDICATES NEW WORK

LIGHT LINE WEIGHT-INDICATES EXISTING EQUIPMENT OR REFERENCED INFORMATION

HATCH MARKS - EQUIPMENT OR MATERIALS TO BE DISCONNECTED AND REMOVED

DASHED LINES-PIPING ROUTED BELOW SLAB OR GRADE

NEW / EXISTING CONNECTIONS

POINT OF NEW CONNECTION

EXISTING SYSTEM COMPONENT TO REMAIN

NEW SYSTEM COMPONENT

EXISTING POINT OF DISCONNECT

POINT OF DISCONNECT

EXISTING SYSTEM COMPONENT TO REMAIN

EXISTING SYSTEM COMPONENT TO BE REMOVED

TEXT LEADER

INFORMATION TEXT

EXISTING CONNECTIONS

CAP OFF EXISTING

EXISTING SYSTEM COMPONENT TO REMAIN

DRAWING REVISION SYMBOL

1

DRAWING REVISION NUMBER

KEYNOTE

X — KEYNOTE NUMBER

DRAWING/ DETAIL TITLE

NOTE:
DRAWING TITLE MAY NOT APPEAR ON LARGE SCALE DETAIL DRAWINGS

DETAIL NUMBER

A10 P100 DRAWING TITLE

##" = 1'-0"

P200 — REFER TO THIS DRAWING FOR DETAIL

ADDITIONAL DRAWING WHERE DETAIL IS REFERENCED

SECTION CUT SYMBOL

SECTION NUMBER

1 M101

SHEET WHERE SECTION IS DRAWN

NORTH ARROW

N

PROJECT NORTH

TRUE NORTH

ENLARGED PLAN DETAIL

ENLARGED PLAN NUMBER

1 M101

REFER TO THIS SHEET FOR ENLARGED PLAN

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PLUMBING LEGEND, SYMBOLS AND ABBREVIATIONS

REVISIONS

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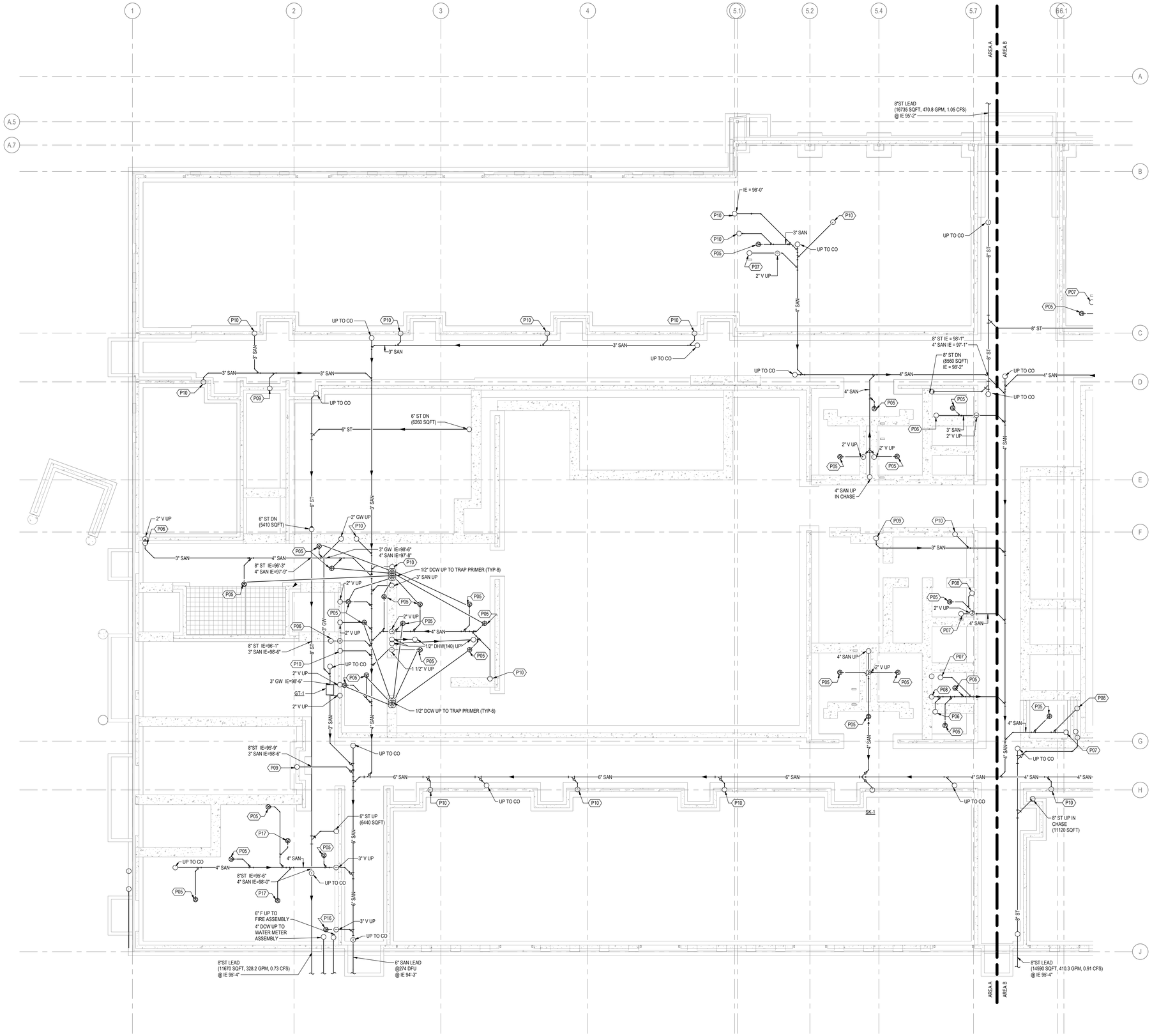


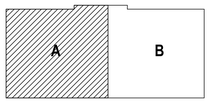
UNDERGROUND PLUMBING PLAN - AREA A
1/8" = 1'-0"

PLUMBING GENERAL NOTES

1. THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE PLUMBING SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, TRANSITIONS, ETC. AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.
2. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF ALL NEW PLUMBING FIXTURES.
3. ALL PLUMBING RELATED CORING THROUGH FLOORS SHALL BE BY PLUMBING CONTRACTOR.
4. COORDINATE ALL NEW LOCATIONS, SIZES AND ELEVATIONS OF SLEEVES THROUGH WALLS, SLABS AND FOUNDATIONS WITH STRUCTURAL DRAWINGS AND FIELD CONDITIONS.
5. COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS, AND ALL OTHER TRADES TO AVOID INTERFERENCES.
6. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.
7. ALL OVERHEAD DOMESTIC WATER AND STORM PIPING SHALL BE INSULATED PER PLUMBING PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
8. ALL PIPING SHALL BE CONCEALED IN WALLS, CEILING SPACES OR ARCHITECTURAL SOFFITS UNLESS NOTED OTHERWISE.
9. SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.
10. COORDINATE LOCATIONS AND ELEVATIONS OF ALL NEW UNDERGROUND UTILITIES WITH CIVIL SITE PLANS PRIOR TO START OF CONSTRUCTION.
11. CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD PIPING.
12. RUN ALL SANITARY, VENT, AND STORM PIPING AT SLOPES COMPLYING WITH THE MICHIGAN PLUMBING CODE LATEST EDITION.
13. PROVIDE WALL CLEANOUT AT THE BASE OF ALL VERTICAL STORM AND SANITARY CONDUCTORS.
14. PROVIDE SHUT-OFF VALVES AT ALL PLUMBING FIXTURES. LOCATE ALL PLUMBING SHUT-OFF VALVES IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.
15. FURNISH AND INSTALL BALANCING VALVES AT ALL BRANCHES OF HOT WATER RECIRCULATION PIPING SYSTEM. AT COMPLETION OF PIPING INSTALLATION, THE CONTRACTOR MUST BALANCE THE HOT WATER RECIRCULATING SYSTEM TO FLOW RATES INDICATED AND SUBMIT BALANCE RESULTS IN WRITING TO ARCHITECT/ENGINEER.
16. MINIMUM UNDERGROUND STORM AND SANITARY PIPING SHALL BE 3".
17. REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.
18. PROVIDE VENT PIPING THROUGH ROOF A MINIMUM OF 10' AWAY FROM PARAPET WALL AND A MINIMUM OF 10' CLEAR OR MORE FROM ANY OUTSIDE AIR INTAKES AS REQUIRED BY THE LATEST EDITION OF THE STATE LOCALLY ADOPTED PLUMBING CODE.

(X) PLUMBING KEYNOTES

P05 ROUTE 3" SAN AND CONNECT TO FLOOR DRAIN.
P06 ROUTE 3" SAN UP TO SERVICE SINK/MOP BASIN.
P07 ROUTE 4" SAN UP TO FLOOR MOUNTED WATER CLOSET.
P08 ROUTE 2" SAN UP IN CHASE.
P09 ROUTE 2" SAN UP TO ELECTRIC WATER COOLER.
P10 ROUTE 2" SAN UP TO SINK.
P16 ROUTE 6" SAN AND CONNECT TO FLOOR DRAIN.
P17 ROUTE 4" SAN AND CONNECT TO FLOOR DRAIN.



KEY PLAN
NOT TO SCALE

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UNDERGROUND PLUMBING PLAN - AREA A

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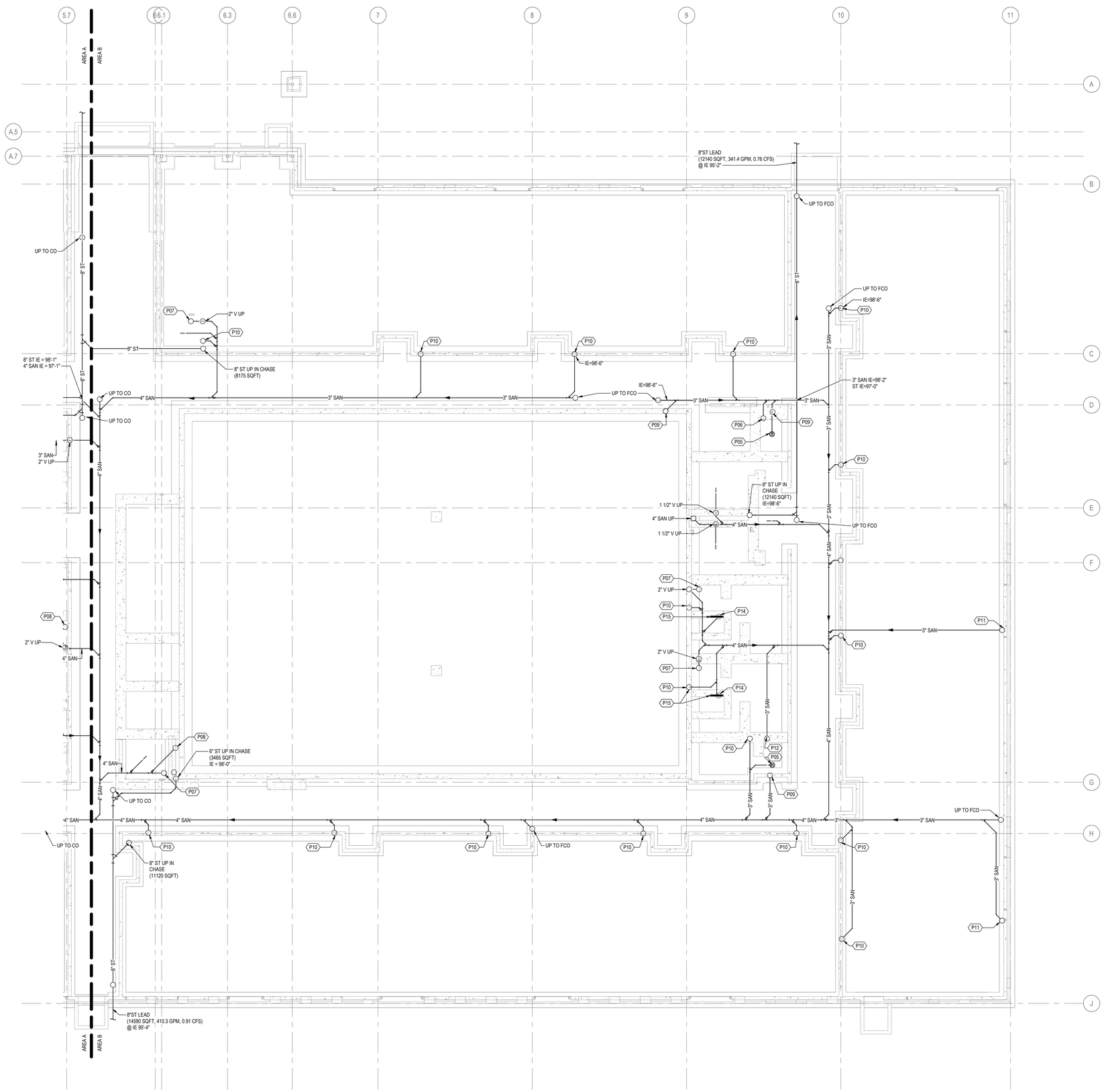

UNDERGROUND PLUMBING PLAN - AREA B
1/8" = 1'-0"

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P09 ROUTE 2" SAN UP TO ELECTRIC WATER COOLER.
P10 ROUTE 2" SAN UP TO SINK.
P11 ROUTE 3" SAN UP IN PIPE ENCLOSURE BEHIND CABINET.
P12 ROUTE 3" SAN UP TO CLOTHES WASHER STANDPIPE.
P14 ROUTE 2" SAN AND CONNECT TO SHOWER DRAIN.
P15 PROVIDE WATER SAVER TRAP PRIMER FROM LAVATORY SINK TO SHOWER TRENCH DRAIN.

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1215 E Mt Hope Ave, Lansing, MI 48910

UNDERGROUND PLUMBING PLAN - AREA B

REVISIONS

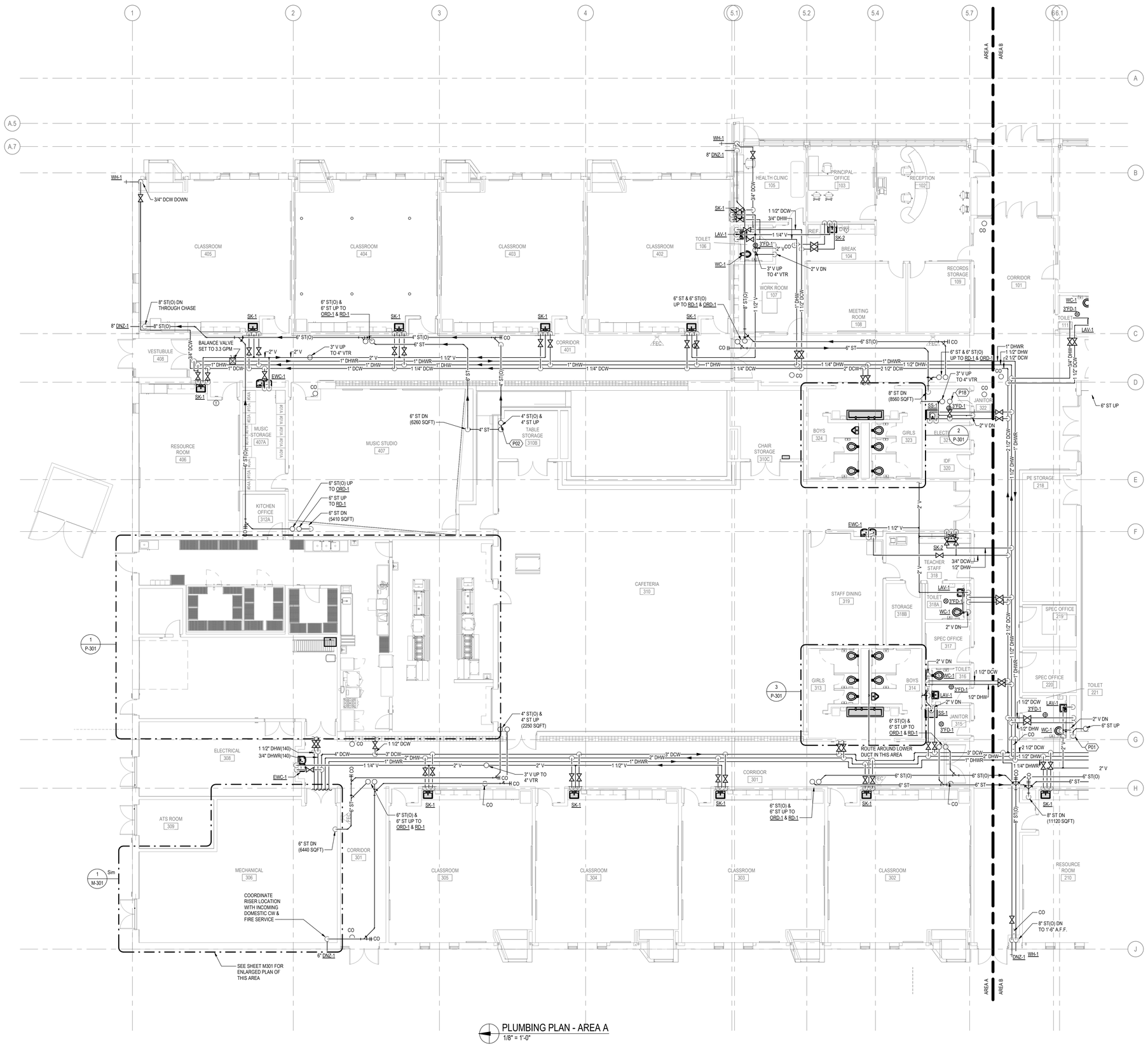
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-110B

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/28/2023 9:36:43 AM
Autodesk Docs://220116_LSD_Mt HOPE/Lsd_Lmsd_214100906_Mt_Hope.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



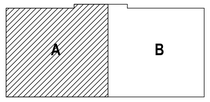
PLUMBING PLAN - AREA A
1/8" = 1'-0"

PLUMBING GENERAL NOTES

1. THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE PLUMBING SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, TRANSITIONS, ETC. AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.
2. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF ALL NEW PLUMBING FIXTURES.
3. ALL PLUMBING RELATED CORING THROUGH FLOORS SHALL BE BY PLUMBING CONTRACTOR.
4. COORDINATE ALL NEW LOCATIONS, SIZES AND ELEVATIONS OF SLEEVES THROUGH WALLS, SLABS AND FOUNDATIONS WITH STRUCTURAL DRAWINGS AND FIELD CONDITIONS.
5. COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS, AND ALL OTHER TRADES TO AVOID INTERFERENCES.
6. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.
7. ALL OVERHEAD DOMESTIC WATER AND STORM PIPING SHALL BE INSULATED PER PLUMBING PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
8. ALL PIPING SHALL BE CONCEALED IN WALLS, CEILING SPACES OR ARCHITECTURAL SOFFITS UNLESS NOTED OTHERWISE.
9. SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.
10. COORDINATE LOCATIONS AND ELEVATIONS OF ALL NEW UNDERGROUND UTILITIES WITH CIVIL SITE PLANS PRIOR TO START OF CONSTRUCTION.
11. CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD PIPING.
12. RUN ALL SANITARY, VENT, AND STORM PIPING AT SLOPES COMPLYING WITH THE MICHIGAN PLUMBING CODE LATEST EDITION.
13. PROVIDE WALL CLEANOUT AT THE BASE OF ALL VERTICAL STORM AND SANITARY CONDUCTORS.
14. PROVIDE SHUT-OFF VALVES AT ALL PLUMBING FIXTURES. LOCATE ALL PLUMBING SHUT-OFF VALVES IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.
15. FURNISH AND INSTALL BALANCING VALVES AT ALL BRANCHES OF HOT WATER RECIRCULATION PIPING SYSTEM. AT COMPLETION OF PIPING INSTALLATION, THE CONTRACTOR MUST BALANCE THE HOT WATER RECIRCULATING SYSTEM TO FLOW RATES INDICATED AND SUBMIT BALANCE RESULTS IN WRITING TO ARCHITECT/ENGINEER.
16. MINIMUM UNDERGROUND STORM AND SANITARY PIPING SHALL BE 3".
17. REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.
18. PROVIDE VENT PIPING THROUGH ROOF A MINIMUM OF 10' AWAY FROM PARAPET WALL AND A MINIMUM OF 10' CLEAR OR MORE FROM ANY OUTSIDE AIR INTAKES AS REQUIRED BY THE LATEST EDITION OF THE STATE LOCALLY ADOPTED PLUMBING CODE.

PLUMBING KEYNOTES

P01	ROUTE RAIN CONDUCTOR DOWN IN CHASE. PROVIDE ACCESS FOR BASE OF STACK CLEAN OUT
P02	ROUTE PRIMARY AND SECONDARY RAIN CONDUCTORS OVER SHEET METAL MAIN AND ROUTE DOWN WALL TO LOW ROOF.
P18	ROUTE 3/4" DCW UP TO ROOF HYDRANT.



KEY PLAN
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PLUMBING PLAN - AREA A

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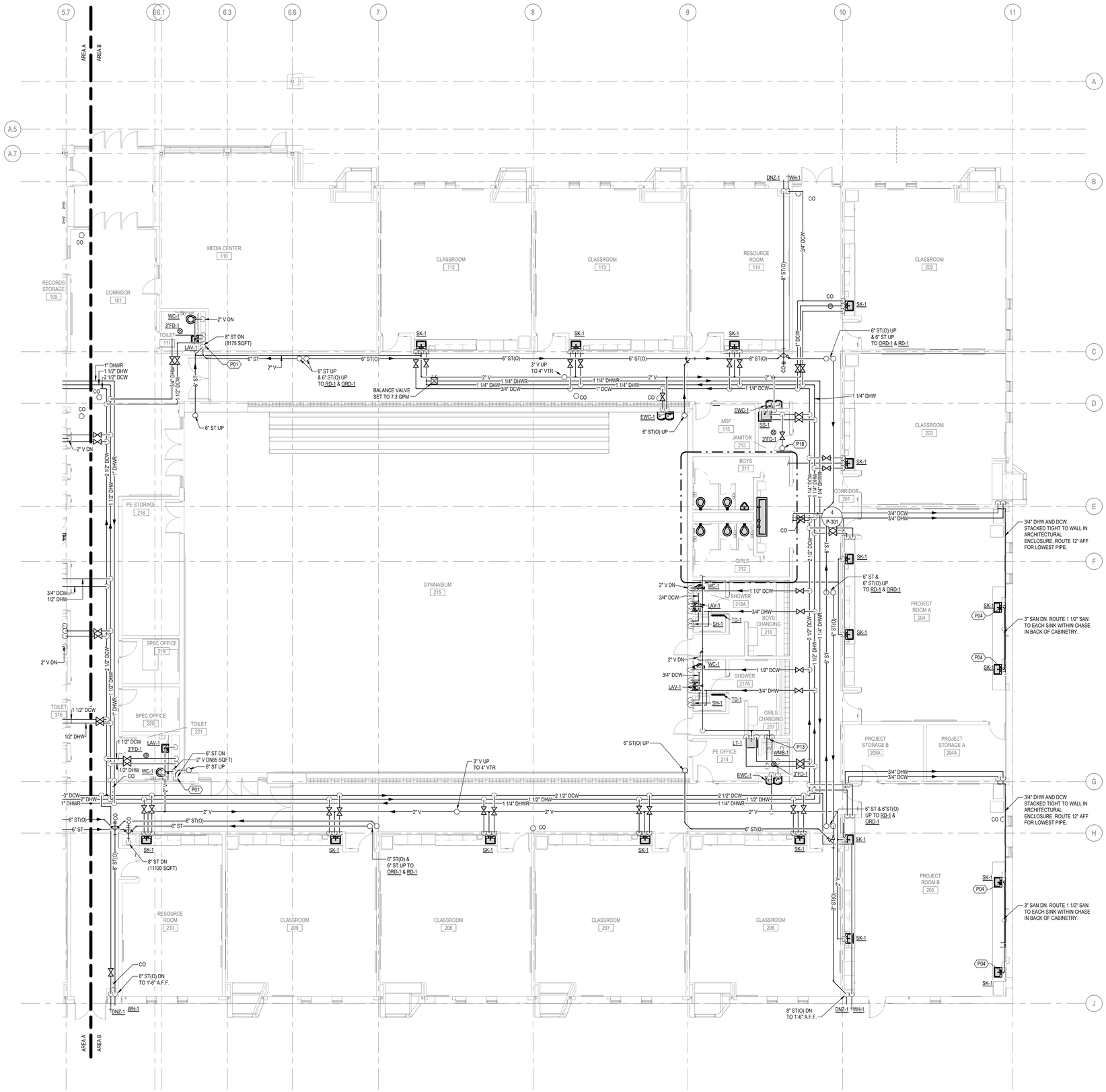

PLUMBING PLAN - AREA B
1/8" = 1'-0"

PLUMBING GENERAL NOTES

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5. COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS, AND ALL OTHER TRADES TO AVOID INTERFERENCES.
6. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.
7. ALL OVERHEAD DOMESTIC WATER AND STORM PIPING SHALL BE INSULATED PER PLUMBING PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
8. ALL PIPING SHALL BE CONCEALED IN WALLS, CEILING SPACES OR ARCHITECTURAL SOFFITS UNLESS NOTED OTHERWISE.
9. SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.
10. COORDINATE LOCATIONS AND ELEVATIONS OF ALL NEW UNDERGROUND UTILITIES WITH CIVIL SITE PLANS PRIOR TO START OF CONSTRUCTION.
11. CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD PIPING.
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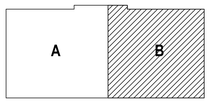
18. PROVIDE VENT PIPING THROUGH ROOF A MINIMUM OF 10' AWAY FROM PARAPET WALL AND A MINIMUM OF 10' CLEAR OR MORE FROM ANY OUTSIDE AIR INTAKES AS REQUIRED BY THE LATEST EDITION OF THE STATE LOCALLY ADOPTED PLUMBING CODE.

PLUMBING KEYNOTES

P01	ROUTE RAIN CONDUCTOR DOWN IN CHASE. PROVIDE ACCESS FOR BASE OF STACK CLEAN OUT
P04	ROUTE PIPING WITHIN PIPE ENCLOSURE BEHIND CABINET TO MAKE CONNECTIONS TO SINK. PROVIDE AIR ADMITTANCE VALVE TO VENT TRAP.
P13	ROUTE 1/2" DCW AND 1/2" DHW AND CONNECT TO CLOTHES WASHER DRAIN BOX. ROUTE 2" SAN FROM DRAIN BOX AND CONNECT TO 3" STANDPIPE.
P18	ROUTE 3/4" DCW UP TO ROOF HYDRANT.



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KITCHEN PLUMBING KEYNOTES

K01 PROVIDE 1/2" DCW DOWN IN WALL TO 36" A.F.F. AND STUB OUT TO REVERSE OSMOSIS SYSTEM. PROVIDE CONNECTION TO RO TANK AND CONNECTION BETWEEN RO TANK AND STEAMER. RO TANK AND STEAMER EQUIPMENT PROVIDED BY FSE TRADES. PROVIDE DCW CONNECTION TO DRAIN WATER TEMPERING KIT. COORDINATE WITH FSE TRADES.

K02 PROVIDE 1/2" DHW DOWN IN WALL AND UNDER FLOOR TO HOT FOOD TABLE. COORDINATE WITH FSE TRADES FOR EXACT RISER LOCATION.

K03 PROVIDE 3/4" DHW DOWN IN WALL AND STUB OUT AND CONNECT TO DISHWASHER / BOOSTER HEATER SYSTEM. (EQUIPMENT BY FSE TRADES). PROVIDE 1/2" DCW CONNECTION TO DRAIN WATER TEMPERING SYSTEM.

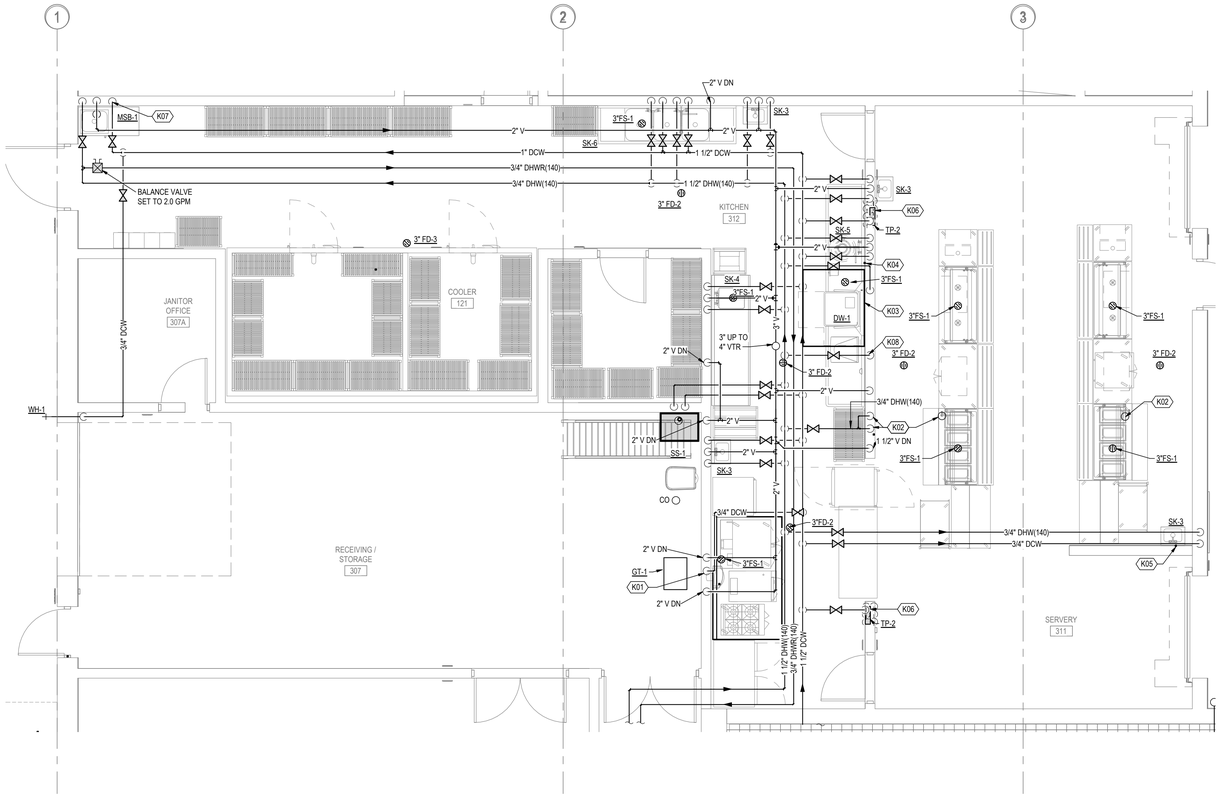
K04 PROVIDE 3/4" DCW DOWN IN WALL AND STUB OUT AND CONNECT TO DISPOSAL SYSTEM. PROVIDE 1/2" DCW CONNECTION OFF 3/4" BRANCH TO CONNECT TO WATER SOFTENER AND FILTRATION SYSTEM (EQUIPMENT BY FSE TRADES)

K05 HAND SINK LOCATED ON HALF-WALL. PROVIDE 1/2" DCW & DHW DOWN IN ADJACENT WALL. STUB OUT AND RUN SUPPLIES TIGHT TO WALL TO CONNECT TO HAND SINK. PROVIDE AAV VENT DOWNSTREAM OF TRAP BELOW SINK.

K06 PROVIDE 3/4" DCW DOWN IN WALL TO TRAP PRIMER CABINET. PROVIDE PT-8 TYPE FOR 8 OUTLETS.

K07 ROUTE 1/2" DCW, 1/2" DHW, AND 2" SAN TO MOP SINK.

K08 ROUTE 1/2" HW DOWN IN WALL TO WATER SOFTENER. INDIRECT WASTE TO FLOOR SINK FROM SOFTENER.



1 P-301 ENLARGED KITCHEN AREA PLUMBING PLAN

1/4" = 1'-0"

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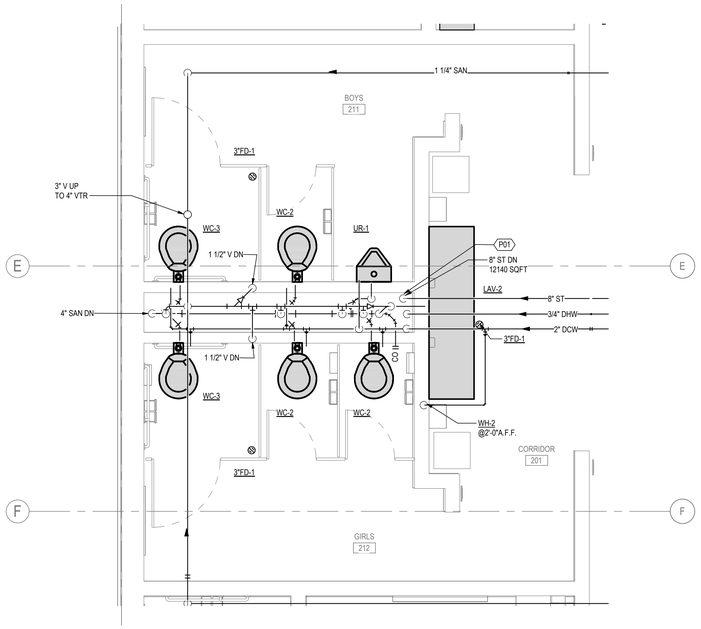
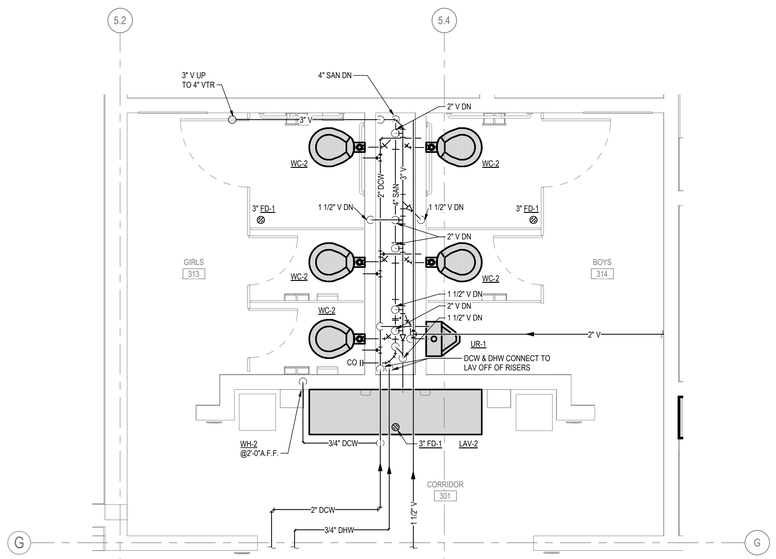
PLUMBING KEYNOTES

P01 ROUTE RAIN CONDUCTOR DOWN IN CHASE. PROVIDE ACCESS FOR BASE OF STACK CLEAN OUT



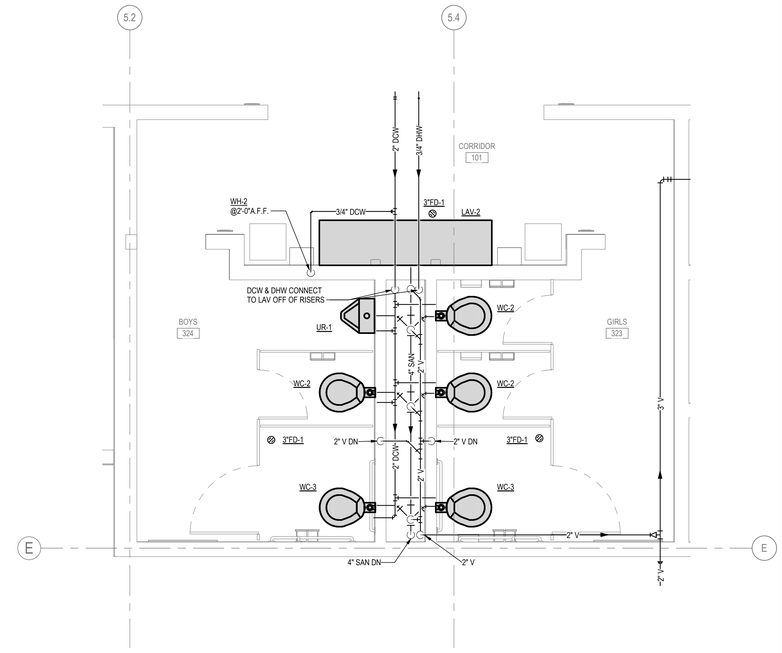
4 P-301 ENLARGED TOILET ROOMS GIRLS 212 AND BOYS 211 PLUMBING PLAN

3/8" = 1'-0"



3 P-301 ENLARGED TOILET ROOMS GIRLS 313 AND BOYS 314 PLUMBING PLAN

3/8" = 1'-0"



2 P-301 ENLARGED TOILET ROOMS GIRLS 323 AND BOYS 324 PLUMBING PLAN

3/8" = 1'-0"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

WHITE

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ENLARGED PLUMBING PLANS

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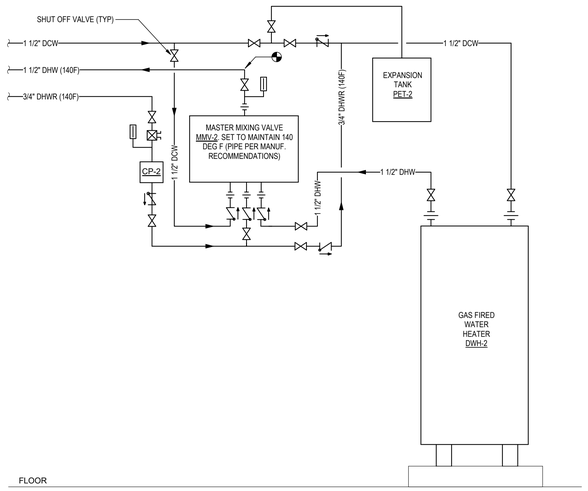
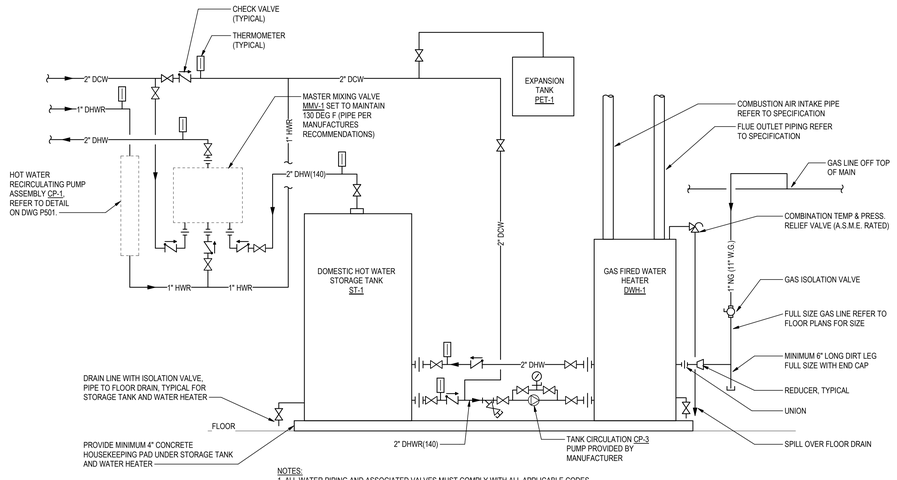


NOTES:
1. ALL WATER PIPING AND ASSOCIATED VALVES MUST COMPLY WITH ALL APPLICABLE CODES.

2. MASTER MIXING VALVE PIPING ARRANGEMENT SHALL BE COORDINATED AND INSTALLED PER MANUFACTURER RECOMMENDATIONS. PROVIDE ANY VALVING/PIPING PER THEIR SPECIFIC REQUIREMENTS.

KITCHEN DOMESTIC WATER HEATING PIPING DIAGRAM

SCALE: NONE



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BUILDING DOMESTIC WATER HEATER PIPING DIAGRAM

SCALE: NONE

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PLUMBING DIAGRAMS

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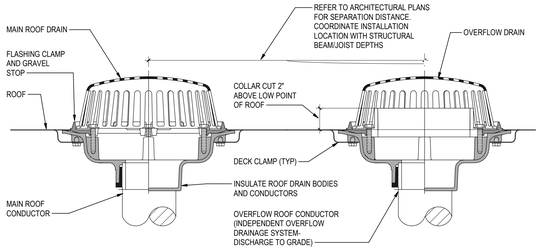
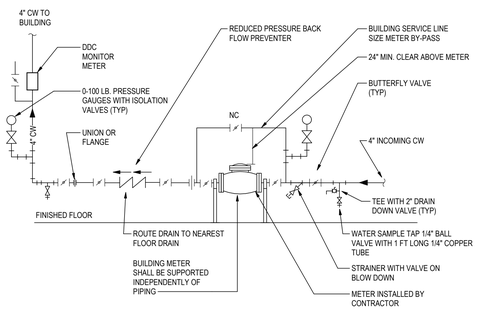
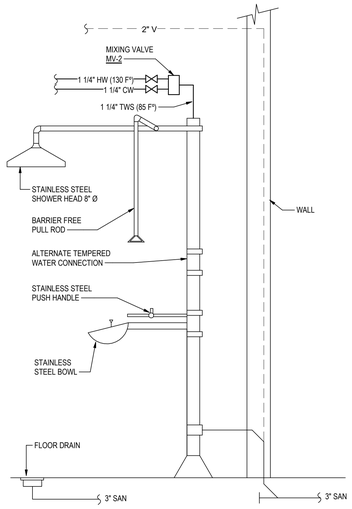


COMBINED ROOF DRAIN DETAIL
SCALE: NONE



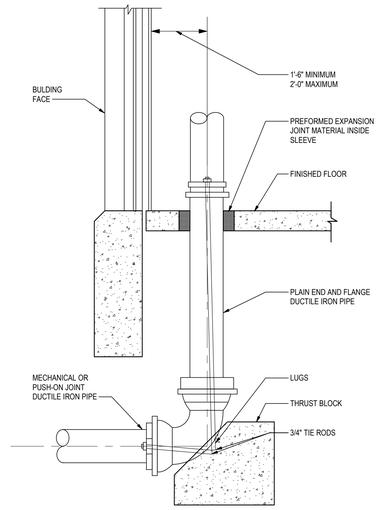
NOTE:
1. WATER METER AND BACKFLOW PREVENTER SHALL BE SIZED FOR XXX GPM FLOW.

WATER SERVICE PIPING DIAGRAM
SCALE: NONE



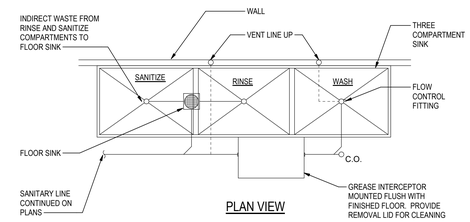
NOTES:
1. CONNECT TEMPERED WATER PIPING PER MANUFACTURER RECOMMENDATIONS.

EMERGENCY COMBINATION SHOWER/EYEWASH DETAIL
SCALE: NONE

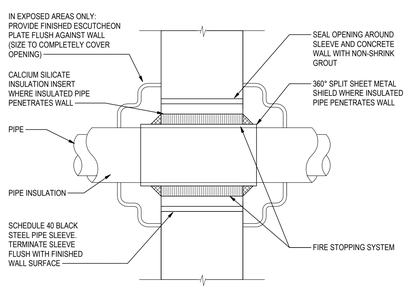


NOTE:
1. LOCATE FLANGE AT 12" AFF . FLANGE TO BE PLUMB, LEVEL 3/4" TIE RODS.

WATER SERVICE LINE SCHEMATIC

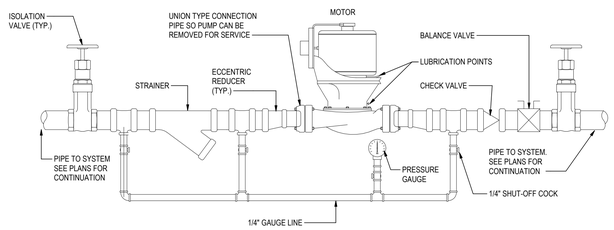


PLAN VIEW



NOTES:
1. DETAIL INDICATES THE INSULATION REQUIREMENTS FOR A FIRE RATED ASSEMBLY. FOR A NON-FIRE RATED ASSEMBLY PACK SLEEVED OPENING WITH INSULATION MATERIAL AND CAULK WITH NON-HARDENING SEALANT.
2. PIPE PENETRATION DETAIL SIMILAR FOR UNINSULATED PIPING.

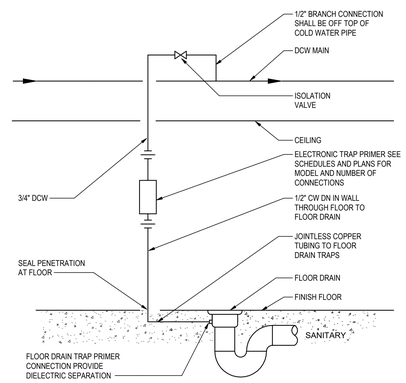
FIRE RATED AND NON-FIRE RATED POURED CONCRETE OR BLOCK WALL PIPE PENETRATION DETAIL
SCALE: NONE



INSTALLATION NOTES:

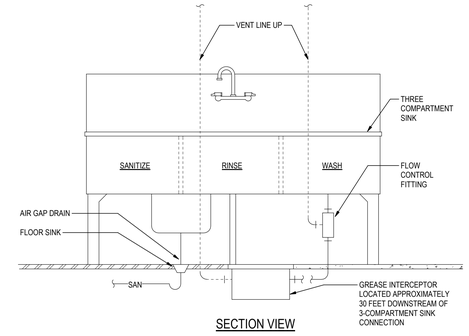
1. THE PUMP SHALL BE INSTALLED DEAD LEVEL, AND SHALL NOT TOUCH OR REST ON ANY PART OF THE BUILDING STRUCTURE.
2. THE ELECTRICAL CONNECTION TO THE PUMP SHALL BE MADE THROUGH THE USE OF FLEXIBLE CONDUIT (GREENFIELD) AT LEAST 18" LONG.
3. THE PUMP SUPPORTED INDEPENDENTLY OF PIPING AND SHALL BE INSTALLED SUCH THAT THE PUMP CAN BE COMPLETELY REMOVED WITHOUT THE DISMANTLING OR REMOVAL OF ANY PIPING OR VALVES.
4. THE MOTOR & COUPLING SHALL BE CHECKED AND PROPERLY ALIGNED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
5. THE ADJACENT PIPING SHALL BE CAREFULLY FITTED AND ERECTED SO THAT THE PUMP CAN BE INSTALLED OR REMOVED FROM THE PIPE LINE WITHOUT FORCING OR SPRINGING.
6. AFTER THE SYSTEM HAS BEEN COMPLETED AND THE PUMP STARTED THE PUMP AND SYSTEM SHALL BE CHECKED FOR VIBRATION AND EXCESSIVE NOISE AND ANY SUCH NOISE OR VIBRATION SHALL BE IMMEDIATELY CORRECTED.
7. PROVIDE PIPE FLEXIBLE CONNECTION FOR PUMPS WITH MOTORS GREATER THAN 1/2 HORSEPOWER.

IN-LINE CIRCULATING PUMP PIPING DETAIL
SCALE: NONE



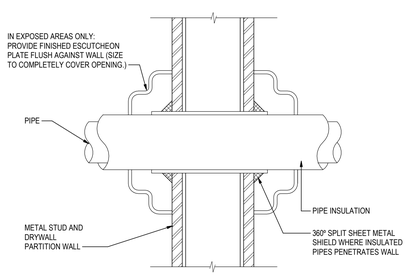
NOTES:
1. INSTALL TRAP PRIMER IN ACCESSIBLE LOCATION. COORDINATE ACCESS PANEL LOCATION WITH ARCHITECTURAL TRADES.
2. TUBING FROM TRAP PRIMER SHALL GRAVITY DRAIN TO FLOOR DRAIN TRAP PRIMER CONNECTION.

MULTIPLE TRAP PRIMER DETAIL
SCALE: NONE



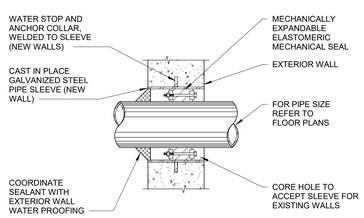
SECTION VIEW

GREASE INTERCEPTOR DETAIL
SCALE: NONE

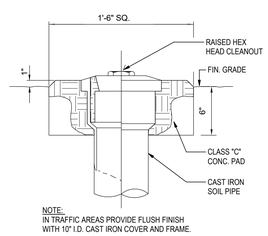


NOTES:
1. PIPE PENETRATION DETAIL SIMILAR FOR UNINSULATED PIPING.

NON-FIRE RATED STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL
SCALE: NONE

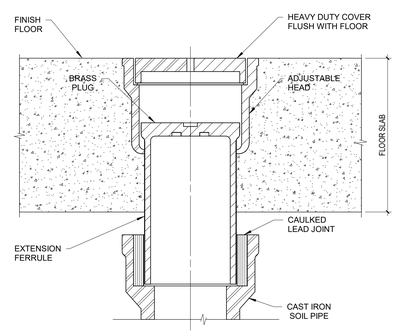


PIPE PENETRATION THROUGH EXTERIOR BELOW GRADE WALL DETAIL
SCALE: NONE

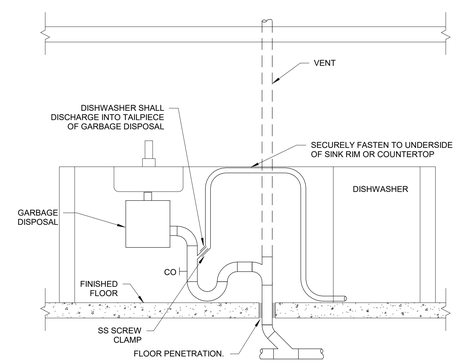


NOTE:
IN TRAFFIC AREAS PROVIDE FLUSH FINISH WITH 10" I.D. CAST IRON COVER AND FRAME.

EXTERIOR CLEAN OUT DETAIL
SCALE: NONE



CLEAN OUT DETAIL
SCALE: NONE



BREAKROOM DISHWASHER DRAINAGE PIPING DETAIL
SCALE: NONE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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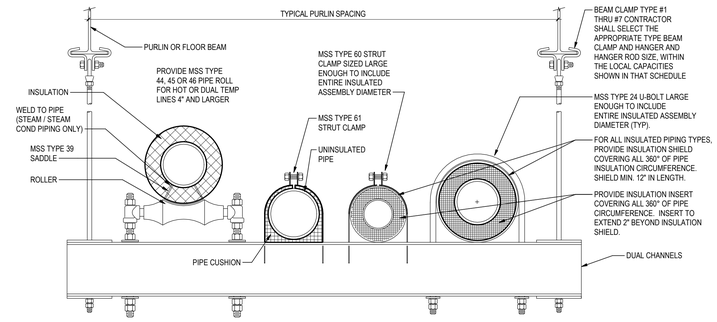
LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

PLUMBING DETAILS

REVISIONS		
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-501

100% CONSTRUCTION DOCUMENTS

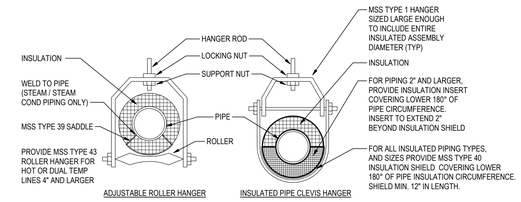


CONTRACTOR SHALL SIZE THE CHANNEL MEMBERS FOR THE LOADS TO BE SUPPORTED SO AS NOT TO EXCEED A MAXIMUM DEFLECTION OF 1/240 OF THE SPAN BETWEEN HANGER RODS

NOTES:
1. FOLLOW THE CONTRACT DOCUMENTS FOR WHERE EACH HANGER TYPE APPLIES.
2. FOLLOW ANY REQUIREMENTS FOR VIBRATION ISOLATION AS NOTED IN THE CONTRACT DOCUMENTS.

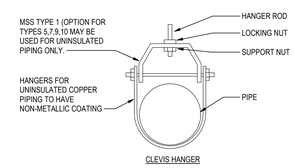
TRAPEZE SUPPORT DETAIL

SCALE: NONE



ADJUSTABLE ROLLER HANGER

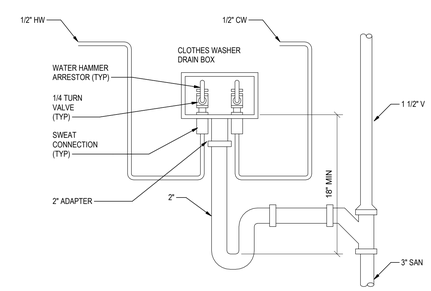
INSULATED PIPE CLEVIS HANGER



CLEVIS HANGER

PIPE HANGER DETAIL

SCALE: NONE



WASHING MACHINE OUTLET BOX DETAIL W/ WATER HAMMER ARRESTORS

SCALE: NONE

NOTES:
1. PROVIDE ACCESS WALL PANEL AT TRAP.

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
WHITE BLACK
WE RECYCLE

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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

PLUMBING DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-502

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK WHITE

WE RECYCLE

PLUMBING PIPING SYSTEM APPLICATION SCHEDULE

SYSTEM	ABBREVIATION	AREA OR SYSTEM SERVED	PIPE LOCATION	PIPE SIZE (DN)	PIPING MATERIAL											JOINING METHOD						CONSTRUCTION					INSULATION				FACTORY...			FIELD JACKET				
					COPPER DWV TUBE	COPPER TYPE K	COPPER TYPE L - ASTM B 88	SCH 40 STEEL	SCH 80 PVC	STAINLESS STEEL TUBE	STAINLESS STEEL	CAST IRON, HUBLESS	DUCTILE IRON	PVC, SOLID WALL	PUSH	MECHANICAL	SOLDERED	GROOVED	FUSION	PRESSURE FITTINGS	SOLVENT CEMENT	OPERATING TEMPERATURE (°F)	MINIMUM WORKING PRESSURE (PSI)	TEST PRESSURE (kPa)	TEST DURATION (HRS)	ACCEPTANCE LEVEL	MINERAL FIBER PREFORMED	FLEXIBLE ELASTOMERIC	THICKNESS (IN)	DENSITY (PCF)	ASJ	ASJ-SS	FSK	PVC ALL	PVC FITTINGS	PVC TO 10 FEET	ALUMINUM	STAINLESS STEEL
DOMESTIC WATER	DCW / DHW / DHWR	DOMESTIC WATER	ABOVEGROUND	NPS 1 1/2 AND SMALLER			X										X					40 - 140	100	150	12	ZERO LOSS/LEAKS	X		1.5	1		X			X			
DOMESTIC WATER	DCW/DHW	DOMESTIC WATER	UNDER BUILDING SLAB	NPS 3/4 AND SMALLER		X																40 - 140	100	150	12	ZERO LOSS/LEAKS												
DOMESTIC WATER	DCW / DHW / DHWR	DOMESTIC WATER	ABOVEGROUND	NPS 2 TO NPS 4			X										X					40 - 140	100	150	12	ZERO LOSS/LEAKS	X		1.5	1		X			X			
DOMESTIC WATER, BUILDING SERVICE	DCW	DOMESTIC WATER	UNDER BUILDING SLAB	NPS 4 AND LARGER								X			X	X						40 - 140	100	150	12	ZERO LOSS/LEAKS	X		1.5	1		X			X			
INDIRECT WASTE	IW	EQUIPMENT WASTE	ABOVEGROUND	ALL SIZES	X												X					40 - 140	100	150	12	ZERO LOSS/LEAKS												
SANITARY & VENT	SAN / V	TOILET ROOMS / SINKS / MISC FLOOR DRAINS	ABOVEGROUND	ALL SIZES								X				X						30 - 140	0.5	NOTE 1	12	ZERO LOSS/LEAKS												
SANITARY & VENT	SAN / V	TOILET ROOMS / SINKS / MISC FLOOR DRAINS	UNDERGROUND	ALL SIZES								X		X		X					X	30 - 140	0.5	NOTE 1	12	ZERO LOSS/LEAKS												
STORM	ST / SST	BUILDING ROOF DRAINAGE	ABOVEGROUND	NPS 6 AND SMALLER								X				X						30 - 120	0.5	NOTE 1	12	ZERO LOSS/LEAKS	X		1.5	1		X			X			
STORM	ST / SST	BUILDING ROOF DRAINAGE	ABOVEGROUND	NPS 8 AND LARGER								X				X						30 - 120	0.5	NOTE 1	12	ZERO LOSS/LEAKS	X		1.5	1		X			X			
STORM	ST / SST	BUILDING ROOF DRAINAGE	UNDERGROUND	NPS 6 AND SMALLER								X		X		X					X	30 - 120	0.5	NOTE 1	12	ZERO LOSS/LEAKS												
STORM	ST / SST	BUILDING ROOF DRAINAGE	UNDERGROUND	NPS 8 AND LARGER								X		X		X					X	30 - 120	0.5	NOTE 1	12	ZERO LOSS/LEAKS												

NOTES:
1. CLOSE OPENING IN PIPING SYSTEM AND FILL TO POINT OF OVERFLOW BUT NOT LESS THAN 10 FOOT HEAD OF WATER.

PLUMBING FIXTURE SCHEDULE

MARK	FIXTURE	SAN	VENT	TRAP	CW	HW	COMMENTS
WMB-1	CLOTHES WASHER DRAIN BOX	2"	-	-	1/2"	1/2"	GUY GREY MODEL MWB-19 RECESSED WHITE POWDER COAT STEEL BOX WITH QUARTER TURN BALL VALVES WITH 1/2" SWEAT CONNECTION AND WATER HAMMER ARRESTERS, TOPMOUNT BOX AND FACEPLATE.
ECS-1	COMBINATION EMERGECNY SHOWER/EYEWASH	1 1/4"	-	-	1 1/4"	1 1/4"	BRADLEY S19314 COMBINATION DRENCH SHOWER AND EYE/FACE WASH WITH 6" BARRIER FREE DRAIN HEIGHT, STAY-OPEN CHROME PLATED BRASS SHOWER AND EYEWASH, PLASTIC SHOWERHEAD WITH STAINLES STEEL SHROUD, HALO EYE/FACE WASH, 304SS BOWL WITH DUST COVER, 304 SS HANDLE WITH 304 SS FOOT PEDAL, AND ANTI-SCALD VALVE. ADDITIONALLY PROVIDE MV-1 TO SERVE SYSTEM PRIOR TO PLUMBING CONNECTIONS TO FIXTURE. ROUTE DRAIN TO NEAREST FLOOR DRAIN. ROUTE TO PREVENT TRIP HAZARD.
EWC-1	ELECTRIC WATER COOLER	1 1/2"	1 1/2"	INTEGRAL	1/2"	-	ELKAY LMABFTL8WSSK BARRIER-FREE, BI-LEVEL STAINLESS STEEL ELECTRIC WATER COOLER WITH BOTTLE FILLING STATION MOUNTED ON THE UPPER LEVEL. PUSHBAR ACTIVATION WITH VANDAL-RESISTANT BUBBLER. PROVIDE WITH CORD AND PLUG, 115V/1PH/60HZ. PROVIDE WITH VISUAL FILTER MONITOR. PROVIDE EACH WITH EXTRA FILTER.
RD-1	ROOF DRAIN	-	-	-	-	-	JAY R. SMITH 1010Y-E-C-U-CID CAST IRON ROOF DRAIN WITH CAST IRON LOW SILHOUETTE DOME. SIZE AS INDICATED ON PLANS. PROVIDE ALL ACCESSORIES AS REQUIRED FOR BUILDING ROOFING SYSTEM.
ORD-1	OVERFLOW ROOF DRAIN	-	-	-	-	-	JAY R. SMITH 1080Y-E-C-U-CID CAST IRON SECONDARY ROOF DRAIN WITH WATER DAM AND CAST IRON LOW SILHOUETTE DOME. SIZE AS INDICATED ON PLANS. PROVIDE ALL ACCESSORIES AS REQUIRED FOR BUILDING ROOFING SYSTEM.
DNZ-1	DOWNSPOUT NOZZLE	-	-	-	-	-	JAY R. SMITH 1770-BS CAST BROZE NOZZLE AND FLANGE WITH BIRD SCREEN. SIZE AS INDICATED ON PLANS. PROVIDE ALL NECESSARY MATERIALS FOR A COMPLETE INSTALLATION INTO EXTERIOR WALL SYSTEM.
FD-1	GENERAL FLOOR DRAIN	REFER TO FLOOR PLANS	-	REFER TO FLOOR PLANS	-	-	ZURN MODEL Z415S FLOOR DRAIN WITH TYPE "S" STRAINER AND SEDIMENT BUCKET. CAST IRON BODY WITH BOTTOM OUTLET, COMBINATION INVERTIBLE MEMBRANE CLAMP AND ADJUSTABLE COLLAR.
FD-2	GENERAL FLOOR DRAIN	REFER TO FLOOR PLANS	-	REFER TO FLOOR PLANS	-	-	ZURN MODEL Z415S-AR FLOOR DRAIN WITH TYPE "S" STRAINER AND SEDIMENT BUCKET. CAST IRON BODY WITH ACID RESISTANT COATING AND BOTTOM OUTLET, COMBINATION INVERTIBLE MEMBRANE CLAMP AND ADJUSTABLE COLLAR. PROVIDE 1/2" TRAP PRIMER CONNECTION FOR TRAP PRIMER TP-2.
FD-3	FUNNEL FLOOR DRAIN	REFER TO FLOOR PLANS	-	REFER TO FLOOR PLANS	-	-	ZURN Z415E-AR FUNNEL FLOOR DRAIN WITH TYPE "E" STRAINER, CAST IRON BODY WITH ACID RESISTANT EPOXY COATING. PROVIDE 1/2" TRAP PRIMER CONNECTION FOR TRAP PRIMER TP-2
FD-4	FLOOR DRAIN	6"	-	6"	-	-	JAY R. SMITH 3200Y 16.5" SQUARE TOP SANI-CEPTOR ACID RESISTANT COATED FLOOR DRAIN WITH ALUMINUM DOME BOTTOM STRAINER.
FS-1	FLOOR SINK	REFER TO FLOOR PLANS	-	REFER TO FLOOR PLANS	-	-	JAY R SMITH 3151Y 12.5" SQUARE TOP, ACID RESISTANT COATED INDIRECT WASTE DRAIN WITH NICKEL BRONZE TOP, WHITE ABS SEDIMENT BUCKET, HALF-GRATE.
TD-1	TRENCH DRAIN	2"	-	2"	-	-	LUXE LINEAR SHOWER DRAIN - PATTERN GRATE. 18 GAUGE 304 STAINLESS STEEL, SLOPED INNER CHANNEL FOR CENTER DRAINAGE. 30"Lx3 3/16"W x 3/4"D. SATIN STAINLESS FINISH. PROVIDE WITH LUXE 2" PVC DRAIN BASE. PROVIDE TRAP PRIMER FITTING FOR CONNECTION TO TP-3.
TP-1	TRAP SEAL	-	-	-	-	-	RECTORSEAL "SURE SEAL" INLINE FLOOR DRAIN WATERLESS TRAP SEALER. HDPE HOUSING WITH DIAPHRAGM AND RUBBER SEALING GASKET. COMPLIANT WITH PERFORMANCE REQUIREMENTS OF ASSE 1072. SIZE TO MATCH PIPE/OUTLET SIZE OF DRAIN.
TP-2	TRAP PRIMER	-	-	-	3/4"	-	PPP PT-X ELECTRONIC TRAP PRIMER MANIFOLD.FLUSH MOUNT 14"Wx16"Hx3.4"D, 120V SINGLE POINT CONNECTION, W/ATMOSPHERIC VACUUM BREAKER, PRE-SET 24 HOUR TIMER, 1/2" OUTLET COMPRESSION FITTINGS. (SEE PLANS FOR NUMBER OF OUTLETS)
TP-3	TRAP PRIMER	-	-	-	3/4"	-	ZURN Z1021 WATER SAVER TRAP PRIMER.
LAV-1	LAVATORY	1 1/2"	1 1/2"	1 1/4" x 1 1/2"	1/2"	1/2"	KOHLER "GREENWICH" MODEL K-2032 20.75"x18.25" WALL MOUNTED VITREOUS CHINA LAVATORY. SEE ARCHITECTURAL PLANS FOR MOUNTING HEIGHT. SLOAN ETF-600, ELECTRONIC FAUCET WITH 0.5 GPM AERATOR, 24 VAC, 50/60 HZ, PROVIDE TRANSFORMER. PROVIDE DRAIN, CONICAL STRAINER, TAILPIECE, P-TRAP WITH CLEANOUT PLUG, QUARTER-TURN ANGLE STOPS AND SUPPLIES. INSULATE EXPOSED WASTE AND WATER PIPING. PROVIDE POINT OF USE THERMOSTATIC MIXING VALVE MMV-3 BENEATH SINK.
LAV-2	3- STATION LAVATORY	1 1/2"	1 1/2"	1 1/2"	3/4"	3/4"	BRADLEY LVAD3 "VERGE" 3-STATION WASH BASIN WITH QUARTZ EVERO CLASSIC - GEO SERIES "ANTARCTICA" CONSTRUCTION/FINISH. PROVIDE WITH "VERGE" FAUCET "LINEA" SERIES TOUCH FREE 0.5 GPM SILICONE TIP WITH BRUSHED STAINLESS FINISH. AC POWERED, PROVIDE TRANSFORMER AS REQUIRED. PROVIDE WITH THERMOSTATIC MIXING ASSEMBLY, POLLYPRO P-TRAP, QUARTER TURN ANGLE STOPS AND SUPPLIES. PROVIDE ACCESS PANEL.
LT-1	LAUNDRY TUB	1 1/2"	1 1/2"	1 1/2"	3/4"	3/4"	FIAT P-1 POLYETHYLENE 23"x21.5" SINGLE BOWL LAUNDRY TUB FLOOR MOUNTED WITH LEGS, INTEGRAL DRAIN, AND DRAIN PLUG. PROVIDE WITH A1 6 3/4" SWING SPOUT FAUCET WITH BLADE HANDLES, 4" CENTERSET, CHROME PLATED, METAL CONSTRUCTED. PROVIDE 1 1/2" TAILPIECE, P-TRAP WITH C.O. PLUG. PROVIDE QUARTER-TURN ANGLE STOPS AND SUPPLIES AND STOP VALVES.
SH-1	SHOWER	2"	-	2"	3/4"	3/4"	SYMMONS "ORIGINS" 9605-PLR-TRM SHOWER/HAND SHOWER TRIM WITH 1 MODE WALL MOUNTED SHOWER HEAD, WALL MOUNTED METAL LEVER HANDLE, WALL MOUNTED ADA 36" GRAB BAR FOR HAND SHOWER WAND WITH CLIP. ADA 1 MODE HAND SHOWER WAND WITH NON-POSITIVE SHUTOFF AND 60" FLEXIBLE HOSE. PROVIDE WITH TEMPTROL PRESSURE BALANCING SHOWER VALVE AND SYMMONS DUAL OUTLET DIVERTER VALVE. ALL COMPONENTS TO HAVE POLISHED CHROME FINISH.
SK-1	CLASSROOM SINK	1 1/2"	1 1/2"	1 1/2"	1/2"	1/2"	KOHLER "UNDERTONE" K-3332-NA UNDERMOUNT SINK. SINGLE BOWL, 18 GA STAINLESS STEEL 23"Lx17.5"Wx7.5"D. PROVIDE CHICAGO FAUCET 50-E35-317XKABCP WITH 5 1/4" RIGID/SWING GOOSENECK FAUCET WITH SINGLE HOLE MOUNT. PROVIDE P-TRAP WITH CO PLUG, 1 1/2" TAILPIECE, QUARTER-TURN ANGLE SUPPLIES AND STOP VALVES. PROVIDE POINT-OF-USE THERMOSTATIC MIXING VALVE MV-1. INSULATE WASTE AND WATER PIPING WHERE ANY WILL BE EXPOSED. PROVIDE ZURN Z1180 SOLIDS INTERCEPTOR FOR EACH SINK WITHIN PROJECT ROOMS A & B
SK-2	BREAK ROOM SINK	1 1/2"	1 1/2"	1 1/2"	1/2"	1/2"	KOHLER "UNDERTONE" K-3325 UNDERMOUNT KITCHEN SINK. SINGLE BOWL, 18 GA STAINLESS STEEL 23"Lx17.5"Wx9.5"D. PROVIDE KOHLER "SIMPLICE" K-596 PULL DOWN 1.5 GPM SWING FAUCET WITH VIBRANT STAINLESS FINISH. PROVIDE P-TRAP WITH C.O. PLUG, 1 1/2" TAILPEICE WITH DISHWASHER CONNECTION, QUARTER-TURN ANGLE SUPPLIES AND STOP VALVES. PROVIDE POINT-OF-USE THERMOSTATIC MIXING VALVE MV-1. PROVIDE TUBING CONNECTIONS FROM DISHWASHER TO SINK DRAIN AND HW SUPPLY PER DISHWASHER MANUF. INSTRUCTIONS. PROVIDE TUBING CONN. FROM CW SUPPLY TO REFRIGERATOR ICE MAKER.
SK-3	KITCHEN HAND SINK	1 1/2"	1 1/2"	1 1/2"	1/2"	1/2"	SINK, FAUCET, AND DRAIN PROVIDED BY FSE TRADES, SEE FSE DRAWINGS FOR REFERENCE. PLUMBING CONTRACTOR TO PROVIDE TAILPIECE, P-TRAP WITH CLEANOUT PLUG, QUARTER-TURN ANGLE STOPS AND SUPPLIES AND STOP VALVES. INSULATE EXPOSED WASTE AND WATER PIPING BELOW SINK. PROVIDE POINT-OF-USE THERMOSTATIC MIXING VALVE MV-1.
SK-4	KITCHEN PREP SINK	1 1/2"	1 1/2"	1 1/2"	3/4"	3/4"	SINK, FAUCET, AND DRAIN.BY FSE TRADES. PLUMBING CONTRACTOR TO PROVIDE INDIRECT WASTE TAILPIECE TO AIR GAP ABOVE FLOOR SINK, QUARTER-TURN ANGLE STOPS AND SUPPLIES AND STOP VALVES.
SK-5	KITCHEN SPRAY RINSE BASIN W/ DISPOSAL	2"	1 1/2"	-	3/4"	3/4"	SINK, FAUCET, BASIN, DISPOSER, AND CONTROL PANEL BY FSE TRADES. PLUMBING CONTRACTOR TO PROVIDE WASTE PIPING CONNECTION TO DISPOSER, DCW CONNECTION TO SYPHON BREAKER/DISPOSER SYSTEM, QUARTER-TURN ANGLE STOPS AND SUPPLIES AND STOP VALVES.
SK-6	KITCHEN 3-COMPARTMENT SINK	(3) 2 1/2"	1 1/2"	(3) 2 1/2"	3/4"	3/4"	SINK, FAUCET AND DRAIN BY FSE TRADES. PLUMBING CONTRACTOR TO PROVIDE INDIRECT WASTE TAILPIECE TO AIR GAP ABOVE FLOOR SINK (2) AND DIRECT DRAIN TO VENTED FLOW CONTROL FITTING, QUARTER-TURN ANGLE STOPS AND SUPPLIES AND STOP VALVES.
SS-1	SERVICE SINK	3"	-	3"	3/4"	3/4"	FIAT "STOCKTON" MODEL TSBC-1611 PRECAST TERRAZO 32"x32" CORNER MOP SINK WITH STAINLESS STEEL CAPS ON CORNER THRESHOLD. PROVIDE CHICAGO FAUCET MODEL 540-LD897SWXF317CP WALL MOUNTED 8" FIXED CENTER FAUCET WITH VACUUM BREAKER AND WRISTBLADE HANDLES. PROVIDE WITH FIAT 832AA HOSE & HOSE BRACKET AND MSG WALL GUARDS.
ST-1	SERVICE TUB	1 1/2"	1 1/2"	1 1/2"	3/4"	3/4"	FIAT MODEL FLTDII MOLDED STONE APPLIANCE DEPTH DB LAUNDRY TUB. FLOOR MOUNTED WITH WHITE BAKED ENAMEL STEEL LEGS. 40"Lx24"Dx14"H COMPRESSION MOLDED STONE BODY WITH (4) 20" TALL LEGS. ONE INTEGRAL DRAIN PER BOWL WITH DRAIN PLUGS. PROVIDE CHICAGO FAUCET MODEL 737-RCF WALL MOUNTED 8" CENTERS S6 CAST SWING SPOUT, 369 LEVEL HANDLES, ROUGH CHROME FINISH WITH 3/4" MALE HOSE THREAD OUTLET. PROVIDE 1 1/2" TAILPIECE, P-TRAP WITH C.O. PLUG PER DRAIN. PROVIDE QUARTER=TURN ANGLE STOPS AND SUPPLIES AND STOP VALVES.
WC-1	WATER CLOSET FLOOR MOUNT	4"	2"	INTEGRAL	1 1/4"	-	KOHLER HIGHCLIFF ULTRA K-96057 BARRIER-FREE, FLOOR MOUNTED, TOP SPUD, VITREOUS CHINA ELONGATED 1.6 GPF FLUSHOMETER TOILET. SLOAN MODEL ROYAL 111-1.6 POLISHED CHROME MANUAL FLUSH VALVE AND OLSONITE MODEL 10SSC/10SSCT ELONGATED TOILET SEAT, HEAVY DUTY, OPEN FRONT, LESS COVER. COLORS TO BE SELECTED BY ARCHITECT.
WC-2	WATER CLOSET WALL MOUNT	4"	2"	INTEGRAL	1 1/4"	-	KOHLER KINGSTON ULTRA K-84325 BARRIER-FREE, WALL MOUNTED, TOP SPUD, VITREOUS CHINA ELONGATED 1.6 GPF FLUSHOMETER TOILET. SLOAN ROYAL 111-1.6 POLISHED CHROME MANUAL FLUSH VALVE. REFER TO ARCH. ELEVATIONS FOR MOUNTING HEIGHTS. PROVIDE OLSONITE 95CT ELONGATED TOILET SEAT, HEAVY DUTY, OPEN FRONT, LESS COVER. ALL COLORS TO BE SELECTED BY ARCHITECT. REFER TO ARCH ELEVATIONS FOR MOUNTING HEIGHTS.
UR-1	URINAL WALL MOUNT	2"	1 1/2"	INTEGRAL	3/4"	-	KOHLER DEXTER K-5016-ET 1.0 GPF WALL MOUNT VITREOUS CHINA URINAL. SLOAN ROYAL 186-1.0 POLISHED CHROME MANUAL FLUSH VALVE. COLORS TO BE SELECTED BY ARCHITECT. REFER TO ARCH. ELEVATIONS FOR MOUNTING HEIGHTS.
WH-1	EXTERIOR WALL HYDRANT	-	-	-	3/4"	-	MIFAB MHY-20 ENCASED NON-FREEZE LOW LEAD WALL HYDRANT. ASSE 1011 APPROVED ANTI-SIPHON AND VANDAL RESISTANT INTEGRAL VACUUM BREAKER. HARDENED BRONZE OPERATING STEM, HEAVY DUTY BRASS CASING, 360 DEGREE SWIVEL INLET CONNECTION, HEAVY DUTY CHROME PLATED BRONZE HEAD CASTING, POLISHED CHROME PLATED FACE PLATE, AND SATIN FINISHED NICKEL BRONZE BOX WITH HINGED LOCKING COVER. PROVIDE WITH OPERATING KEY.
WH-2	INTERIOR WALL HYDRANT	-	-	-	3/4"	-	MIFAB MHY-35 ENCASED TYPE LOW LEAD MODERATE CLIMATE WALL HYDRANT. ASSE 1011 CERTIFIED ANTI-SIPHON VANDAL RESISTANT INTEGRAL VACUUM BREAKER. HARDENED BRONZE OPERATING STEM, HEAVY DUTY CHROME PLATED BRONZE HEAD CASTING, POLISHED CHROME PLATED FACE PLATE AND SATIN FINISHED NICKEL BRONZE BOX WITH HINGED LOCKING COVER. PROVIDE WITH OPERATING KEY.
RH-1	ROOF HYDRANT	-	-	-	3/4"	-	MIFAB MHY-58 NON-FREEZE ROOF HYDRANT WITH HEAVY DUTY CAST-IRON HEAD AND LIFT HANDLE WITH LOCK FEATURE. HARDENED BRONZE OPERATING STEM, GALVANIZED STEEL CASING, HEAVY DUTY BRONZE HEAD CASTING WITH HEAD NUT ASSEMBLY, GALVANIZED STEEL OPERATIN GROD AND A TAPPED DRAIN PORT IN THE BRONZE TAILPIECE. PROVIDE WITH VACUUM BREAKER.

EXPANSION TANK SCHEDULE

UNIT IDENTIFICATION			TANK							SYSTEM					MANUFACTURER	MODEL NUMBER	NOTES
											OPERATING...		OPERATING PRESSURE				
MARK	NUMBER	SYSTEM SERVED	TYPE	ASME CONSTRUCTION	VOLUME (GAL)	ACCEPTANCE VOLUME (GAL)	DIAMETER (IN)	HEIGHT (IN)	WEIGHT (LBS)	FLUID TYPE	MIN TEMP (F)	MAX TEMP (F)	MIN PRESS (PSIG)	MAX PRESS (PSIG)			
PET	1	DWH-1	DIAPHRAGM	NO	10.3	10.3	19	15	23	WATER	40	200	50.0	150.0	BELL & GOSSETT	PT-25V	
PET	2	DWH-2	DIAPHRAGM	NO	10.3	10.3	19	15	23	WATER	40	200	50.0	150.0	BELL & GOSSETT	PT-25V	

NOTES:

FUEL FIRED WATER HEATER

UNIT IDENTIFICATION			CONTROL	TURNDOWN	FUEL			WATER				DIMENSIONS			ELECTRICAL		MANUFACTURER	MODEL NUMBER	NOTES
MARK	NUMBER	AREA SERVED			TYPE	INPUT RANGE (IN. WG)	FIRING RATE (MBH)	STORAGE (GAL)	RECOVERY RATE (GPH)	EWT (F)	LWT (F)	LENGTH / DIAMETER (IN)	DEPTH (IN)	HEIGHT (IN)	VOLTS	PHASE			
DWH	1	BUILDING	MODULATING	5:1	NAT. GAS	4-14	201	-	235	40	130	16	23	33	120	1	A.O. SMITH	XWH-201	1
DWH	2	KITCHEN	MODULATING	3:1	NAT. GAS	4-14	199	100	235	40	140	28	-	76	120	1	A.O. SMITH	BTH-199	

NOTES:
1. PROVIDE SYSTEM WITH CIRC PUMP (SEE CIRC PUMP SCHEDULE)) AND MODEL TJV-140A, 140 GALLON STORAGE TANK (ST-1).

RECIRCULATION PUMP SCHEDULE

UNIT IDENTIFICATION				PUMP				MOTOR		ELECTRICAL		MANUFACTURER	MODEL NUMBER	NOTES
MARK	NUMBER	LOCATION	SYSTEM SERVED	TYPE	COUPLING TYPE	FLOW (GPM)	HEAD (FT)	HP	SPEED (RPM)	VOLTS	PHASE			
CP	1	306 - MECH	DWH-1	INLINE	CLOSED	2	20	1/6	3300	120	1	BELL & GOSSETT	PL-45B	1
CP	2	306 - MECH	DWH-2	INLINE	CLOSED	10.6	36	2/5	3300	120	1	BELL & GOSSETT	PL-55B	1
CP	3	306 - MECH	DWH-1	INLINE	CLOSED	28	30	1/2	3300	120	1	GRUNDFOS	NOTE 2	2

NOTES:
1. PROVIDE ALL LEAD FREE, BRONZE CONSTRUCTION.
2. CIRCULATION PUMP TO BE PROVIDED AS PART OF DWH-1 SYSTEM. PERFORMANCE VALES INDICATED ARE APPROXIMATE. MANUFACTURER TO PROVIDE APPROPRIATE SIZING BASED ON THEIR SYSTEM. PUMP TO BE STAINLESS STEEL CONSTRUCTION AND NSF 372 COMPLIANT.

MIXING VALVE SCHEDULE

MARK	NUMBER	SYSTEM SERVED	MIN FLOW (GPM)	MAX FLOW (GPM)	HOT WATER INLET TEMP (F)	HOT WATER OUTLET TEMP (F)	PRESSURE DROP AT MAX FLOW (PSI)	MANUFACTURER	MODEL NUMBER	NOTES
MMV	1	BUILDING MASTER MIXING VALVE	10	50	140	120	10	POWERS	LFMM-433	
MMV	2	KITCHEN MASTER MIXING VALVE	1	20	140	140	10	POWERS	LFMM-432	
MV	1	POINT OF USE MIXING VALVE	0.5	5	130	105	3	POWERS	LFG-480-00	
MV	2	EMERGENCY COMBINATION SHOWERS	3	20	140	85	15	POWERS	ETV200	

NOTES:

EXPANSION LOOP SCHEDULE

UNIT IDENTIFICATION			PIPE SIZE (IN)	OPERATING...		APPROXIMATE EXPANSION (IN)	CONNECTION TYPE	CONFIGURATION	MANUFACTURER	MODEL NUMBER	NOTES
MARK	NUMBER	SYSTEM SERVED		MIN TEMP (F)	MAX TEMP (F)						
PEL	1	DHW	1-1/2"	40	140	1.5	SOLDER	NESTED	METRAFLEX	MLS30150	1,2
PEL	2	DHWR	1-1/4"	40	140	1.5	SOLDER	NESTED	METRAFLEX	MLS30125	1,2
PEL	3	DCW	2-1/2"	40	100	1.5	SOLDER	NESTED	METRAFLEX	MLS30250	1,2

NOTES:
1. REFER TO DRAWINGS AND FIELD CONDITIONS FOR SPECIFIC CONFIGURATION.
2. LOOPS TO BE ANSI 372/NSF 61 CERTIFIED AND UL LISTED. COPPER ELBOWS AND TURN AND BRONZE HOSE AND BRAID.

GREASE INTERCEPTOR SCHEDULE

MARK	NUMBER	CONN. SIZE (IN)	TYPE	GPM	CAPACITY (LBS)	LENGTH (IN)	WIDTH (IN)	HEIGHT (IN)	MANUFACTURER	MODEL	NOTES
GT	1	3	STEEL NO-HUB	20	40	30	17.5	15	ZURN	Z1170-500	1

NOTES:
1. PROVIDE WITH HEAVY DUTY RATED COVER.

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Mt. Hope
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PLUMBING SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-601

100% CONSTRUCTION DOCUMENTS

6/28/2023 9:39:54 AM
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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

PIPING COMPONENTS

SYMBOL	
	ISOLATION VALVE (GENERIC)
	GATE VALVE
	GLOBE VALVE
	BUTTERFLY VALVE NPS 6 AND LESS
	BUTTERFLY VALVE NPS 8 AND MORE
	BALL VALVE
	PLUG VALVE
	NEEDLE VALVE
	CHECK VALVE (GENERIC)
	BALANCING VALVE
	FLOW LIMITING VALVE
	PRESSURE REDUCING VALVE
	2-WAY CONTROL VALVE (GENERIC)
	3-WAY CONTROL VALVE (GENERIC)
	SOLENOID 2-WAY CONTROL VALVE
	SOLENOID 3-WAY CONTROL VALVE
	FLOAT OPERATED VALVE ACTUATOR
	SAFETY OR RELIEF VALVE
	ANGLE VALVE
	BOILER STOP AND CHECK VALVE
BFP	BACKFLOW PREVENTER (GENERIC)
	MULTI-PURPOSE VALVE (SHUTOFF, BALANCING AND CHECK)
	PUMP (GENERIC)
	Y STRAINER (GENERIC)
	STEAM TRAP (GENERIC)
	AUTOMATIC AIR VENT
	MANUAL AIR VENT
	VACUUM BREAKER
	SHOCK ABSORBER
	TEMPERATURE GAUGE
	PRESSURE GAUGE
	TEMPERATURE AND PRESSURE TAP
	SIGHT FLOW GLASS
	FLEXIBLE CONNECTOR
	EXPANSION JOINT
	GUIDE
	ANCHOR
	FLOW ARROW
1%	PIPING SLOPE
	PIPE CAP
	PIPE BREAK
	PIPE CROSS
	PIPING ELBOW UP
	PIPING ELBOW DOWN
	PIPING TEE UP
	PIPING TEE DOWN
	UNION CONNECTION
	FLANGED CONNECTION
	CONCENTRIC REDUCER
	ECCENTRIC REDUCER
CO	STANDARD CLEAN-OUT IN LINE END OF RUN
CO	STANDARD CLEAN-OUT THROUGH FLOOR END OF RUN
CO	STANDARD CLEAN-OUT THROUGH FLOOR IN LINE

PIPING SYSTEMS (HVAC)

2 1/2"	PIPE SIZE
BBD	BOILER BLOWDOWN
BFW	BOILER FEED WATER
BR	BRINE RETURN
BS	BRINE SUPPLY
CHWR	CHILLED WATER RETURN
CHWR(G)	CHILLED WATER RETURN - GLYCOL
CHWR(P)	CHILLED WATER RETURN - PROCESS
CHWS	CHILLED WATER SUPPLY
CHWS(G)	CHILLED WATER SUPPLY - GLYCOL
CHWS(P)	CHILLED WATER SUPPLY - PROCESS
CWR	CONDENSER WATER RETURN
CWR(CT)	CONDENSER WATER RETURN (COOLING TOWER)
CWS	CONDENSER WATER SUPPLY
CWS(CT)	CONDENSER WATER SUPPLY (COOLING TOWER)
DTR	DUAL TEMPERATURE RETURN (HOT OR CHILLED)
DTS	DUAL TEMPERATURE SUPPLY (HOT OR CHILLED)
FOF	FUEL OIL FILL
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
FOV	FUEL OIL VENT
HPWR	HEAT PUMP WATER RETURN
HPWS	HEAT PUMP WATER SUPPLY
HRR	HEAT RECOVERY LOOP RETURN
HRS	HEAT RECOVERY LOOP SUPPLY
HWR	HEATING WATER RETURN
HWR(G)	HEATING WATER RETURN - GLYCOL
HWS	HEATING WATER SUPPLY
HWS(G)	HEATING WATER SUPPLY - GLYCOL
G	NATURAL GAS
GV	NATURAL GAS VENT
PG	PROPANE GAS
REF(HG)	REFRIGERANT HOT GAS
REF(L)	REFRIGERANT LIQUID
REF(S)	REFRIGERANT SUCTION
REF(V)	REFRIGERANT VENT
RV	RELIEF VENT
S(##)	STEAM (NOMINAL PRESSURE)
CS(##)	STEAM - CLEAN (NOMINAL PRESSURE)
C(##)	STEAM CONDENSATE (NOMINAL PRESSURE)
PC(##)	STEAM PUMPED CONDENSATE (NOMINAL PRESSURE)
SV	STEAM VENT
	PIPE INSULATION

VENTILATION (HVAC)

	AIR FLOW ARROW
18"x12" 18"x12"	RECTANGULAR DUCT AND SIZE*
18"ø 18"ø	ROUND DUCT AND SIZE*
18"x12"ø 18"x12"ø	FLAT OVAL DUCT AND SIZE*
18"x12"	EXTERIOR DUCT TREATMENT*
18"x12" 18"x12"	RECTANGULAR DUCT WITH ACOUSTIC LINING*
30"x12"	DUCT SECTION, SUPPLY AIR. SIZE* IS HORIZONTAL DIM. x VERTICAL DIM. APPLIES TO RECT., ROUND AND OVAL
	DUCT SECTION, OUTSIDE AIR. APPLIES TO RECT., ROUND AND OVAL
	DUCT SECTION, RETURN AIR. APPLIES TO RECT., ROUND AND OVAL
	DUCT SECTION, EXHAUST AIR. APPLIES TO RECT., ROUND AND OVAL
	FLEXIBLE DUCT
	ELBOW TURN, SUPPLY DOWN. APPLIES TO RECT., ROUND AND OVAL
	ELBOW TURN, OUTSIDE AIR DOWN. APPLIES TO RECT., ROUND AND OVAL
	ELBOW TURN, RETURN DOWN. APPLIES TO RECT., ROUND AND OVAL
	ELBOW TURN, EXHAUST DOWN. APPLIES TO RECT., ROUND AND OVAL
UP	CHANGE IN DUCT ELEVATION RISING IN DIRECTION INDICATED
DN	CHANGE IN DUCT ELEVATION DROPPING IN DIRECTION INDICATED
	END CAP
	ELBOW, RECTANGULAR, SMOOTH RADIUS WITH SPLITTER VANES (0.25 R/W DEFAULT)
	ELBOW, RECTANGULAR, SMOOTH RADIUS WITHOUT VANES (1.5 R/W DEFAULT)
	ELBOW, ROUND, SMOOTH RADIUS (1.5 R/W DEFAULT)
	MITERED ELBOW, RECTANGULAR, WITH TURNING VANES
	RECTANGULAR TO ROUND TRANSITION
AD AD AD	DUCT ACCESS DOOR (TOP, SIDE, BOTTOM)
FC	FLEXIBLE CONNECTION

* NOTE: ALL DUCT SIZES ARE INTERIOR, FREE DIMENSIONS (ALWAYS WIDTH X HEIGHT IN FLOOR PLAN AND SECTION)

VENTILATION (HVAC)

BDD	BACKDRAFT DAMPER
	MANUAL DAMPER
M	MOTORIZED DAMPER
	FIRE DAMPER
	SMOKE DAMPER
	SMOKE AND FIRE DAMPER
	DUCT SILENCER
X	CONTROL DEVICE (REFER TO CONTROLS LEGEND)
	AIR FLOW MEASURING STATION (REFER TO CONTROLS LEGEND)
QUANTITY / TYPE / SIZE (IN.) / VOLUME (CFM)	AIR OUTLET OR INLET TAG (REFER TO SCHEDULE)
	RECTANGULAR DIFFUSER, SUPPLY. OPTIONAL ARROWS SHOW THE FLOW DIRECTION.
	RECTANGULAR REGISTER OR GRILLE, RETURN
	RECTANGULAR REGISTER OR GRILLE, EXHAUST
	ROUND DIFFUSER, SUPPLY
	LINEAR DIFFUSER
	SIDEWALL REGISTER OR GRILLE, SUPPLY
	SIDEWALL GRILLE, RETURN OR EXHAUST
UC	UNDERCUT DOOR
	DOOR GRILLE OR LOUVER
	TRANSFER GRILLE OR LOUVER
	COIL (REFER TO CONTROLS LEGEND)
ID-#	EQUIPMENT TAG
QUANTITY / TYPE / LENGTH (FT) / CAPACITY (MBH)	RADIATION HEATING TAG (REFER TO SCHEDULE)

GENERAL SYMBOLS

	DEMOLITION
	EXISTING
	NEW WORK
	POINT OF CONNECTION OF NEW TO EXISTING SYSTEM
	POINT OF DISCONNECTION OF DEMOLITION FROM EXISTING
	CAP OFF EXISTING
? / ?	DETAIL NUMBER; DETAIL CALLOUTS; SHEET ON WHICH DETAIL IS SHOWN
? / ?	SECTION NUMBER; WALL SECTIONS; SHEET ON WHICH SECTION IS SHOWN
FLOOR / 0'-0"	FLOOR OR ROOF LEVEL NAME; VERTICAL ELEVATION
N	NORTH ARROW
?	DRAWING REVISION
	MATCH LINE
	GRAPHIC SCALES - ENGINEERING
0000	ROOM TAG
M01	KEY NOTE TAG
SLOPE	SLOPE ARROW
	CIRCULAR BREAK SYMBOL
	CIRCLE BREAK SYMBOL
℄	CENTER LINE
	GRID BUBBLE AND LINE

EQUIPMENT IDENTIFICATION

AB-#	AIR BLENDER
AC-#	AIR COMPRESSOR
ACU-#	AIR CONDITIONING UNIT
ADS-#	AIR AND DIRT SEPARATOR
AF-#	AIR FILTER
AHU-#	AIR HANDLING UNIT
AS-#	AIR SEPARATOR
ATU-#	AIR TERMINAL UNIT
B-#	BOILER
BCU-#	BLOWER COIL UNIT
CB-#	CHILLED BEAM
CC-#	COOLING COIL
CH-#	CHILLER
CONV-#	CONVECTOR
CRU-#	CONDENSATE RETURN UNIT
CT-#	COOLING TOWER
CUH-#	CABINET UNIT HEATER
CU-#	CONDENSING UNIT
DAC-#	DOOR AIR CURTAIN
DC-#	DUST COLLECTOR
DCT-#	DECONTAMINATION TANK
DF-#	DRINKING FOUNTAIN
DS-#	DUCT SILENCER
DU-#	DEHUMIDIFCATION UNIT
DWH-#	DOMESTIC WATER HEATER
E-#	EXHAUST GRILLE / REGISTER / DIFFUSER
EL-#	EXPANSION LOOP
ERC-#	ENERGY RECOVERY COIL
ERU-#`	ENERGY RECOVERY UNIT
EWC-#	ELECTRIC WATER COOLER
F-#	FAN
F(C)-#	FAN (CEILING)
F(E)-#	FAN (EXHAUST)
F(LE)-#	FAN (LABORATORY EXHAUST)
F(R)-#	FAN (RETURN)
F(S)-#	FAN (SUPPLY)
F(T)-#	FAN (TRANSFER)
FCU-#	FAN COIL UNIT
FD-#	FLOOR DRAIN
FFU-#	FAN FILTER UNIT
FP-#	FIRE PROTECTION PUMP
FPP-#	FIRE PROTECTION JOCKEY PUMP
FPTU-#	FAN POWERED TERMINAL UNIT
FTR-#	FINNED TUBE RADIATOR
FUR-#	FURNACE

EQUIPMENT IDENTIFICATION

GFS-#	GLYCOL FEED SYSTEM
GSG-#	GAS-FIRED STEAM GENERATOR
H-#	HUMIDIFIER
HC-#	HEATING COIL
HP-#	HEAT PUMP
HRU-#	HEAT RECOVERY UNIT
H(C)-#	HOOD (CANOPY)
H(HC)-#	HOOD (HEAT AND CONDENSATE)
H(I)-#	HOOD (INTAKE)
H(K)-#	HOOD (KITCHEN)
H(RH)-#	HOOD (RANGE)
H(R)-#	HOOD (RELIEF)
HX-#	HEAT ELAB AIR TERMINAL UNITXCHANGER
LATU-#	LAB AIR TERMINAL UNIT
LAV-#	LAVATORY
MAC-#	MEDICAL AIR COMPRESSOR
MAU-#	MAKEUP AIR UNIT
MV-#	MIXING VALVE
MVP-#	MEDICAL VACUUM PUMP
P-#	PUMP
PDU-#	POOL DEHUMIDIFICATION UNIT
PRV-#	PRESSURE REDUCING VALVE
PTAC-#	PACKAGED TERMIANL AIR CONDITIONER
RD-#	ROOF DRAIN
R-#	RETURN AIR GRILLE/ REGISTER / DIFFUSER
RP-#	RADIANT PANEL
RTU-#	ROOFTOP UNIT
S-#	SUPPLY GRILLE / REGISTER / DIFFUSER
SH-#	SHOWER
SK-#	SINK
SPC-#	SOLAR PANEL COLLECTOR
SSF-#	SIDE STEAM FILTER
T-#	TRANSFER AIR GRILLE
T(B)-#	TANK (BUFFER TANK)
T(E)-#	TANK (EXPANSION TANK)
T(H)-#	TANK (HYDRO PNEUMATIC TANK)
T(S)-#	TANK (STORAGE TANK)
UH-#	UNIT HEATER
UR-#	URINAL
USG-#	UNFIRED STEAM GENERATOR
UV-#	UNIT VENTILATOR
VA-#	VALVE
WC-#	WATER CLOSET
WS-#	WATER SOFTENER
ZN-#	ZONE

ABBREVIATIONS

AAV	AUTOMATIC AIR VENT
A/C	AIR CONDITIONING
ADA	AMERICANS WITH DISABILITIES ACT
ADJ	ADJUSTABLE
AFC	ABOVE FINISHED CEILING
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AP	ACCESS PANEL / DOOR
APD	AIR PRESSURE DROP
AVG	AVERAGE
BAS	BUILDING AUTOMATION SYSTEM
BDD	BACKDRAFT DAMPER
BHP	BRAKE HORSEPOWER
BMS	BUILDING MANAGEMENT SYSTEM
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BT	BATH TUB
BTU	BRITTISH THERMAL UNIT
BTUH	BRITTISH THERMAL UNIT PER HOUR
C	CELCIUS
CAV	CONSTANT AIR VOLUME
CFM	CUBIC FEET PER MINUTE
C/W	COMPLETE WITH
CV	CONTROL VALVE
dB	DECIBEL(S)
DB	DRY BULB TEMPERATURE
DDC	DIRECT DIGITAL CONTROL
DEG	DEGREE
DIA / Ø	DIAMETER
DIFF	DIFFERENTIAL
DIV	DIVISION
DN	DOWN
DWG	DRAWING
EAT	ENTERING AIR TEMPERATURE
EA	EXHAUST AIR
EA (D)	EXHAUST AIR (DISHWASH)
EA (G)	EXHAUST AIR (GENERAL)
EA (K)	EAXHAUST AIR (KITCHEN)
EA (LAB)	EXHAUST AIR (LAB)
EA (LD)	EXHAUST AIR (LAUNDRY/DRYER)
EAV	EXHAUST AIR VALVE
EA (W)	EXHAUST AIR (WASHROOM)
ED	EXISTING TO BE DEMOLOISHED
EER	ENERGY EFFICIENCY RATIO
EG	ETHELYENE GLYCOL
ER	EXISTING RELOCATED (IN NEW CONSTRUCTION)
ERL	EXISTING TO BE RELOCATED (IN DEMOLITION)
ESP	EXTERNAL STATIC PRESSURE
EEW	EYE WASH STATION
EWT	ENTERING WATER TEMPERATURE
EXIST / (E)	EXISTING
F	FAHRENHEIT
FLA	FULL LOAD AMPERAGE
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FT	FOOT / FEET
GA	GAUGE
GAL	GALLON
GC	GENERAL CONTRACTOR
GPM	GALLONS PER MINUTE
HEPA	HIGH EFFICIENCY PARTICULATE AIR (FILTER)
HP	HORSEPOWER
HR	HOUR
HVAC	HEATING / VENTILATION / AIR CONDITIONING

ABBREVIATIONS

HZ	HERTZ
IE	INVERT ELEVATION
IN	INCHES
IN WG	INCHES WATER GAUGE
IPLV	INTEGRATED PART LOAD VALUE
kW	KILOWATT
kWh	KILOWATT HOUR
LAT	LEAVING AIR TEMPEATURE
LBS	POUNDS
LF	LINEAR FEET
LWT	LEAVING WATER TEMPERATURE
M	METER
MAX	MAXIMUM
MBH	THOUSAND OF BTUH
MCA	MAXIMUM CIRCUIT AMPS
MFR	MANUFACTURER
MIN	MINIMUM
MOP	MAXIMUM OVERCURRENT PROTECTION
MSK	MOP SINK
N/A	NOT APPLICABLE
NC	NOISE CRITERIA
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NPS	NOMINAL PIPE SIZE
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFE	OWNER FURNISHED EQUIPMENT
OFOI	OWNER FURNISHED / OWNER INSTALLED
PG	PROPYLENE GLYCOL
POE	POINT OF ENTRANCE
POS	POINT OF SERVICE
PPM	PARTS PER MILLION
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH, ABSOLUTE
PSIG	POUNDS PER SQUARE INCH, GAGE
PTS	PNEUMATIC TUBE STATION
PVC	POLYVINYL CHOLORIDE
RA	RETURN AIR
RELA	RELIEF AIR
REQD	REQUIRED
RH	RELATIVE HUMIDITY
RPM	ROTATIONS PER MINUTE
SA	SUPPLY AIR
SP	STATIC PRESSURE
SP	STAIR PRESSURIZATION AIR
SRV	SAFETY RELIEF VALVE
TA	TRANSFER AIR
TEMP	TEMPERATURE
TSP	TOTAL STATIC PRESSURE
TSTAT	THERMOSTAT
TYP	TYPICAL
UC	UNDER CUT (DOOR)
UG	UNDERGROUND
VAV	VARIABLE AIR VOLUME
VFD	VARIABLE FREQUENCY DRIVE
VIF	VERIFY IN FIELD
VTR	VENT - THRU ROOF
W/	WITH
W/O	WITHOUT
WB	WET BULB TEMPERATURE
WG	WATER GAUGE

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK WHITE
6/28/2023 9:51:05 AM
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MECHANICAL LEGEND, SYMBOLS, AND ABBREVIATIONS
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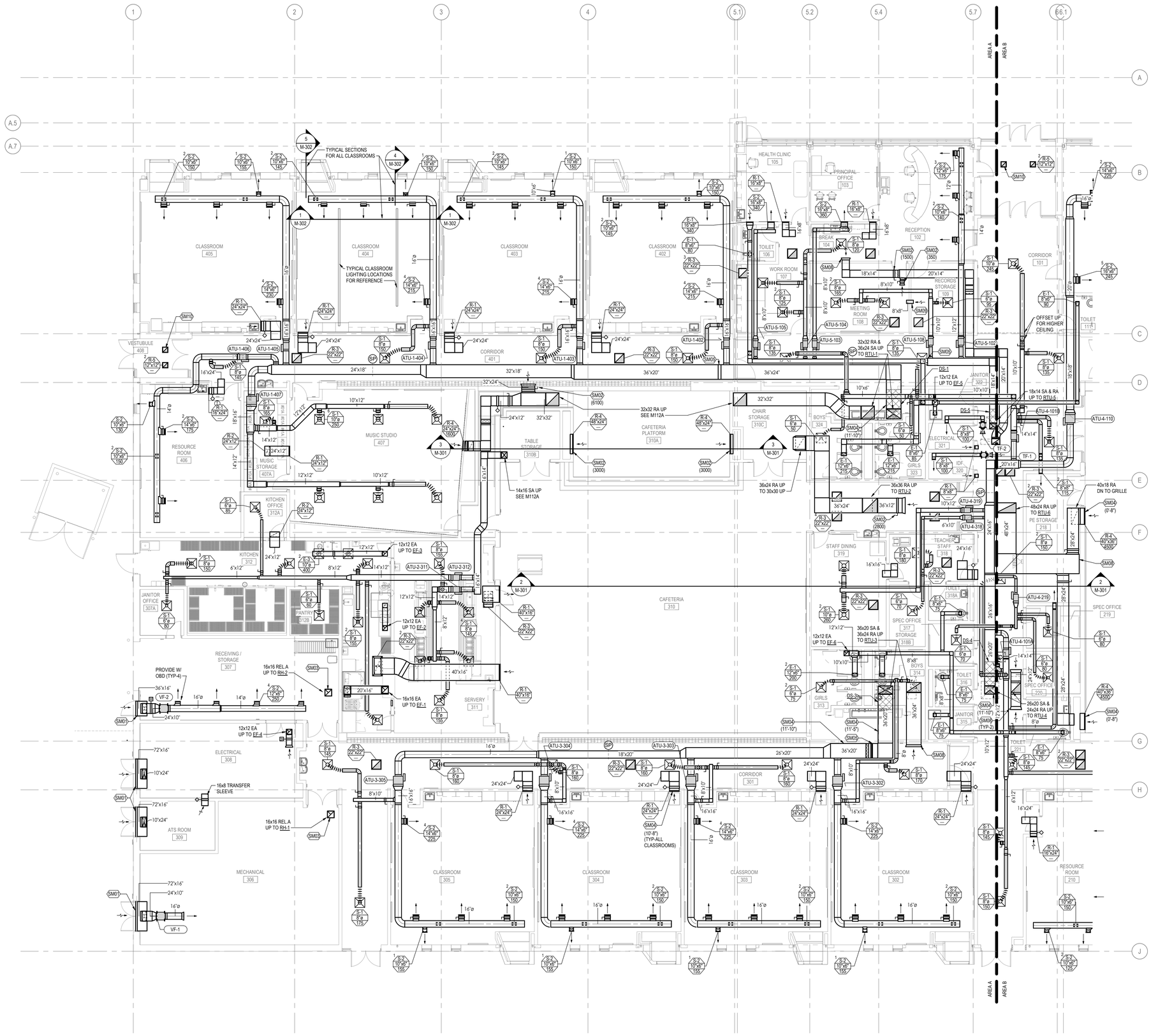


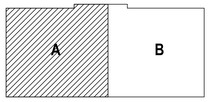
SHEET METAL PLAN - AREA A
1/8" = 1'-0"

SHEET METAL GENERAL NOTES

1. COORDINATE NEW DUCTWORK WITH SITE CONDITIONS EQUIPMENT MANUFACTURER AND ALL OTHER TRADES TO AVOID INTERFERENCES.
2. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURERS RECOMMENDATIONS.
3. VAV BOXES AND VALVES SHALL BE LOCATED NO MORE THAN 24 INCHES ABOVE SUSPENDED CEILINGS FOR ACCESS.
4. ALL DUCTWORK SHALL BE ROUTED AS HIGH AS POSSIBLE, UNLESS OTHERWISE NOTED. COORDINATE ROUTING WITH OTHER TRADES TO AVOID INTERFERENCES.
5. BALANCE ALL AIR SYSTEMS TO INDICATED AIR FLOW RATES.
6. DUCT SIZES TO DIFFUSERS SHALL MATCH NECK SIZE OF EACH. REFER TO GRILLE, REGISTER & DIFFUSER SCHEDULE.
7. REFER TO DUCT SYSTEM APPLICATION SCHEDULE AND SPECIFICATIONS FOR DUCTWORK INSULATION REQUIREMENTS.
8. ALL DUCTWORK SHALL BE CONCEALED IN WALLS AND/OR CEILING SPACE, UNLESS OTHERWISE NOTED.
9. SEAL ALL PENETRATIONS THROUGH WALLS PER DETAILS AND SPECIFICATIONS.
10. COORDINATE EXACT LOCATIONS OF ALL DIFFUSERS AND RETURN GRILLES WITH ARCHITECTURAL REFLECTED CEILING AND LIGHTING PLANS.

(X) SHEET METAL KEYNOTES

SM01 OA LOUVER MOUNTED IN TRANSOM ABOVE DOOR BY ARCH TRADES. PROVIDE AND CONNECT OA PLENUM OF SIZE INDICATED TO LOUVER AND PROVIDE VERTICAL DUCT TAP OFF TOP OF PLENUM WITH MOTORIZED DAMPER. SEE DETAIL ON M502.
SM02 BALANCE VOLUME DAMPER TO INDICATED CFM.
SM03 SEE RELIEF HOOD DETAIL ON M501 FOR REQUIREMENTS.
SM04 LOCATE DUCT, GRILLE OR REGISTER AT INDICATED HEIGHT ABOVE FINISHED FLOOR.
SM05 PROVIDE DOUBLE WALL DUCT FROM OUTLET OF UPSTREAM DUCT SILENCER TO THIS FITTING
SM08 PROVIDE 1" THICK INTERNAL ACOUSTICAL LINER ON RETURN DUCT FROM CONNECTION TO UNIT TO THIS POINT.
SM09 TRANSFER AIR DUCT SLEEVE ABOVE CEILING.
SM10 TRANSFER AIR OPENINGS FOR TEMPERING AIR ABOVE VESTIBULE.



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SHEET METAL PLAN - AREA A

REVISIONS

REV	DESCRIPTION	DATE

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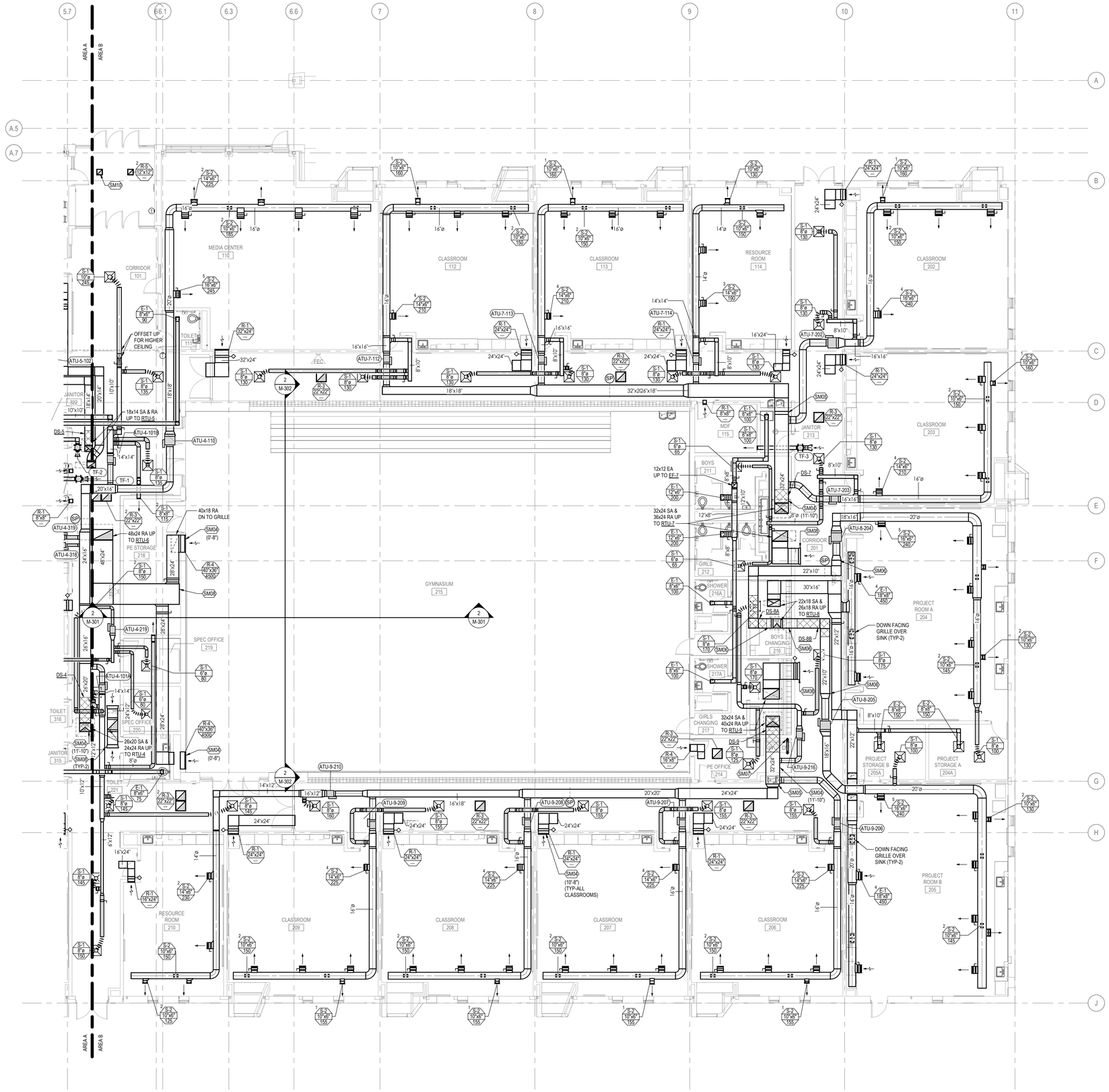


SHEET METAL PLAN - AREA B
1/8" = 1'-0"

SHEET METAL GENERAL NOTES

1 COORDINATE NEW DUCTWORK WITH SITE CONDITIONS EQUIPMENT MANUFACTURER AND ALL OTHER TRADES TO AVOID INTERFERENCES.

2 PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURERS RECOMMENDATIONS.

3 VAV BOXES AND VALVES SHALL BE LOCATED NO MORE THAN 24 INCHES ABOVE SUSPENDED CEILINGS FOR ACCESS.

4 ALL DUCTWORK SHALL BE ROUTED AS HIGH AS POSSIBLE, UNLESS OTHERWISE NOTED. COORDINATE ROUTING WITH OTHER TRADES TO AVOID INTERFERENCES.

5 BALANCE ALL AIR SYSTEMS TO INDICATED AIR FLOW RATES.

6 DUCT SIZES TO DIFFUSERS SHALL MATCH NECK SIZE OF EACH. REFER TO GRILLE, REGISTER & DIFFUSER SCHEDULE.

7 REFER TO DUCT SYSTEM APPLICATION SCHEDULE AND SPECIFICATIONS FOR DUCTWORK INSULATION REQUIREMENTS.

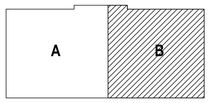
8 ALL DUCTWORK SHALL BE CONCEALED IN WALLS AND/OR CEILING SPACE, UNLESS OTHERWISE NOTED.

9 SEAL ALL PENETRATIONS THROUGH WALLS PER DETAILS AND SPECIFICATIONS.

10 COORDINATE EXACT LOCATIONS OF ALL DIFFUSERS AND RETURN GRILLES WITH ARCHITECTURAL REFLECTED CEILING AND LIGHTING PLANS.

SHEET METAL KEYNOTES

SM04 LOCATE DUCT, GRILLE OR REGISTER AT INDICATED HEIGHT ABOVE FINISHED FLOOR.
SM05 PROVIDE DOUBLE WALL DUCT FROM OUTLET OF UPSTREAM DUCT SILENCER TO THIS FITTING
SM06 PROVIDE DOUBLE WALL DUCT FROM OUTLET OF RTU TO THIS FITTING.
SM07 PROVIDE 4" RIGID ROUND GALVANIZED DRYER EXHAUST PIPE UP THROUGH ROOF AND TERMINATE WITH GOOSENECK (OPENING 2'-6" ABOVE ROOF SURFACE). ELECTRIC DRYER BEING PROVIDED BY OWNER.
SM08 PROVIDE 1" THICK INTERNAL ACOUSTICAL LINER ON RETURN DUCT FROM CONNECTION TO UNIT TO THIS POINT.
SM10 TRANSFER AIR OPENINGS FOR TEMPERING AIR ABOVE VESTIBULE.



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SHEET METAL PLAN - AREA B

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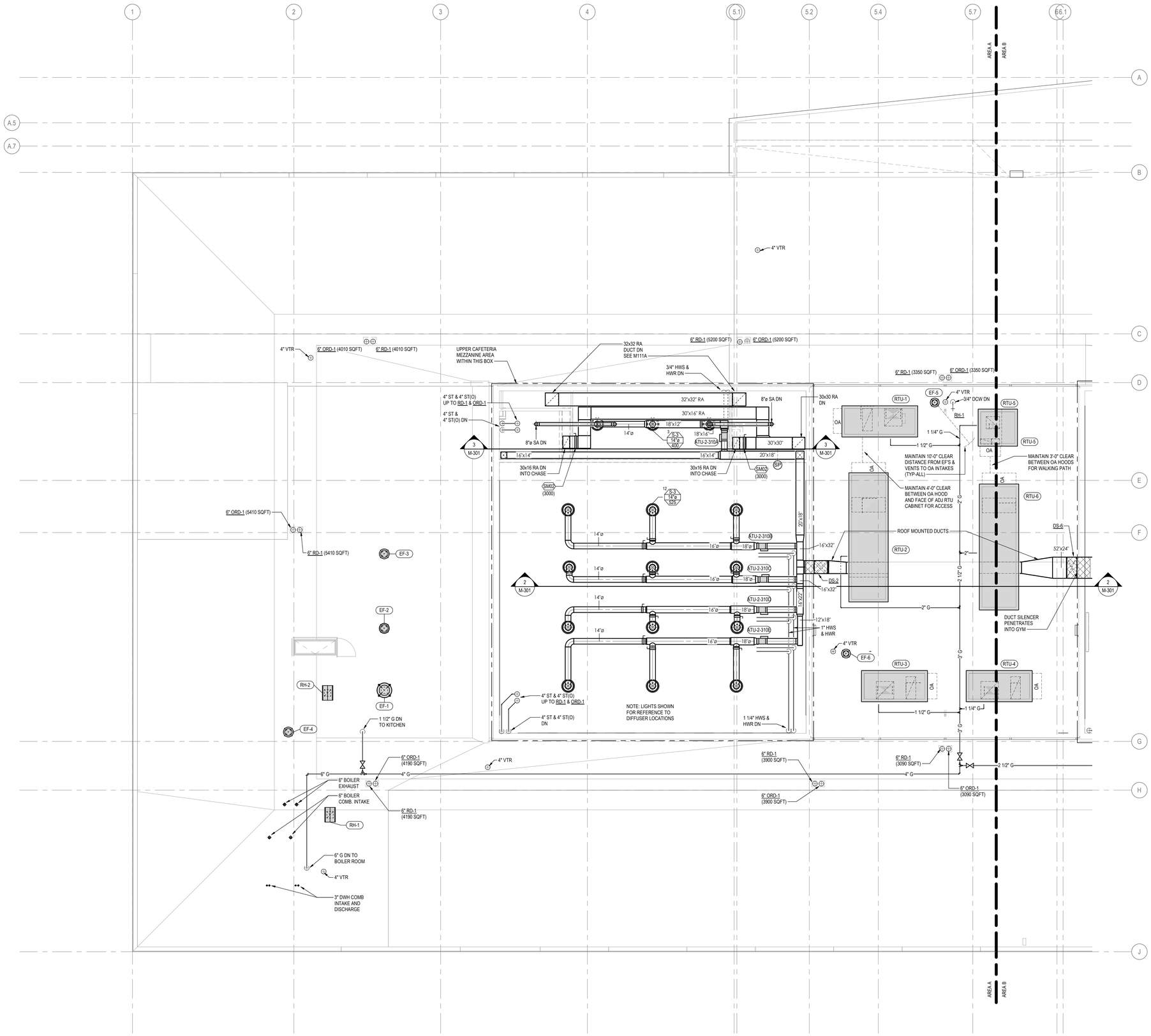


MECHANICAL AND PLUMBING LOWER ROOF AND UPPER CAFE PLAN - AREA A
1/8" = 1'-0"

SHEET METAL GENERAL NOTES

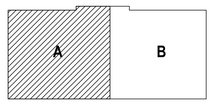
1. COORDINATE NEW DUCTWORK WITH SITE CONDITIONS EQUIPMENT MANUFACTURER AND ALL OTHER TRADES TO AVOID INTERFERENCES.
2. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURERS RECOMMENDATIONS.
3. VAV BOXES AND VALVES SHALL BE LOCATED NO MORE THAN 24 INCHES ABOVE SUSPENDED CEILINGS FOR ACCESS.
4. ALL DUCTWORK SHALL BE ROUTED AS HIGH AS POSSIBLE, UNLESS OTHERWISE NOTED. COORDINATE ROUTING WITH OTHER TRADES TO AVOID INTERFERENCES.
5. BALANCE ALL AIR SYSTEMS TO INDICATED AIR FLOW RATES.
6. DUCT SIZES TO DIFFUSERS SHALL MATCH NECK SIZE OF EACH. REFER TO GRILLE, REGISTER & DIFFUSER SCHEDULE.
7. REFER TO DUCT SYSTEM APPLICATION SCHEDULE AND SPECIFICATIONS FOR DUCTWORK INSULATION REQUIREMENTS.
8. ALL DUCTWORK SHALL BE CONCEALED IN WALLS AND/OR CEILING SPACE, UNLESS OTHERWISE NOTED.
9. SEAL ALL PENETRATIONS THROUGH WALLS PER DETAILS AND SPECIFICATIONS.
10. COORDINATE EXACT LOCATIONS OF ALL DIFFUSERS AND RETURN GRILLES WITH ARCHITECTURAL REFLECTED CEILING AND LIGHTING PLANS.

PLUMBING GENERAL NOTES

1. THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE PLUMBING SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, TRANSITIONS, ETC. AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.
2. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF ALL NEW PLUMBING FIXTURES.
3. ALL PLUMBING RELATED CORING THROUGH FLOORS SHALL BE BY PLUMBING CONTRACTOR.
4. COORDINATE ALL NEW LOCATIONS, SIZES AND ELEVATIONS OF SLEEVES THROUGH WALLS, SLABS AND FOUNDATIONS WITH STRUCTURAL DRAWINGS AND FIELD CONDITIONS.
5. COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS, AND ALL OTHER TRADES TO AVOID INTERFERENCES.
6. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.
7. ALL OVERHEAD DOMESTIC WATER AND STORM PIPING SHALL BE INSULATED PER PLUMBING PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
8. ALL PIPING SHALL BE CONCEALED IN WALLS, CEILING SPACES OR ARCHITECTURAL SOFFITS UNLESS NOTED OTHERWISE.
9. SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.
10. COORDINATE LOCATIONS AND ELEVATIONS OF ALL NEW UNDERGROUND UTILITIES WITH CIVIL SITE PLANS PRIOR TO START OF CONSTRUCTION.
11. CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD PIPING.
12. RUN ALL SANITARY, VENT, AND STORM PIPING AT SLOPES COMPLYING WITH THE MICHIGAN PLUMBING CODE LATEST EDITION.
13. PROVIDE WALL CLEANOUT AT THE BASE OF ALL VERTICAL STORM AND SANITARY CONDUCTORS.
14. PROVIDE SHUT-OFF VALVES AT ALL PLUMBING FIXTURES. LOCATE ALL PLUMBING SHUT-OFF VALVES IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.
15. FURNISH AND INSTALL BALANCING VALVES AT ALL BRANCHES OF HOT WATER RECIRCULATION PIPING SYSTEM. AT COMPLETION OF PIPING INSTALLATION, THE CONTRACTOR MUST BALANCE THE HOT WATER RECIRCULATING SYSTEM TO FLOW RATES INDICATED AND SUBMIT BALANCE RESULTS IN WRITING TO ARCHITECT/ENGINEER.
16. MINIMUM UNDERGROUND STORM AND SANITARY PIPING SHALL BE 3".
17. REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.
18. PROVIDE VENT PIPING THROUGH ROOF A MINIMUM OF 10' AWAY FROM PARAPET WALL AND A MINIMUM OF 10' CLEAR OR MORE FROM ANY OUTSIDE AIR INTAKES AS REQUIRED BY THE LATEST EDITION OF THE STATE LOCALLY ADOPTED PLUMBING CODE.

SHEET METAL KEYNOTES

SM02 BALANCE VOLUME DAMPER TO INDICATED CFM.



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MECHANICAL AND PLUMBING
LOWER ROOF AND UPPER
CAFE PLAN - AREA A

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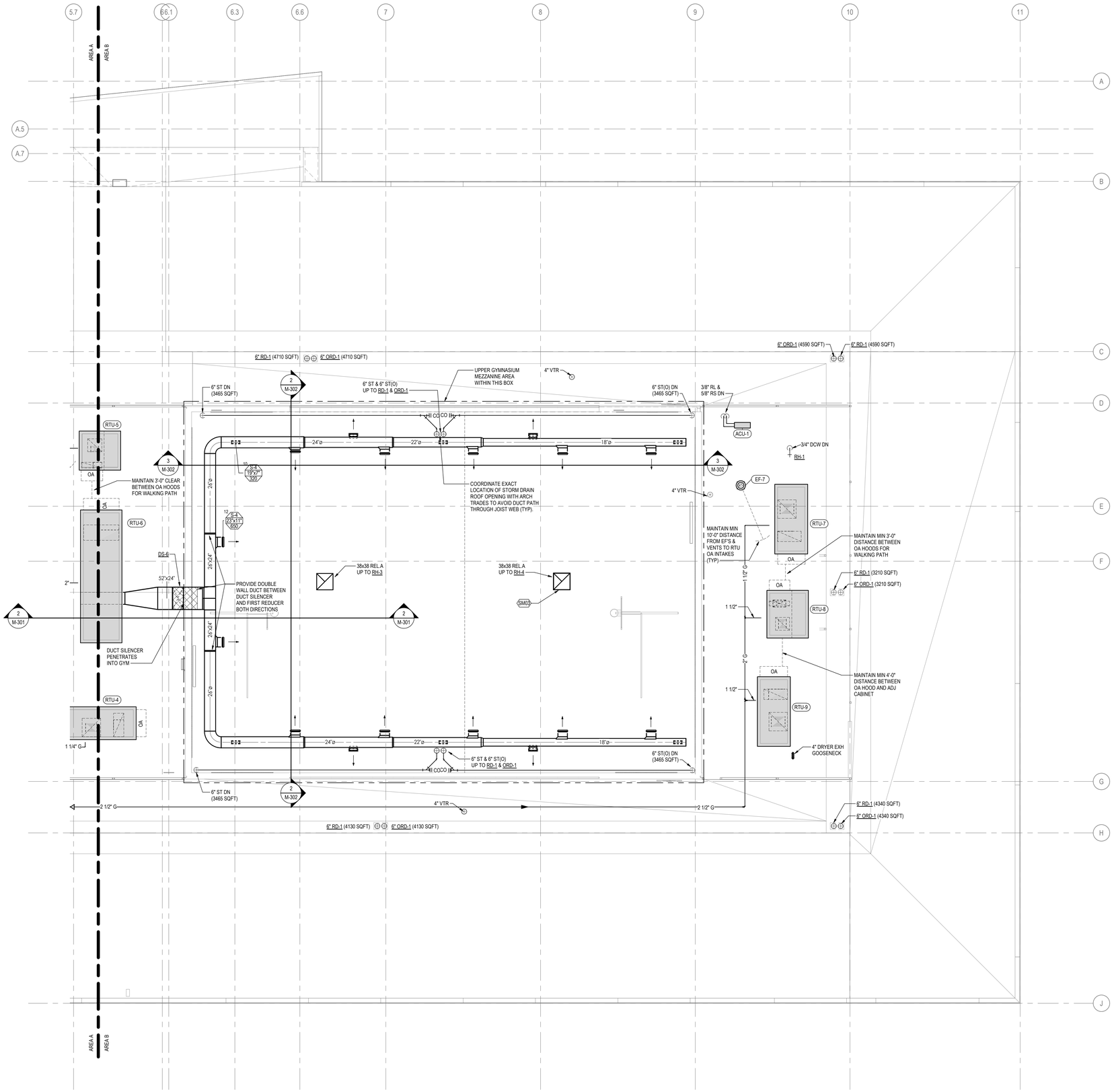


MECHANICAL AND PLUMBING LOWER ROOF AND UPPER GYM PLAN - AREA B
1/8" = 1'-0"

SHEET METAL GENERAL NOTES

1 COORDINATE NEW DUCTWORK WITH SITE CONDITIONS EQUIPMENT MANUFACTURER AND ALL OTHER TRADES TO AVOID INTERFERENCES.

2 PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURERS RECOMMENDATIONS.

3 VAV BOXES AND VALVES SHALL BE LOCATED NO MORE THAN 24 INCHES ABOVE SUSPENDED CEILINGS FOR ACCESS.

4 ALL DUCTWORK SHALL BE ROUTED AS HIGH AS POSSIBLE, UNLESS OTHERWISE NOTED. COORDINATE ROUTING WITH OTHER TRADES TO AVOID INTERFERENCES.

5 BALANCE ALL AIR SYSTEMS TO INDICATED AIR FLOW RATES.

6 DUCT SIZES TO DIFFUSERS SHALL MATCH NECK SIZE OF EACH. REFER TO GRILLE, REGISTER & DIFFUSER SCHEDULE.

7 REFER TO DUCT SYSTEM APPLICATION SCHEDULE AND SPECIFICATIONS FOR DUCTWORK INSULATION REQUIREMENTS.

8 ALL DUCTWORK SHALL BE CONCEALED IN WALLS AND/OR CEILING SPACE, UNLESS OTHERWISE NOTED.

9 SEAL ALL PENETRATIONS THROUGH WALLS PER DETAILS AND SPECIFICATIONS.

10 COORDINATE EXACT LOCATIONS OF ALL DIFFUSERS AND RETURN GRILLES WITH ARCHITECTURAL REFLECTED CEILING AND LIGHTING PLANS.

PLUMBING GENERAL NOTES

1 THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE PLUMBING SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, TRANSITIONS, ETC. AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.

2 REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF ALL NEW PLUMBING FIXTURES.

3 ALL PLUMBING RELATED CORING THROUGH FLOORS SHALL BE BY PLUMBING CONTRACTOR.

4 COORDINATE ALL NEW LOCATIONS, SIZES AND ELEVATIONS OF SLEEVES THROUGH WALLS, SLABS AND FOUNDATIONS WITH STRUCTURAL DRAWINGS AND FIELD CONDITIONS.

5 COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS, AND ALL OTHER TRADES TO AVOID INTERFERENCES.

6 PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.

7 ALL OVERHEAD DOMESTIC WATER AND STORM PIPING SHALL BE INSULATED PER PLUMBING PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.

8 ALL PIPING SHALL BE CONCEALED IN WALLS, CEILING SPACES OR ARCHITECTURAL SOFFITS UNLESS NOTED OTHERWISE.

9 SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.

10 COORDINATE LOCATIONS AND ELEVATIONS OF ALL NEW UNDERGROUND UTILITIES WITH CIVIL SITE PLANS PRIOR TO START OF CONSTRUCTION.

11 CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD PIPING.

12 RUN ALL SANITARY, VENT, AND STORM PIPING AT SLOPES COMPLYING WITH THE MICHIGAN PLUMBING CODE LATEST EDITION.

13 PROVIDE WALL CLEANOUT AT THE BASE OF ALL VERTICAL STORM AND SANITARY CONDUCTORS.

14 PROVIDE SHUT-OFF VALVES AT ALL PLUMBING FIXTURES. LOCATE ALL PLUMBING SHUT-OFF VALVES IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.

15 FURNISH AND INSTALL BALANCING VALVES AT ALL BRANCHES OF HOT WATER RECIRCULATION PIPING SYSTEM. AT COMPLETION OF PIPING INSTALLATION, THE CONTRACTOR MUST BALANCE THE HOT WATER RECIRCULATING SYSTEM TO FLOW RATES INDICATED AND SUBMIT BALANCE RESULTS IN WRITING TO ARCHITECT/ENGINEER.

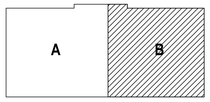
16 MINIMUM UNDERGROUND STORM AND SANITARY PIPING SHALL BE 3".

17 REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.

18 PROVIDE VENT PIPING THROUGH ROOF A MINIMUM OF 10' AWAY FROM PARAPET WALL AND A MINIMUM OF 10' CLEAR OR MORE FROM ANY OUTSIDE AIR INTAKES AS REQUIRED BY THE LATEST EDITION OF THE STATE LOCALLY ADOPTED PLUMBING CODE.

(X) SHEET METAL KEYNOTES

SM03 SEE RELIEF HOOD DETAIL ON M501 FOR REQUIREMENTS.



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MECHANICAL AND PLUMBING
LOWER ROOF AND UPPER
GYM PLAN - AREA B

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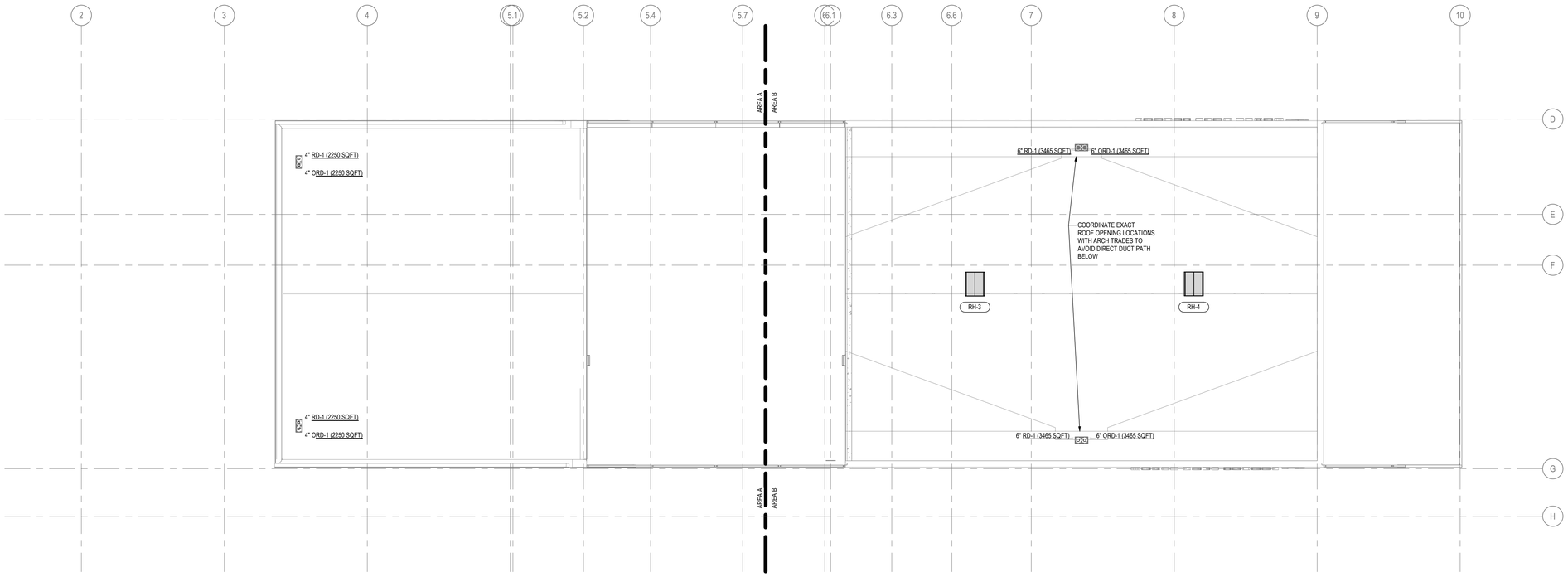

MECHANICAL AND PLUMBING UPPER ROOF PLAN
3/32" = 1'-0"

SHEET METAL GENERAL NOTES

1 COORDINATE NEW DUCTWORK WITH SITE CONDITIONS EQUIPMENT MANUFACTURER AND ALL OTHER TRADES TO AVOID INTERFERENCES.

2 PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURERS RECOMMENDATIONS.

3 VAV BOXES AND VALVES SHALL BE LOCATED NO MORE THAN 24 INCHES ABOVE SUSPENDED CEILINGS FOR ACCESS.

4 ALL DUCTWORK SHALL BE ROUTED AS HIGH AS POSSIBLE, UNLESS OTHERWISE NOTED. COORDINATE ROUTING WITH OTHER TRADES TO AVOID INTERFERENCES.

5 BALANCE ALL AIR SYSTEMS TO INDICATED AIR FLOW RATES.

6 DUCT SIZES TO DIFFUSERS SHALL MATCH NECK SIZE OF EACH. REFER TO GRILLE, REGISTER & DIFFUSER SCHEDULE.

7 REFER TO DUCT SYSTEM APPLICATION SCHEDULE AND SPECIFICATIONS FOR DUCTWORK INSULATION REQUIREMENTS.

8 ALL DUCTWORK SHALL BE CONCEALED IN WALLS AND/OR CEILING SPACE, UNLESS OTHERWISE NOTED.

9 SEAL ALL PENETRATIONS THROUGH WALLS PER DETAILS AND SPECIFICATIONS.

10 COORDINATE EXACT LOCATIONS OF ALL DIFFUSERS AND RETURN GRILLES WITH ARCHITECTURAL REFLECTED CEILING AND LIGHTING PLANS.

PLUMBING GENERAL NOTES

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2 REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF ALL NEW PLUMBING FIXTURES.

3 ALL PLUMBING RELATED CORING THROUGH FLOORS SHALL BE BY PLUMBING CONTRACTOR.

4 COORDINATE ALL NEW LOCATIONS, SIZES AND ELEVATIONS OF SLEEVES THROUGH WALLS, SLABS AND FOUNDATIONS WITH STRUCTURAL DRAWINGS AND FIELD CONDITIONS.

5 COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS, AND ALL OTHER TRADES TO AVOID INTERFERENCES.

6 PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.

7 ALL OVERHEAD DOMESTIC WATER AND STORM PIPING SHALL BE INSULATED PER PLUMBING PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.

8 ALL PIPING SHALL BE CONCEALED IN WALLS, CEILING SPACES OR ARCHITECTURAL SOFFITS UNLESS NOTED OTHERWISE.

9 SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.

10 COORDINATE LOCATIONS AND ELEVATIONS OF ALL NEW UNDERGROUND UTILITIES WITH CIVIL SITE PLANS PRIOR TO START OF CONSTRUCTION.

11 CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD PIPING.

12 RUN ALL SANITARY, VENT, AND STORM PIPING AT SLOPES COMPLYING WITH THE MICHIGAN PLUMBING CODE LATEST EDITION.

13 PROVIDE WALL CLEANOUT AT THE BASE OF ALL VERTICAL STORM AND SANITARY CONDUCTORS.

14 PROVIDE SHUT-OFF VALVES AT ALL PLUMBING FIXTURES. LOCATE ALL PLUMBING SHUT-OFF VALVES IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.

15 FURNISH AND INSTALL BALANCING VALVES AT ALL BRANCHES OF HOT WATER RECIRCULATION PIPING SYSTEM . AT COMPLETION OF PIPING INSTALLATION, THE CONTRACTOR MUST BALANCE THE HOT WATER RECIRCULATING SYSTEM TO FLOW RATES INDICATED AND SUBMIT BALANCE RESULTS IN WRITING TO ARCHITECT/ENGINEER.

16 MINIMUM UNDERGROUND STORM AND SANITARY PIPING SHALL BE 3".

17 REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.

18 PROVIDE VENT PIPING THROUGH ROOF A MINIMUM OF 10' AWAY FROM PARAPET WALL AND A MINIMUM OF 10' CLEAR OR MORE FROM ANY OUTSIDE AIR INTAKES AS REQUIRED BY THE LATEST EDITION OF THE STATE LOCALLY ADOPTED PLUMBING CODE.

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MECHANICAL AND PLUMBING UPPER ROOF PLAN

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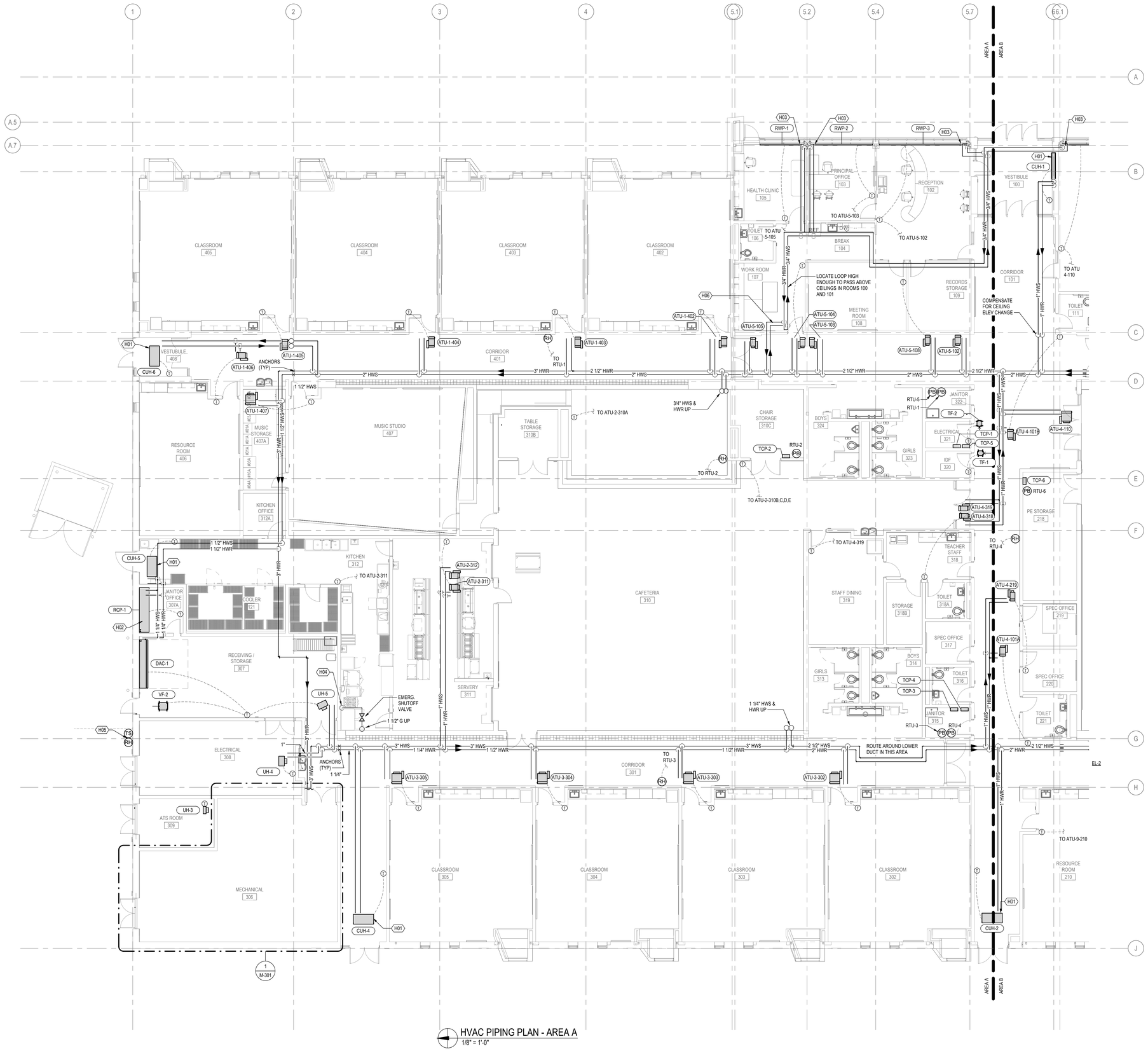


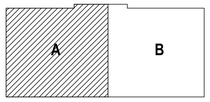
HVAC PIPING PLAN - AREA A
1/8" = 1'-0"

HVAC PIPING GENERAL NOTES

1. THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE HVAC PIPING SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, AND TRANSITIONS AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.
2. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.
3. ALL HVAC PIPING SHALL BE INSULATED PER THE PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
4. COORDINATE ALL RADIANT WALL PANEL LENGTHS AND LOCATIONS ALONG WITH ASSOCIATED PIPE DROPS WITH ARCHITECTURAL AND STRUCTURAL TRADES.
5. CONNECT ALL PIPING TO TERMINAL UNIT COILS PER DETAILS. DO NOT INSTALL PIPING WITHIN THE SERVICE CLEARANCE FOR TERMINAL UNIT CONTROL PANEL OR ACCESS DOOR CLEARANCE ZONES.
6. LOCATE ALL HVAC SHUT-OFF VALVES AND TERMINAL UNITS IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.
7. SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.
8. CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD HVAC PIPING.
9. COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS AND ALL OTHER TRADES TO AVOID INTERFERENCES.
10. REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.
11. COORDINATE ALL THERMOSTAT LOCATIONS WITH FURNITURE AND ARCHITECTURAL ELEMENTS. LOCATE AS CLOSE AS POSSIBLE TO DOOR WHERE INDICATED BY DOOR.
12. ALL BRANCH PIPING TO TERMINAL UNITS SHALL BE 3/4" DIAMETER UNLESS NOTED OTHERWISE. BRANCH PIPING SERVING MORE THAN ONE TERMINAL UNIT SHALL BE 1" DIAMETER UNLESS NOTED OTHERWISE.
13. ALL BRANCH PIPING SERVING CABINET UNIT HEATERS AND HOT WATER UNIT HEATERS SHALL BE 1" UNLESS NOTED OTHERWISE.
14. COORDINATE WITH SHEET METAL TRADES LOCATIONS OF DUCT-MOUNTED HYDRONIC DEVICES.
15. PIPING LOCATED WITHIN AIR DISTRIBUTION PLENUMS SHALL BE UL LISTED TO MEET CODE REQUIRED FLAME/SMOKE SPREAD RATINGS OR BE PROVIDED WITH FLAME/SMOKE RATED INSULATION TO MAKE THE PIPING PLENUM APPROVED. CONTRACTOR SHALL COORDINATE AIR DISTRIBUTION PLENUM LOCATIONS WITH SHEET METAL CONTRACTOR AND SHEET METAL FABRICATION DRAWINGS
16. ALL THERMOSTATS SHOWN WITHIN CORRIDORS, VESTIBULES, MECHANICAL ROOMS, IDF ROOMS AND ELECTRICAL ROOMS SHALL BE A STAINLESS STEEL FLAT PLATE SENSOR FLUSH MOUNTED TO WALL.

HVAC PIPING KEYNOTES

H01 SEE SHEET M503 FOR CUH COIL CONNECTION DETAIL.
H02 SEE SHEET M50X FOR RCP COIL CONNECTION DETAIL.
H03 ROUTE HWS & HWR BRANCHES TO RWP DOWN IN COLUMN BOX-OUT. ALL VALVES AND ACCESSORIES TO BE LOCATED ABOVE CLOSEST CONCEALED CEILING.
H04 ROUTE GAS PIPING DOWN ADJACENT TO HOOD TIGHT TO WALL. SEE SHEET M401 AND FSE PLANS FOR EQUIP CONNECTION DETAILS TO BE COMPLETED BY MECH CONTRACTOR.
H05 SEE SHEET M701 FOR REQUIREMENTS.
H06 SEE DETAIL ON SHEET M503 FOR RADIANT WALL PANEL LOOP PIPING ASSEMBLY REQUIREMENTS.



KEY PLAN
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HVAC PIPING PLAN - AREA A

REVISIONS		
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-211A

100% CONSTRUCTION DOCUMENTS

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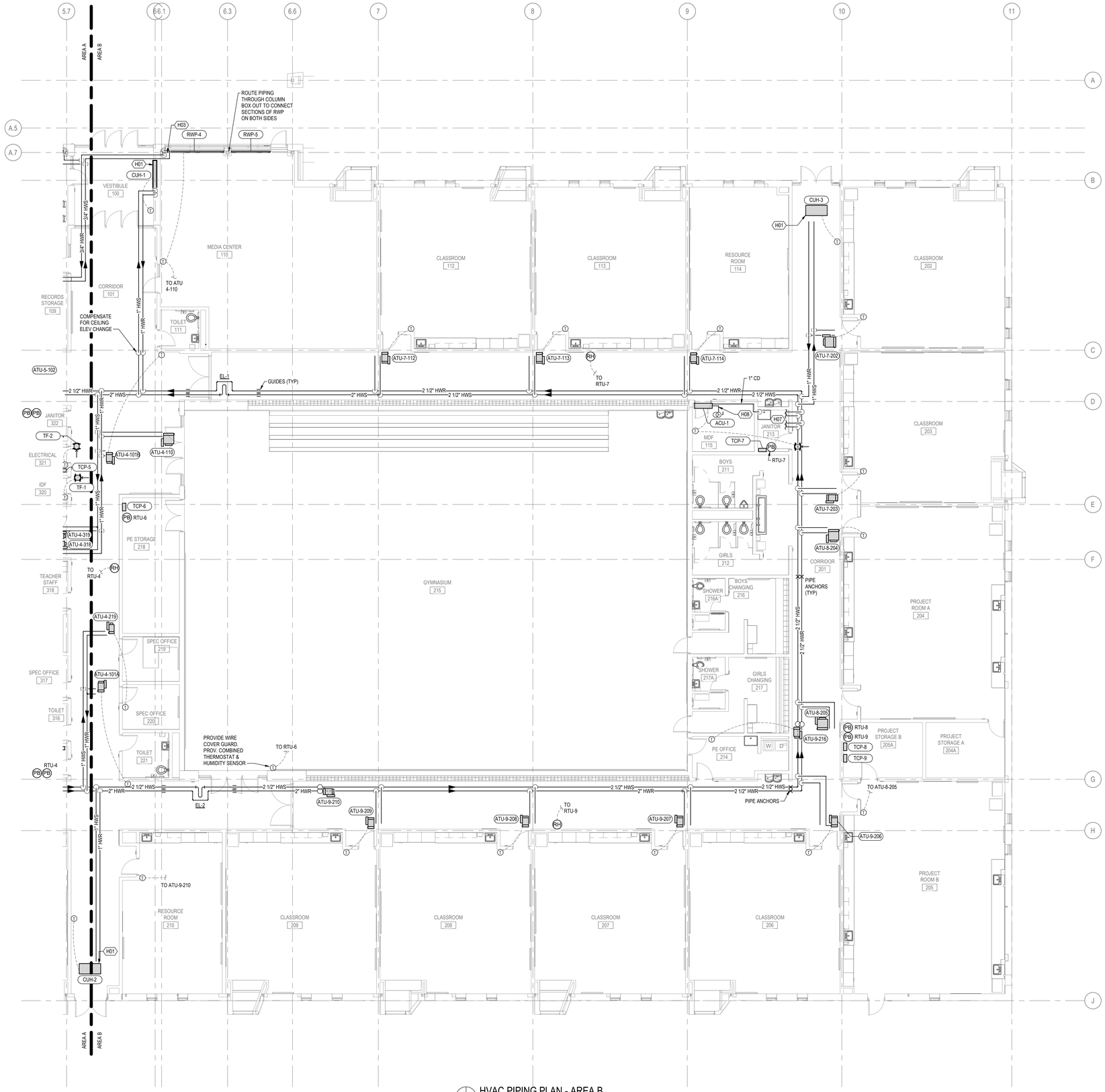
CHECKED BY: Checker APPROVED BY: Approver



HVAC PIPING PLAN - AREA B

1/8" = 1'-0"

HVAC PIPING GENERAL NOTES

1. THESE DRAWINGS INDICATE THE GENERAL EXTENT OF WORK BUT ARE NOT FABRICATION DRAWINGS. COORDINATE HVAC PIPING SYSTEMS WITH WORK OF ALL OTHER TRADES PRIOR TO ANY FABRICATION OR INSTALLATION. PROVIDE ALL FITTINGS, OFFSETS, AND TRANSITIONS AS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.
2. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.
3. ALL HVAC PIPING SHALL BE INSULATED PER THE PIPING SYSTEM APPLICATION SCHEDULE AND LABELED IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
4. COORDINATE ALL RADIANT WALL PANEL LENGTHS AND LOCATIONS ALONG WITH ASSOCIATED PIPE DROPS WITH ARCHITECTURAL AND STRUCTURAL TRADES.
5. CONNECT ALL PIPING TO TERMINAL UNIT COILS PER DETAILS. DO NOT INSTALL PIPING WITHIN THE SERVICE CLEARANCE FOR TERMINAL UNIT CONTROL PANEL OR ACCESS DOOR CLEARANCE ZONES.
6. LOCATE ALL HVAC SHUT-OFF VALVES AND TERMINAL UNITS IN AN ACCESSIBLE LOCATION ABOVE AN ACCESS PANEL AND NO MORE THAN 24" ABOVE THE CEILING.
7. SEAL ALL PENETRATIONS THROUGH WALLS AND FLOORS AIR AND WATER TIGHT.
8. CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCES (PER THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE) ABOVE AND AROUND ANY NEW ELECTRICAL PANELS, EQUIPMENT, AND TRANSFORMERS WHEN ROUTING OVERHEAD HVAC PIPING.
9. COORDINATE ALL PIPE ROUTING WITH SITE CONDITIONS, EQUIPMENT MANUFACTURER'S RECOMMENDATIONS AND ALL OTHER TRADES TO AVOID INTERFERENCES.
10. REFER TO PIPING DIAGRAMS, DETAILS, AND SPECIFICATIONS FOR VALVES, FITTINGS, AND OTHER ACCESSORIES.
11. COORDINATE ALL THERMOSTAT LOCATIONS WITH FURNITURE AND ARCHITECTURAL ELEMENTS. LOCATE AS CLOSE AS POSSIBLE TO DOOR WHERE INDICATED BY DOOR.
12. ALL BRANCH PIPING TO TERMINAL UNITS SHALL BE 3/4" DIAMETER UNLESS NOTED OTHERWISE. BRANCH PIPING SERVING MORE THAN ONE TERMINAL UNIT SHALL BE 1" DIAMETER UNLESS NOTED OTHERWISE.
13. ALL BRANCH PIPING SERVING CABINET UNIT HEATERS AND HOT WATER UNIT HEATERS SHALL BE 1" UNLESS NOTED OTHERWISE.
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16. ALL THERMOSTATS SHOWN WITHIN CORRIDORS, VESTIBULES, MECHANICAL ROOMS, IDF ROOMS AND ELECTRICAL ROOMS SHALL BE A STAINLESS STEEL FLAT PLATE SENSOR FLUSH MOUNTED TO WALL.

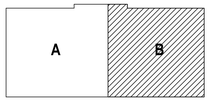
(X) HVAC PIPING KEYNOTES

H01 SEE SHEET M503 FOR CUH COIL CONNECTION DETAIL.

H03 ROUTE HWS & HWR BRANCHES TO RWP DOWN IN COLUMN BOX-OUT. ALL VALVES AND ACCESSORIES TO BE LOCATED ABOVE CLOSEST CONCEALED CEILING.

H07 PROVIDE 1 1/2" BRANCHES TO MINIMUM FLOW BYPASS VALVE ASSEMBLY AND 3/8" BRANCHES TO DIFFERENTIAL PRESSURE SENSOR ASSEMBLY PIPING. MOUNT BOTH ACCESSIBLE ON WALL WITHIN JANITOR CLOSET

H08 MOUNT ACU-1 AT 8'-0" A.F.F. CENTERED ABOVE DOOR. PROVIDE 3/8" RL & 5/8" RS REFRIGERANT PIPING FROM EVAPORATOR UP THROUGH ROOF TO ACU-1 CONDENSING UNIT. PROVIDE 1" CONDENSATE DRAIN TIGHT TO WALL FROM EVAPORATOR THROUGH WALL INTO JANITORS CLOSET AND DOWN TO TERMINATE OVER SERVICE SINK.



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HVAC PIPING PLAN - AREA B

REVISIONS

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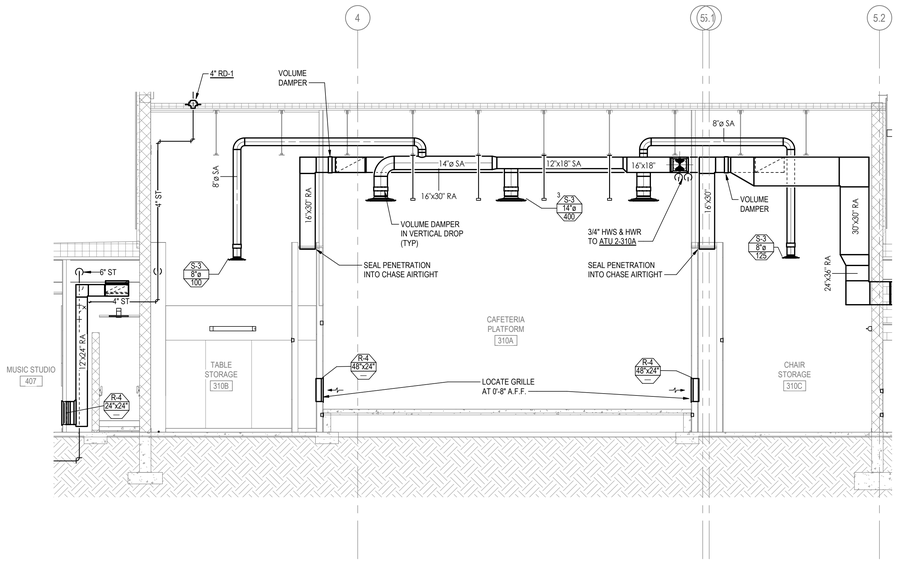
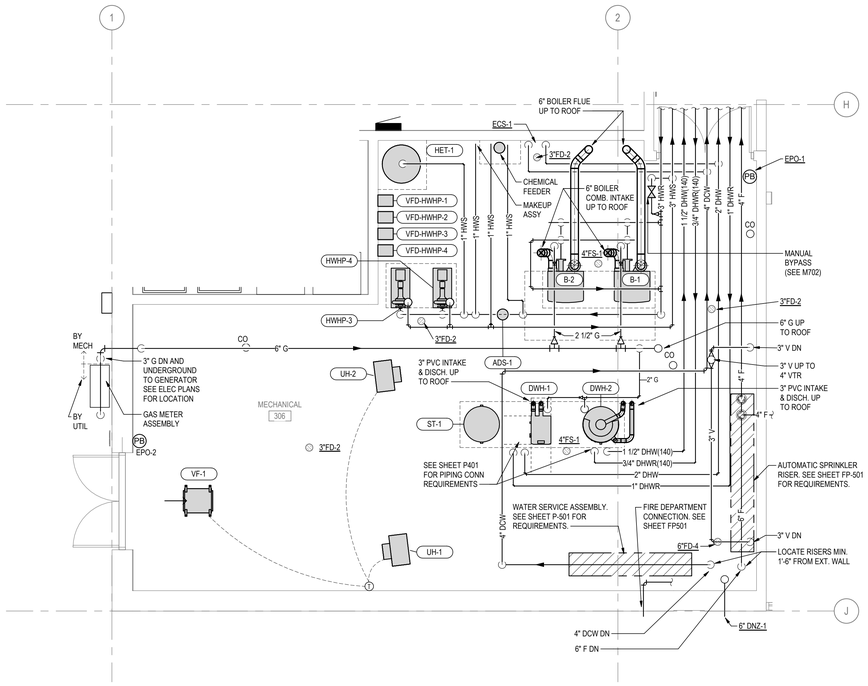
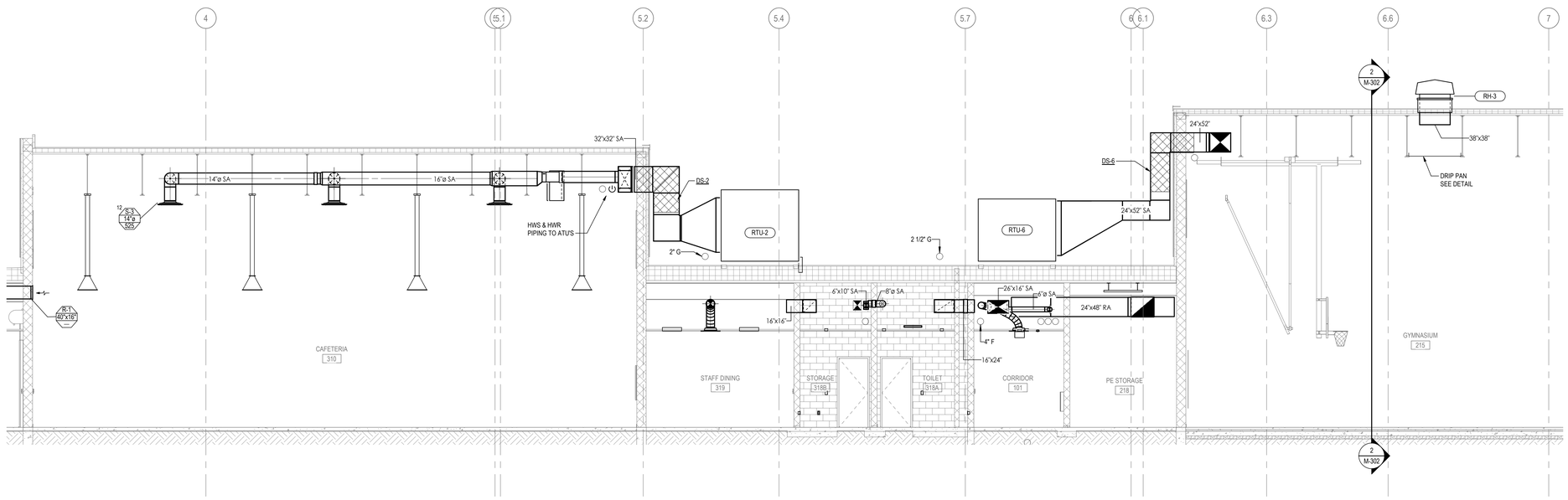
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



3 / M-301 MECHANICAL SECTION THROUGH PLATFORM 310A
3/16" = 1'-0"



1 / M-301 ENLARGED BOILER ROOM MECHANICAL PLAN
1/4" = 1'-0"



2 / M-301 MECHANICAL SECTION THROUGH CAFE AND GYMNASIUM
3/16" = 1'-0"

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ENLARGED MECHANICAL PLANS AND SECTIONS

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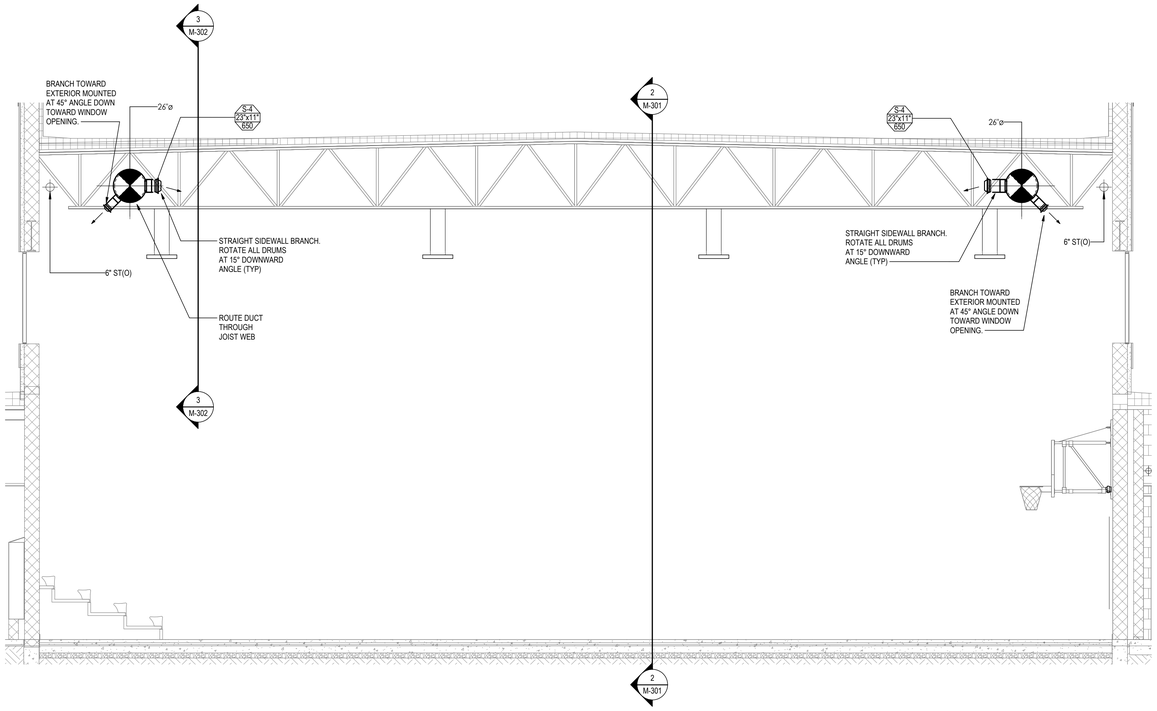
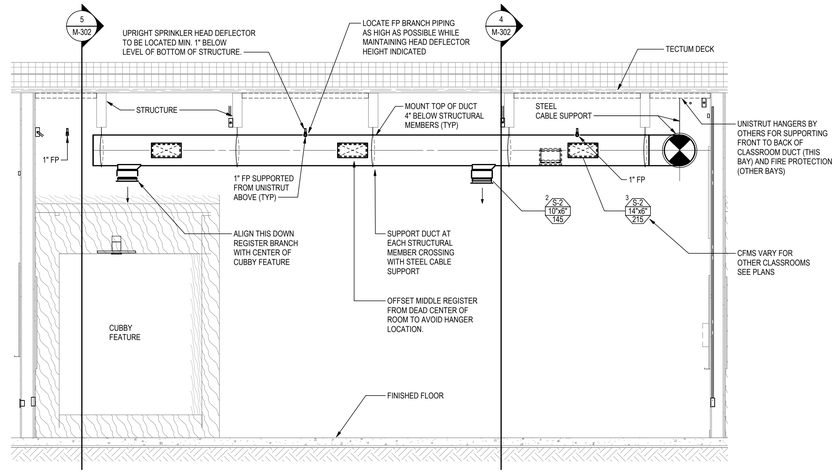
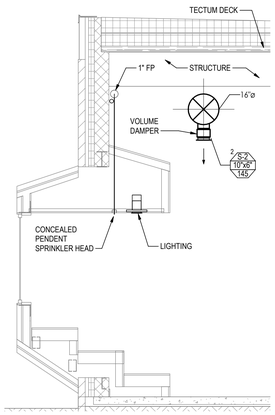


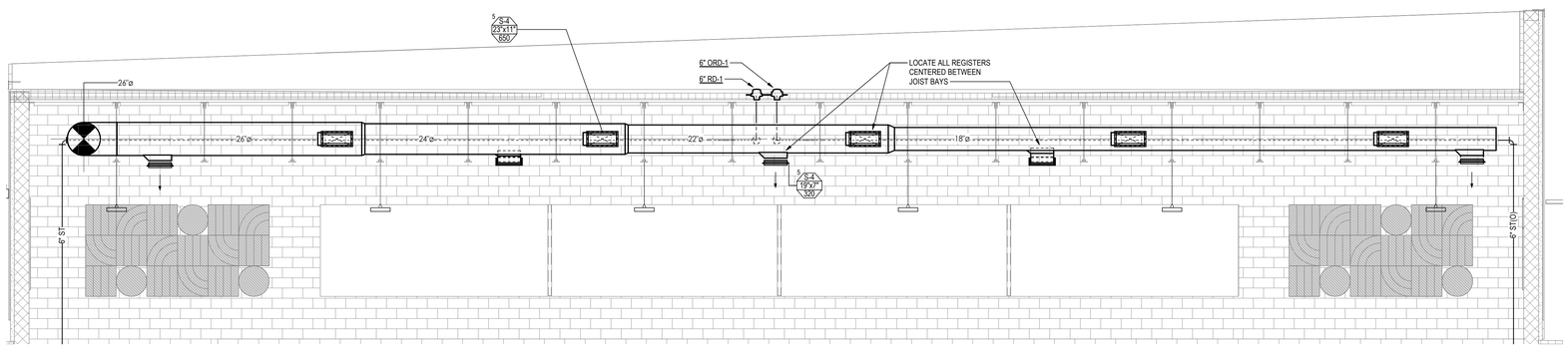
2 M-302 **MECHANICAL SECTION THROUGH GYMNASIUM**
1/4" = 1'-0"



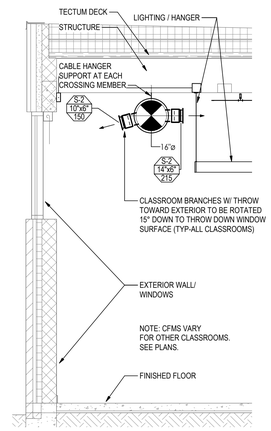
1 M-302 **TYPICAL CLASSROOM SECTION**
3/8" = 1'-0"



5 M-302 **TYPICAL CLASSROOM EXTERIOR SECTION**
3/8" = 1'-0"



3 M-302 **UPPER GYM DUCTWORK / STORM ELEVATION**
1/4" = 1'-0"



4 M-302 **TYPICAL CLASSROOM DUCTWORK SECTION**
3/8" = 1'-0"

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PROJ. #: 220116
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NEW METER
NATURAL GAS LOAD SCHEDULE

EQUIPMENT	PRESSURE (IN W.C.)	LOAD (CFH)
BOILER (B-1)	4 - 14	1,000
BOILER (B-2)	4 - 14	1,000
DOM. WATER HEATER (DWH-1)	4 - 7	199
DOM. WATER HEATER (DWH-2)	4 - 7	285
RANGE	7 - 14	177
CONV. OVEN	7 - 14	90
STEAMER	4 - 14	125
RTU-1	5 - 14	300
RTU-2	5 - 14	400
RTU-3	5 - 14	300
RTU-4	5 - 14	200
RTU-5	5 - 14	200
RTU-6	5 - 14	600
RTU-7	5 - 14	300
RTU-8	5 - 14	300
RTU-9	5 - 14	300
GENERATOR	7 - 14	2,700
TOTAL @ 11" W.C.		8,476 CFH

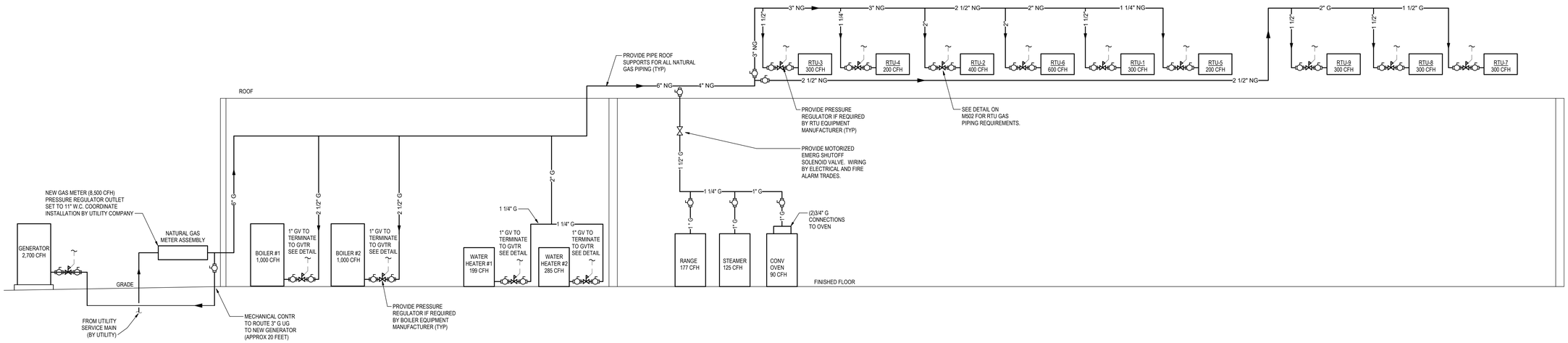
NOTES:
NATURAL GAS PIPING SYSTEM FROM BUILDING REGULATOR TO NEW EQUIPMENT IS BASED ON 8,500 CFH WITH A TOTAL FARTHEST DISTANCE RUN OF 375 FEET, 1.0 INCH WATER COLUMN LOSS, 0.6 SPECIFIC GRAVITY GAS, SCHEDULE 40 PIPING. REFER TO SCHEDULE BELOW.

BASED ON 11" W.C.	GAS PIPE SIZE (INCH)										
NOMINAL	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8
ACTUAL ID	0.62	0.82	1.049	1.38	1.61	2.067	2.469	3.068	4.026	6.065	7.981
LENGTH (FT)	CAPACITY (CUBIC FEET PER HOUR)										
450	32	67	127	260	390	751	1198	2119	4323	12670	26050

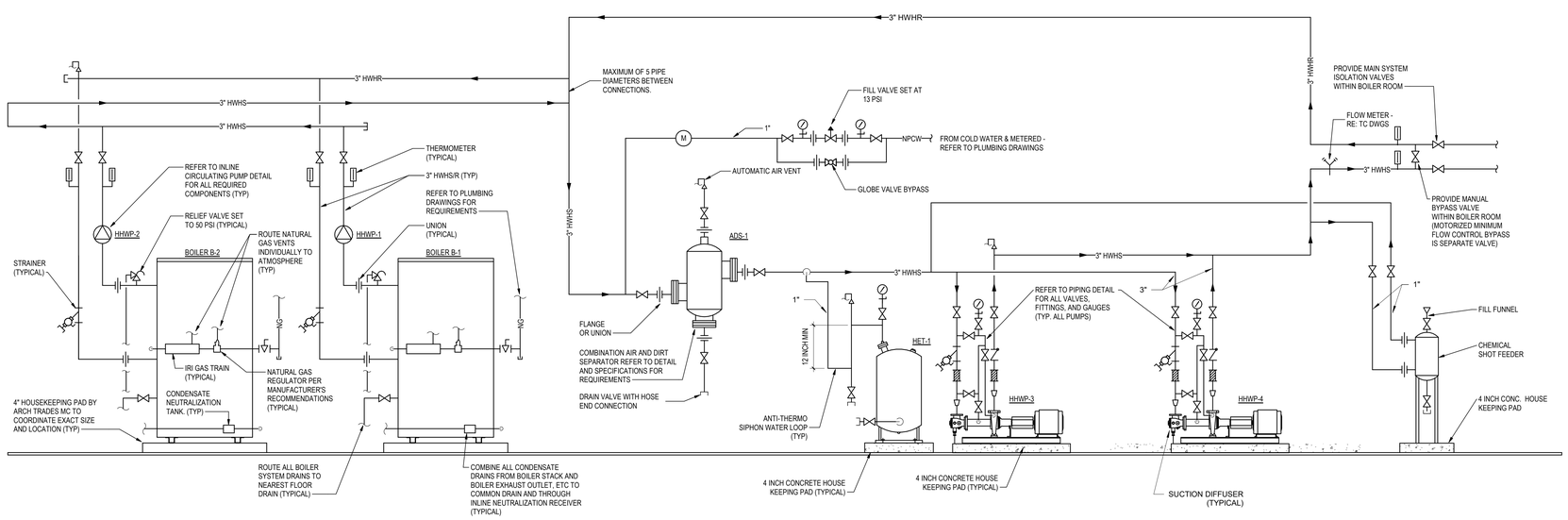
NOTES:
SCHEDULE IS BASED ON INTERNATIONAL FUEL GAS CODE LOW PRESSURE GAS EQUATION.

Q=(D^19.17(H/C^L)^.206)^(1/.381)

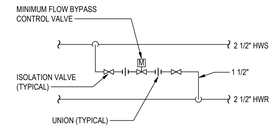
Q= CAPACITY (CUBIC FEET PER HOUR)
D= INSIDE PIPE DIAMETER (INCHES)
L= LENGTH OF PIPE (FEET)
H= PRESSURE DROP (INCH WATER COLUMN)
C= 0.6094



1 NATURAL GAS RISER DIAGRAM
NTS

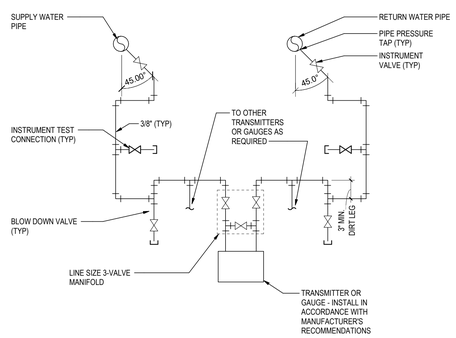


3 NEW HEATING HOT WATER SYSTEM DIAGRAM
NTS



NOTE: SEE PLANS FOR LOCATION.

MINIMUM FLOW CONTROL BYPASS VALVE
SCALE: NONE



NOTES:
1. ON HORIZONTAL PIPES, INSTALL PIPE PRESSURE TAP AT 45° ANGLE FROM BOTTOM.
2. PROVIDE LINE SIZE 3-VALVE MANIFOLD AS INDICATED FOR EACH TRANSMITTER AND GAUGE.
3. SEE PLANS FOR LOCATION.

DIFFERENTIAL PRESSURE SENSING DEVICE DETAIL
SCALE: NONE

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MECHANICAL DIAGRAMS

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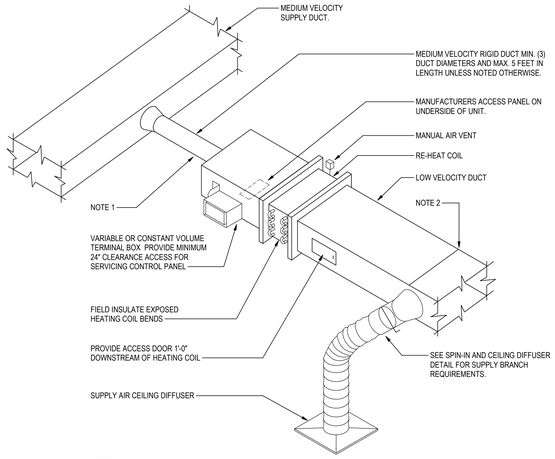
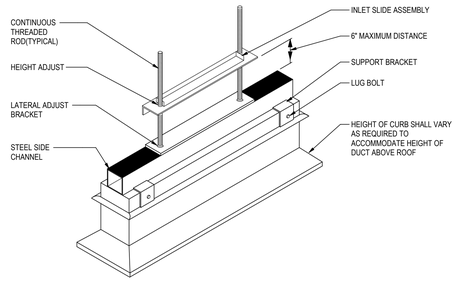


NOTES:
1. FOR RUNOUT PIPE SIZES AND DUCT CONNECTIONS TO AIR TERMINAL UNITS SEE SCHEDULES.
2. THE FIRST TAKE-OFF FROM ATU SHALL BE A MIN. OF 3' - 0" DOWN STREAM OF BOX OUTLET.

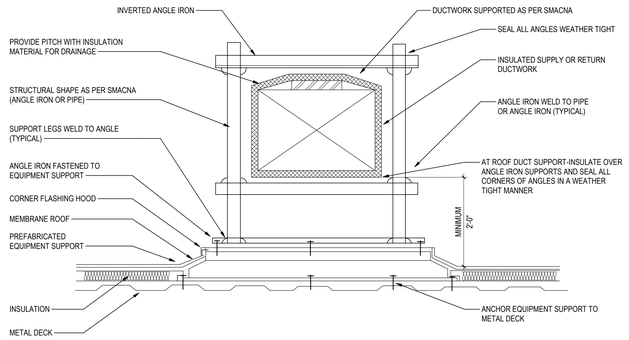
TYPICAL AIR TERMINAL DEVICE DETAIL AND RELATED SUPPLY AIR DUCTWORK

SCALE: NONE



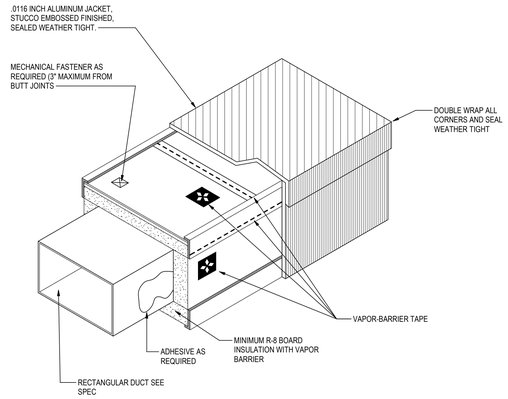
DUCT MOUNTING PEDESTAL DETAIL (ROOF MOUNTED DUCTWORK)

SCALE: NONE



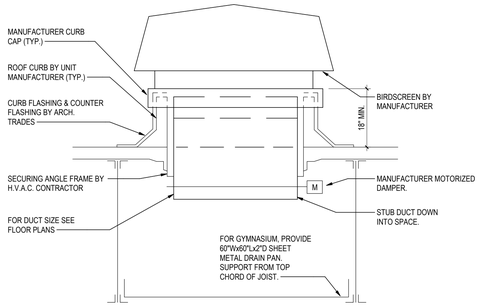
DUCT SUPPORT ON ROOF DETAIL

SCALE: NONE



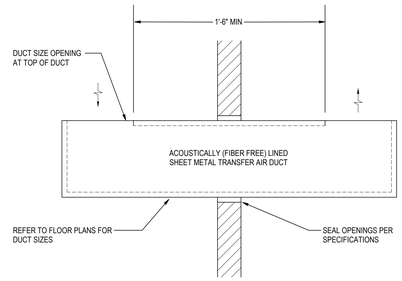
OUTDOOR DUCT INSULATION DETAIL

SCALE: NONE



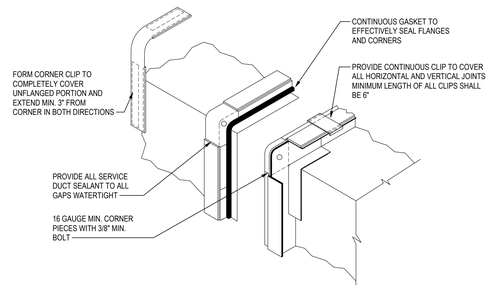
RELIEF HOOD DETAIL

SCALE: NONE



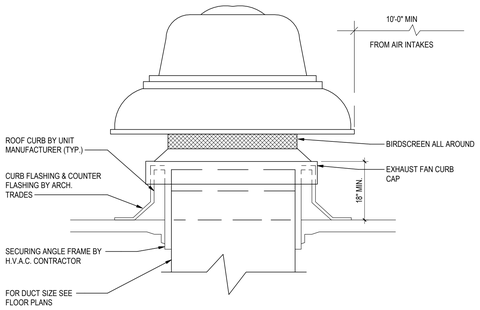
TYPICAL TRANSFER DUCT SLEEVE DETAIL

SCALE: NONE



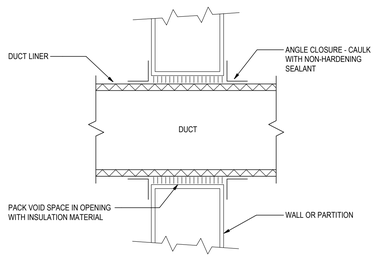
EXTERIOR DUCT SEALING DETAIL

SCALE: NONE



EXHAUST FAN DETAIL

SCALE: NONE



NON-FIRE RATED ASSEMBLY HORIZONTAL DUCT PENETRATION DETAIL

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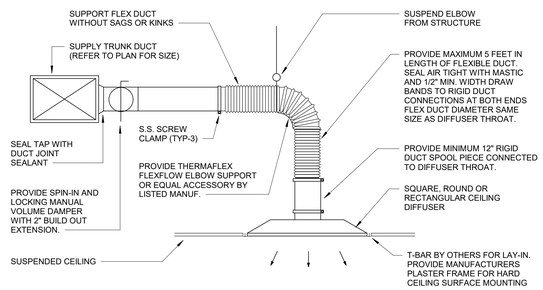
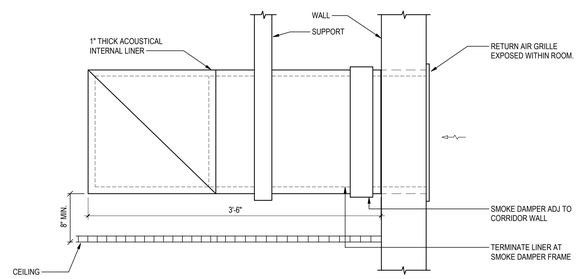


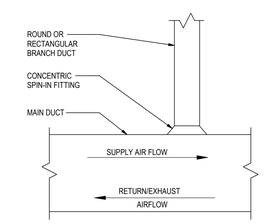
SUPPLY AIR BRANCH SPIN-IN AND CEILING DIFFUSER DETAIL

SCALE: NONE



RETURN AIR TRANSFER DUCT DETAIL

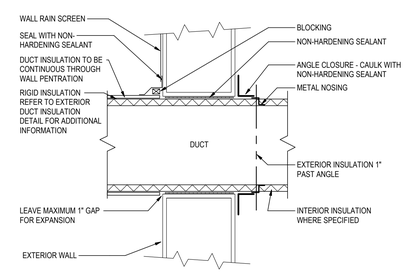
SCALE: NONE



NOTE:
1. FURNISH THIS TYPE CONNECTION FOR BRANCHES WITH LESS THAN 25% OF THE TOTAL AIR FLOW

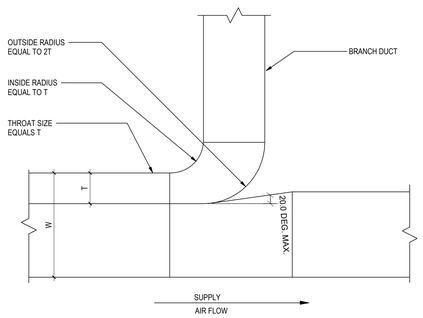
ROUND/RECTANGULAR DUCT BRANCH CONNECTION DETAIL

SCALE: NONE



EXTERIOR WALL DUCT PENETRATION DETAIL

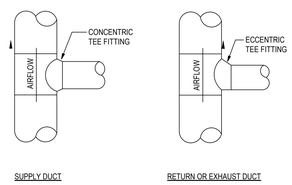
SCALE: NONE



NOTES:
1. FURNISH THIS TYPE CONNECTION FOR BRANCHES WITH MORE THAN 25% OF THE TOTAL AIR FLOW OR AS SHOWN ON DRAWINGS.
2. THIS TYPE OF CONNECTION MUST BE USED WHEN W > 36 IN.
3. SIZE THE LEADING END OF THE ELBOW (T) IN THE SAME RATIO TO THE MAIN DUCT SIZE AS THE RATIO OF THE RELATIVE AIR QUANTITIES HANDLED.

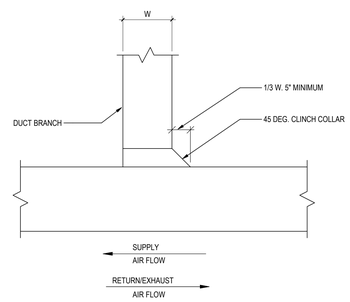
RECTANGULAR DUCT CONNECTION DETAIL

SCALE: NONE



ROUND OR FLAT OVAL DUCT BRANCH TAKE-OFF DETAIL

SCALE: NONE



NOTE:
1. FURNISH THIS TYPE CONNECTION FOR BRANCHES WITH LESS THAN 25% OF TOTAL AIR FLOW.

RECTANGULAR DUCT BRANCH CONNECTION DETAIL

SCALE: NONE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

DESIGNED BY:
CHECKED BY: APPROVED BY: Approver

6/28/2023 9:32:29 AM
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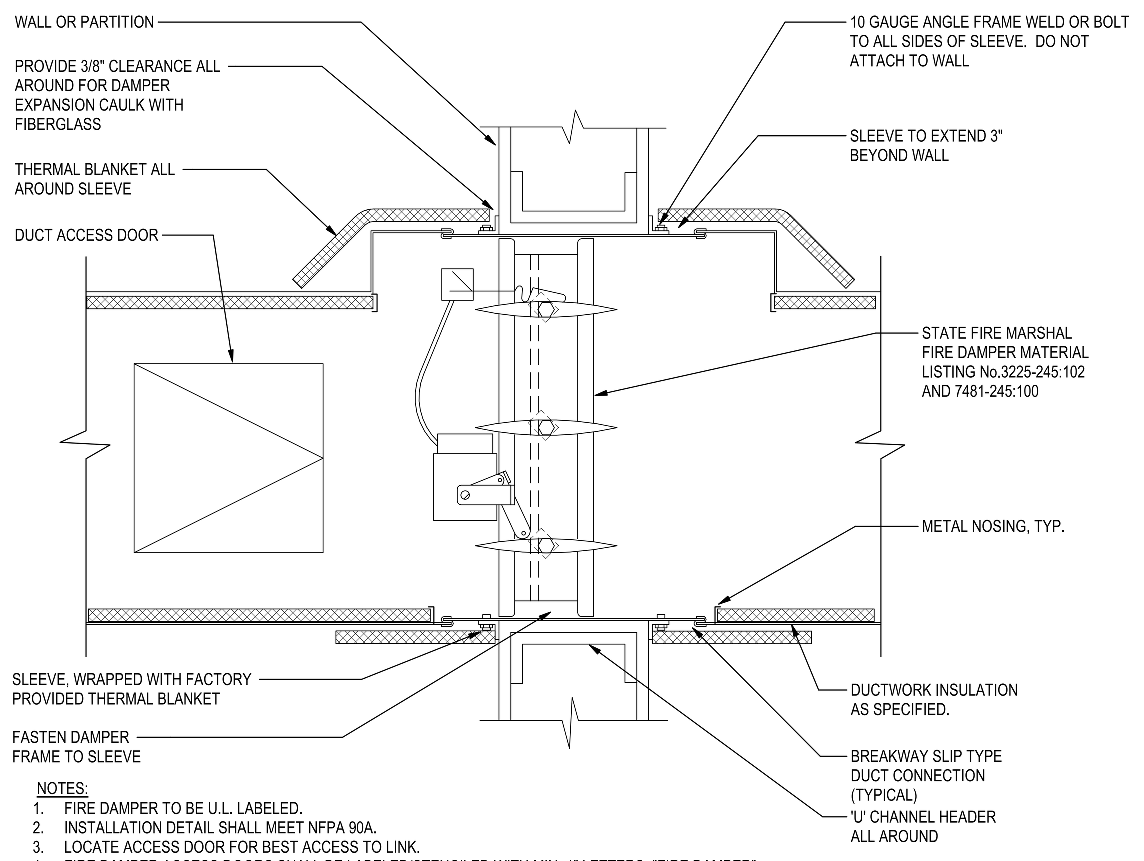
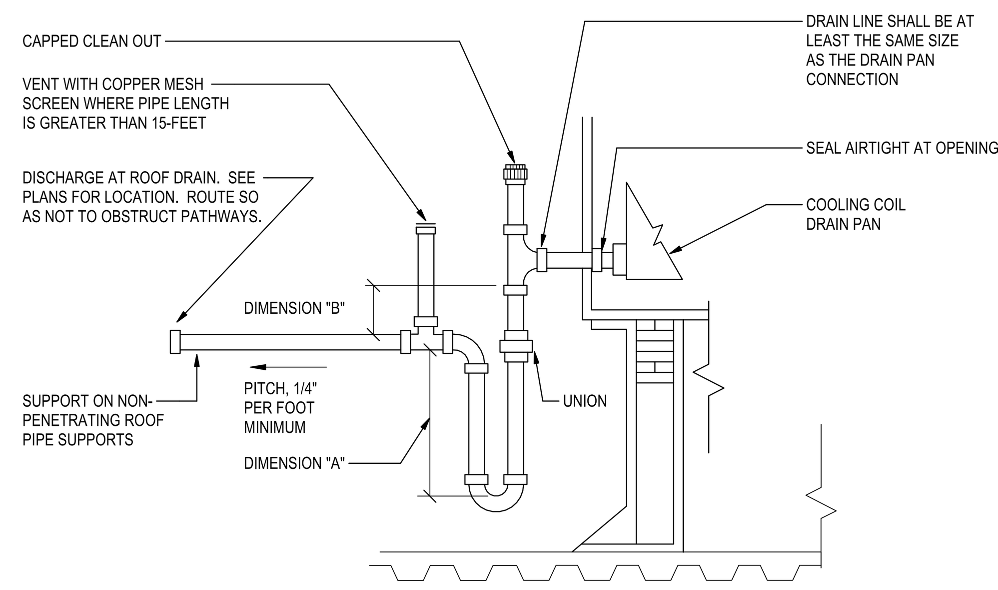


NOTES:
1. FIRE DAMPER TO BE U.L. LABELED.
2. INSTALLATION DETAIL SHALL MEET NFPA 90A.
3. LOCATE ACCESS DOOR FOR BEST ACCESS TO LINK.
4. FIRE DAMPER ACCESS DOORS SHALL BE LABELED/STENCILED WITH MIN. 1" LETTERS: "FIRE DAMPER".
5. DAMPER SHALL BE CONSTRUCTED TESTED AND INSTALLED IN ACCORDANCE WITH U.L. STANDARD 555 & 555S.
6. FIRE DAMPER ASSEMBLIES, INCLUDING SLEEVES AND INSTALLATION PROCEDURES SHALL BE APPROVED BY THE BUILDING INSPECTOR PRIOR TO INSTALLATION.
7. DUCT SMOKE DETECTORS SHALL BE FURNISHED, INSTALLED, AND WIRED TO THE FIRE ALARM SYSTEM BY THE ELECTRICAL CONTRACTOR. THE CONTRACTOR SHALL PROVIDE DUCT SMOKE DETECTOR WIRING INTERLOCK TO MOTOR STARTER OR VFD'S. REFER TO ELECTRICAL DRAWINGS FOR DUCT SMOKE DETECTOR LOCATIONS.

FIRE / SMOKE DAMPER DETAIL

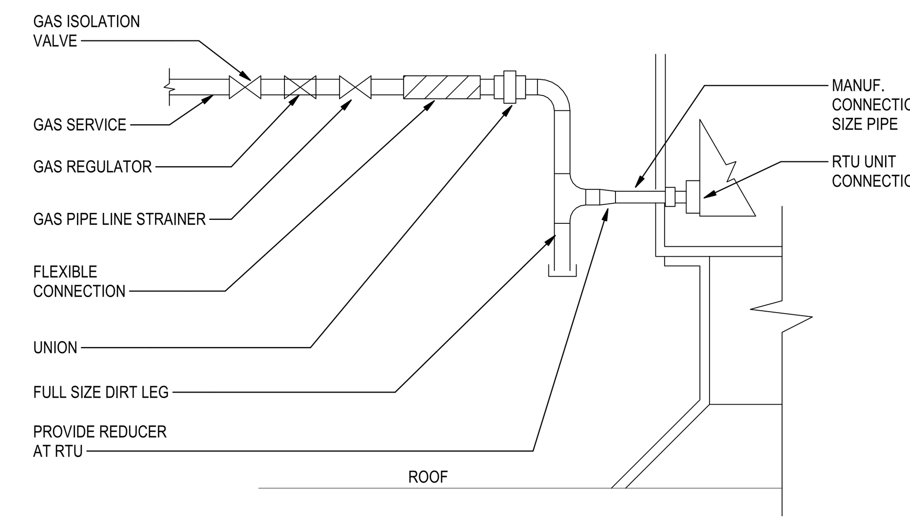
SCALE: NONE



NOTES:
1. FOR DRAW THROUGH UNITS - DIMENSION "A" = 1/2 OF DIMENSION "B". DIMENSION "B" = FAN SUCTION STATIC PRESSURE PLUS 2 INCHES.
2. FOR BLOW THROUGH UNITS - DIMENSION "A" = FAN DISCHARGE STATIC PRESSURE PLUS 2 INCHES. DIMENSION "B" = 2 INCHES.
3. REFER TO AIR HANDLING UNIT SCHEDULE FOR SUCTION OR DISCHARGE STATIC PRESSURE.

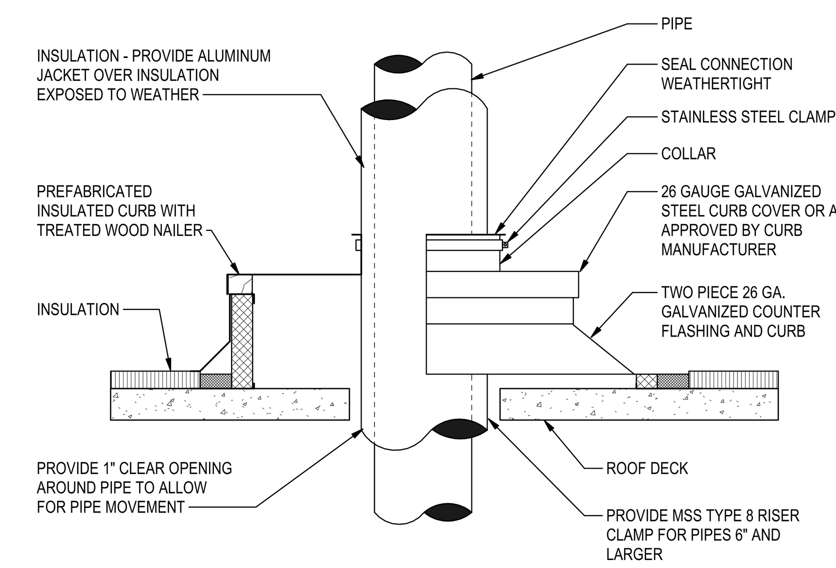
COOLING COIL AND ENERGY RECOVERY SECTION CONDENSATE DRAIN TRAP PIPING DETAIL

SCALE: NONE



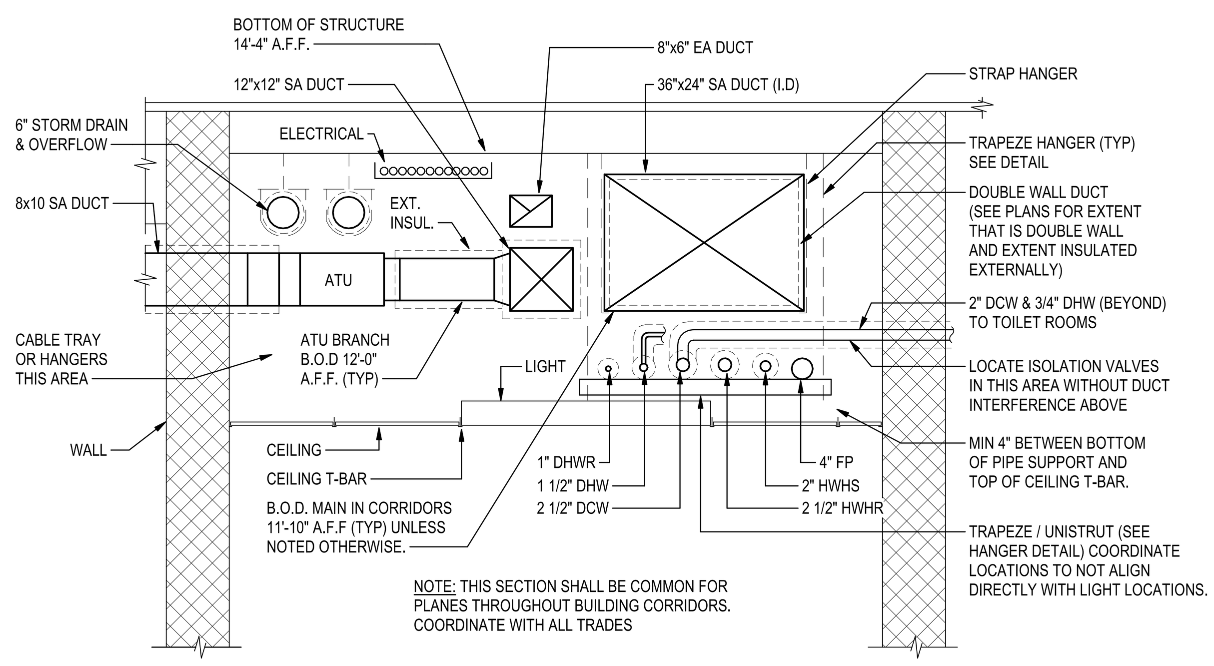
RTU GAS PIPING DETAIL

SCALE: NONE



PIPE ROOF PENETRATION DETAIL

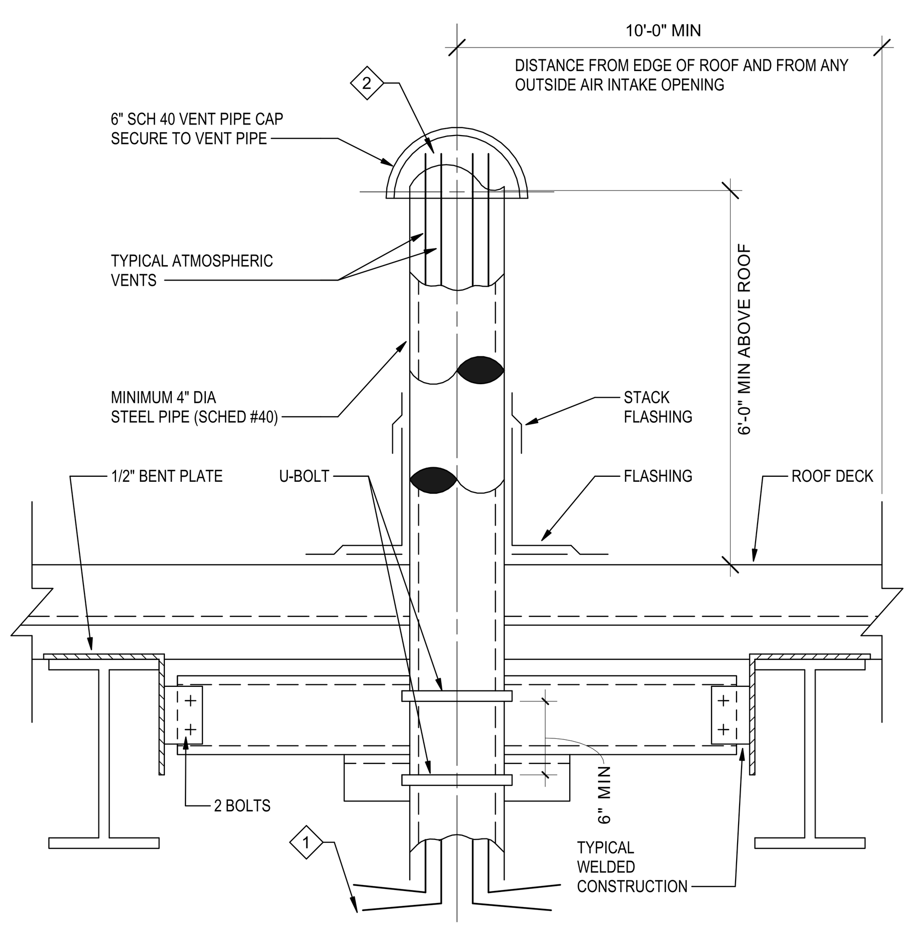
SCALE: NONE



NOTE: THIS SECTION SHALL BE COMMON FOR PLANES THROUGHOUT BUILDING CORRIDORS. COORDINATE WITH ALL TRADES

CORRIDOR 101 SECTION VIEW

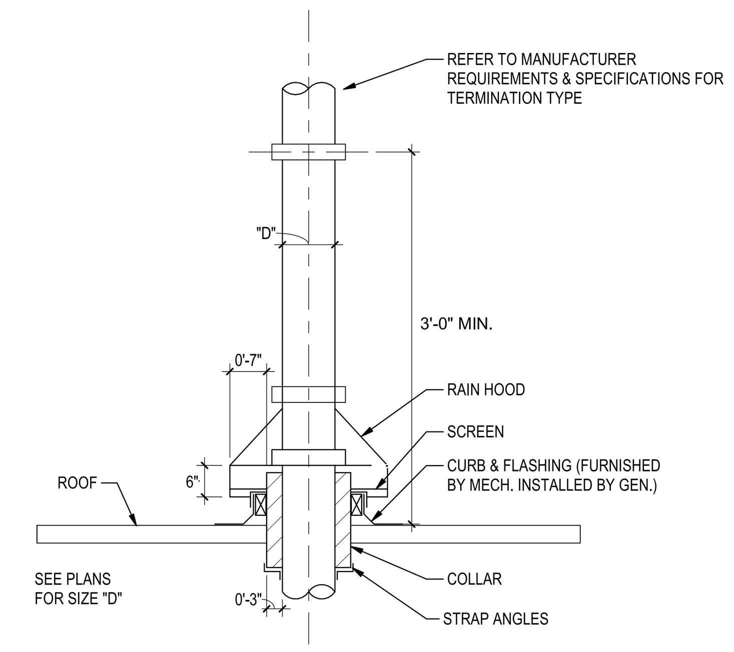
SCALE: 1/2" = 1'-0"
(LOOKING SOUTH OUTSIDE ROOM 108)



1. SIZE SAFETY RELIEF VENTS IN ACCORDANCE WITH MANUFACTURERS WRITTEN RECOMMENDATIONS.
2. TERMINATE SAFETY RELIEF VENTS AT A MINIMUM SIZE OF 1 INCH AT ROOF PENETRATION.

GAS ATMOSPHERE SAFETY RELIEF VENT THRU ROOF DETAIL

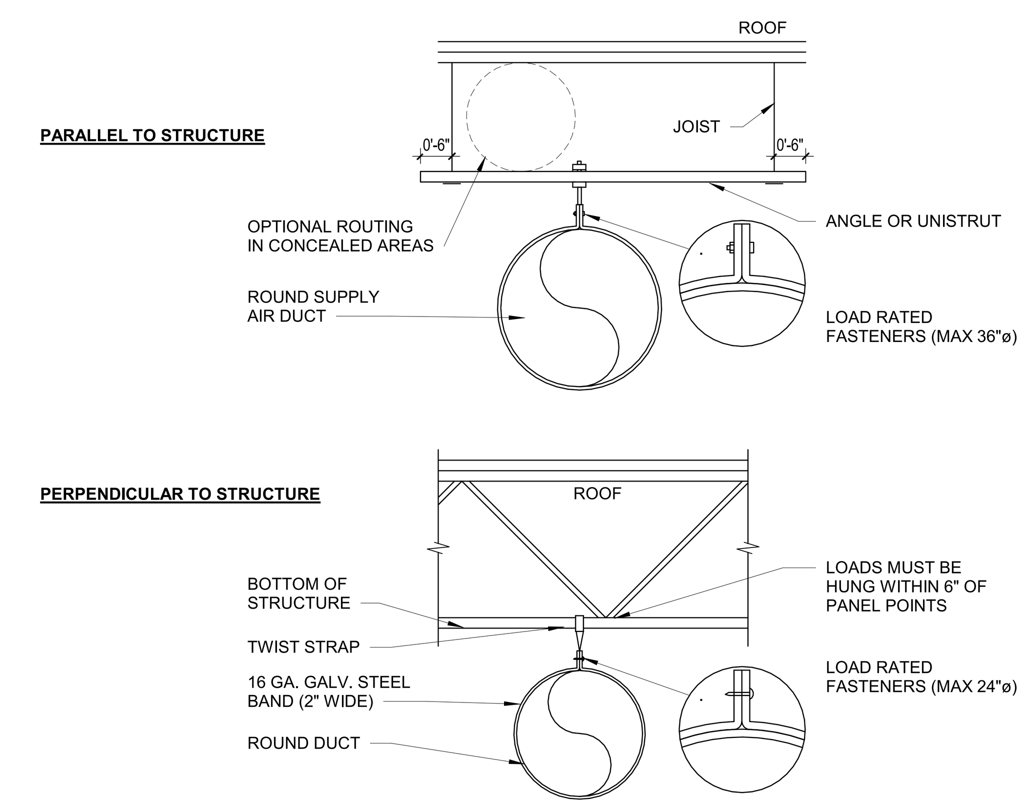
SCALE: NONE



NOTE:
PROVIDE COLLAR, STRAP ANGLES, ETC.. FOR ADDITIONAL PENETRATION THRU CEILING CONTRUCTION.

FLUE THROUGH ROOF DETAIL

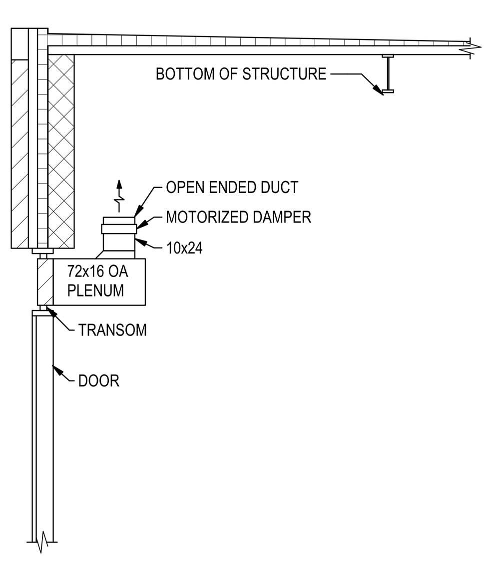
SCALE: NONE



NOTES:
1. USE THREADED ROD FOR ALL DUCTS LARGER THAN 60"ø WIDE

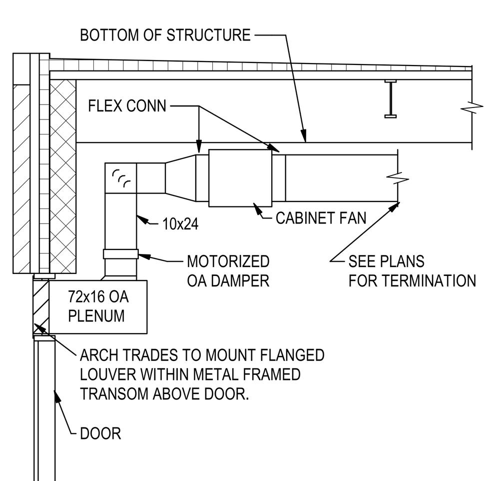
ROUND DUCT SUPPORT DETAIL

SCALE: NONE



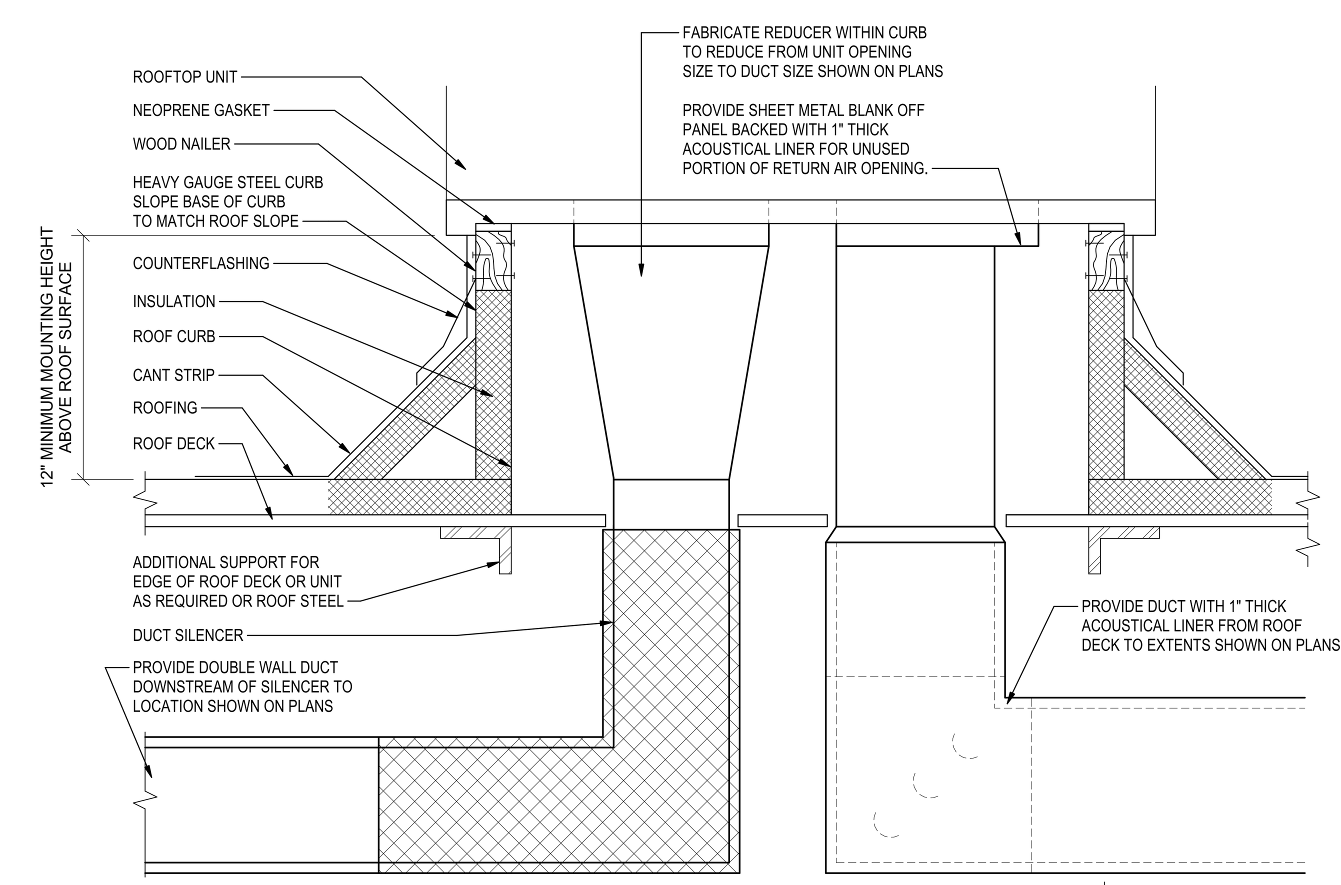
ELECTRICAL AND ATS ROOM AIR INTAKE SECTION VIEW

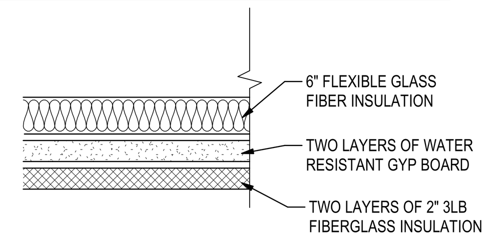
SCALE: NONE



MECHANICAL AND RECEIVING ROOM AIR INTAKE SECTION VIEW

SCALE: NONE

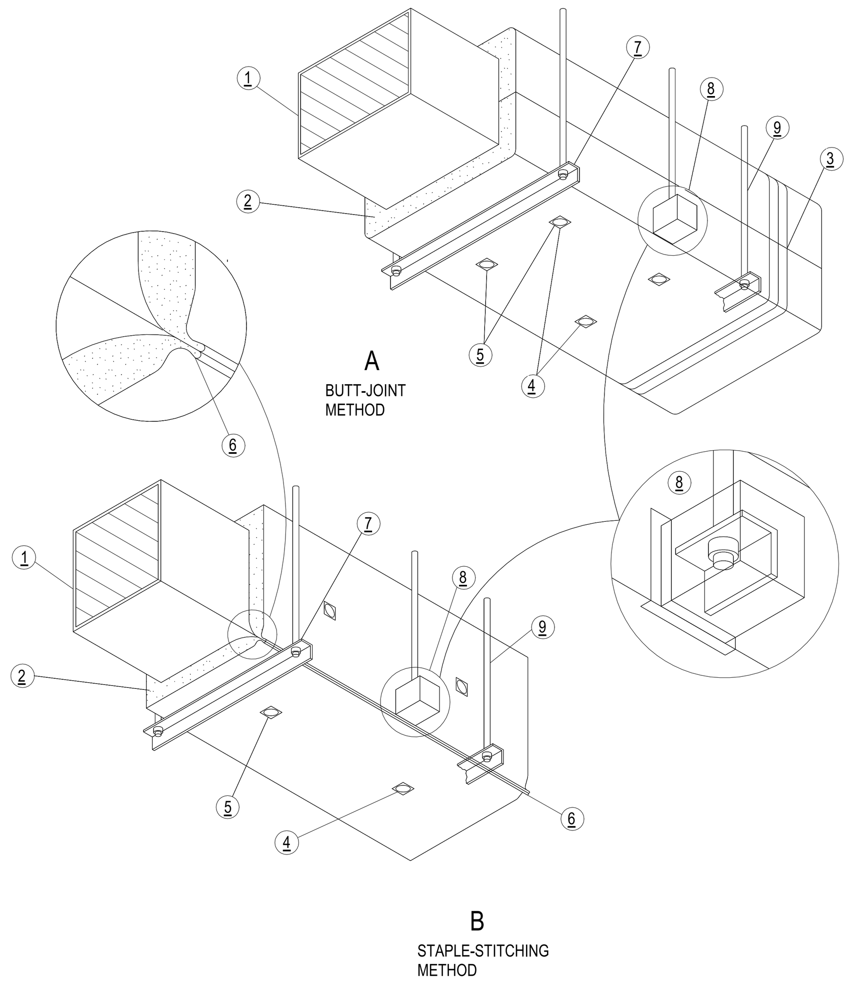




ROOFTOP EQUIPMENT CURB AND DUCT DROP DETAIL

SCALE: NONE

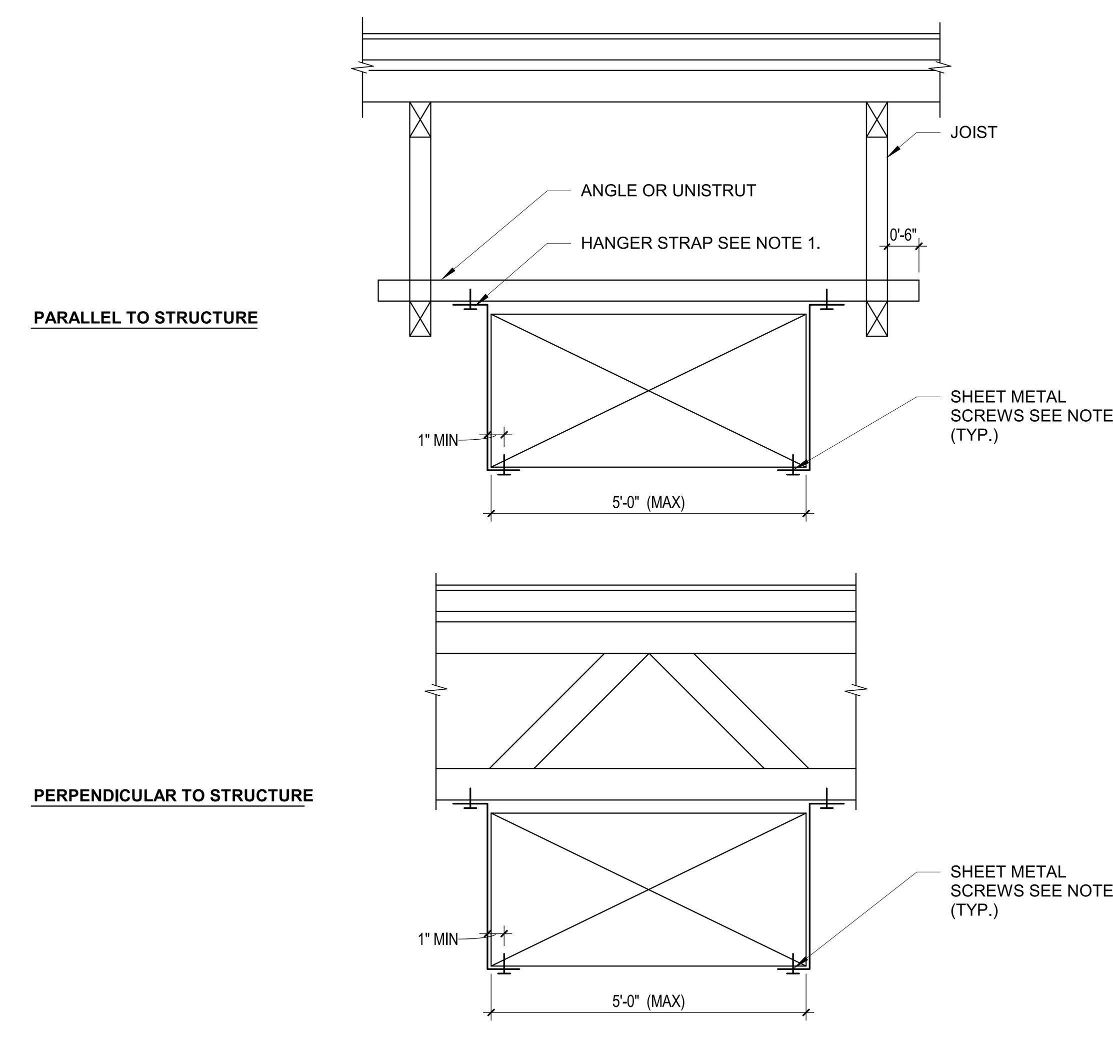
NOTES:
ALL DUCT, PIPING, AND ELECTRICAL CONNECTIONS TO UNIT BELOW CURB SHALL HAVE FLEXIBLE CONNECTIONS. CUT INSULATION, GYP BOARD, ROOFING INSULATION, AND ROOF DECKING PENETRATIONS TIGHT TO ITEMS PENETRATING THROUGH THE ASSEMBLY. PACK ALL PENETRATION OPENINGS WITH FLEXIBLE INSULATION. PROVIDE SEALS AND GASKETS AT ALL ROOFTOP PENETRATIONS.



NOTES:
1. BLANKET INSULATION WITH FACTORY-APPLIED VAPOR-RETARDER JACKET.
2. FACTORY LAP ALL SEALS (SEALED WITH ADHESIVE AND/OR STAPLES OR VAPOR-RETARDER TAPE).
3. MECHANICAL FASTENERS SUPPORTING INSULATION ON UNDERSIDE OF DUCTS OVER 24" WIDE (SPACED 3" MAXIMUM FROM THE BUTT JOINT).
4. VAPOR-RETARDER TAPE OVER TEARS AND PENETRATIONS OF THE VAPOR-RETARDER JACKET TO KEEP AIR TIGHT CONDITION.
5. ALTERNATE METHOD OF LAP SEAL - LONGITUDINAL JOINT LAPPED AND FOLDED, THEN STAPLED SECURELY IN PLACE.
6. HANGER ON EXTERIOR OF INSULATION. ENCAPSULATE EXPOSED END OF ANGLE. SEAL WITH ADHESIVE OR VAPOR-RETARDER TAPE.
7. HANGER EMBEDDED IN INSULATION. ENCAPSULATE EXPOSED END OF ANGLE. SEAL WITH ADHESIVE OR VAPOR-RETARDER TAPE.
8. COMPLETELY ENCAPSULATE HANGER ROD AND ANGLE. SEAL TOP PENETRATION. ENCAPSULATE A ND SEAL STRAP HANGERS IN A SIMILAR MANNER.

BLANKET FIBERGLASS INSULATION DETAIL

SCALE: NONE



NOTES:
1. USE THREADED ROD FOR ALL DUCTS LARGER THAN 60"ø WIDE
2. SHEET METAL SCREWS MAY BE OMITTED IT HANGER STRAP IS CONTINUOUS AND LOOPS UNDER ENTIRE DUCT

RECTANGULAR DUCT SUPPORT DETAIL

SCALE: NONE

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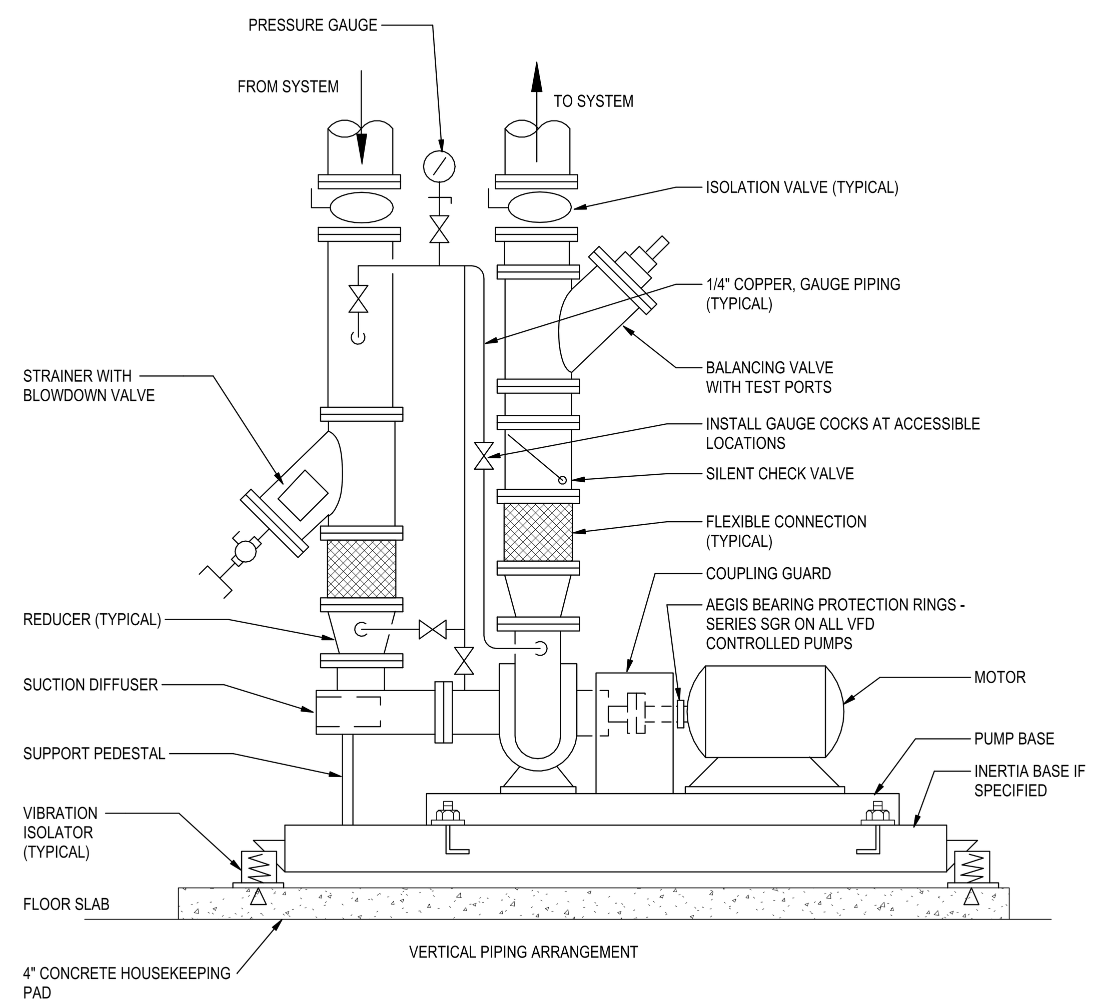
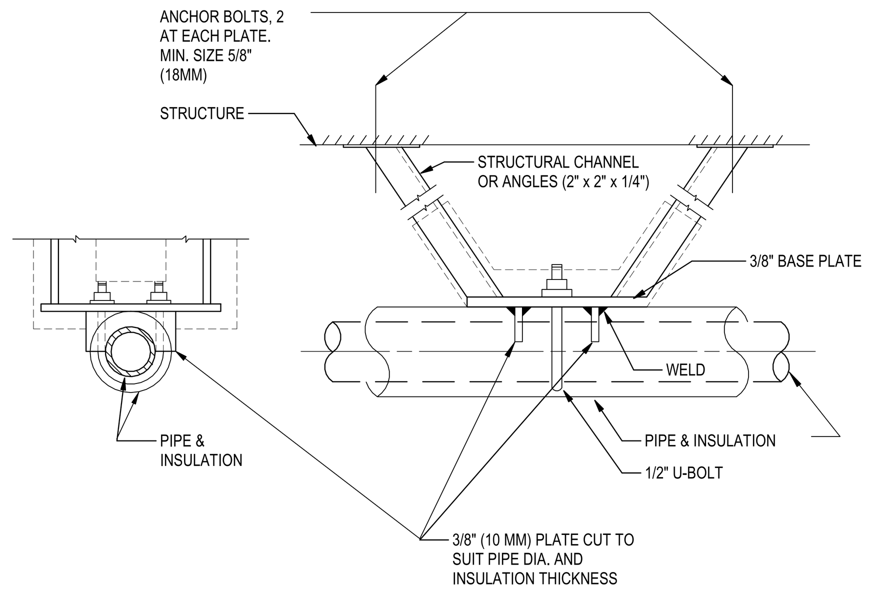
CHECKED BY:
APPROVED BY: Approver



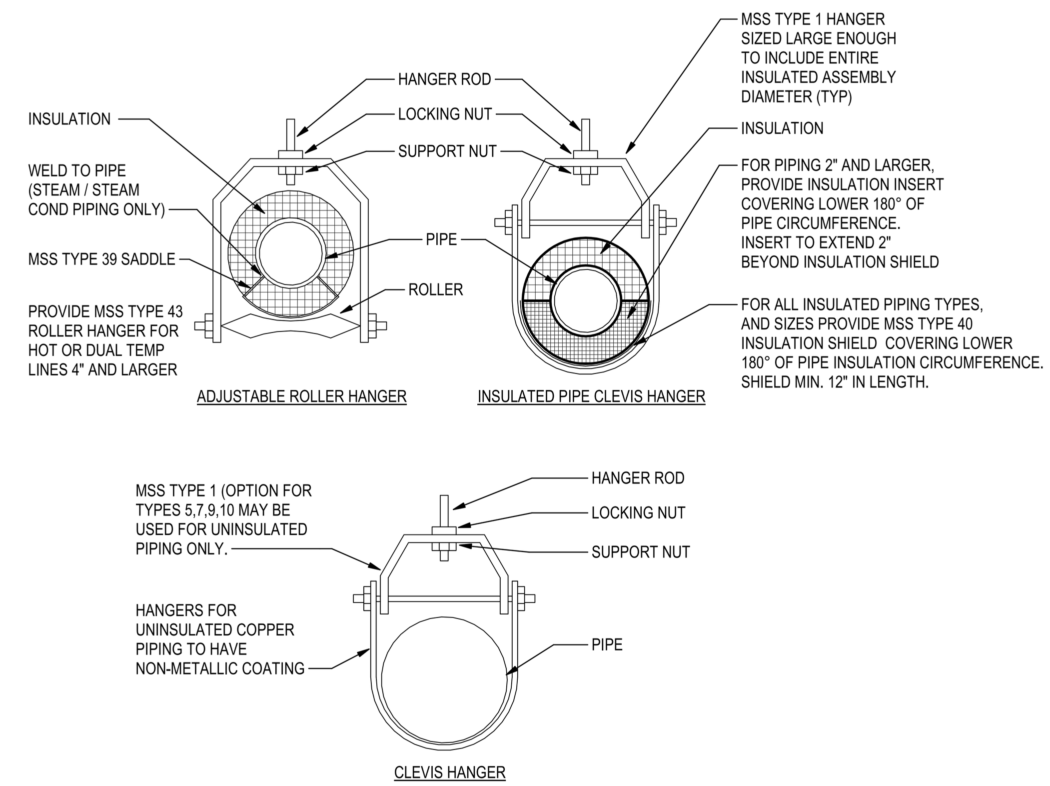
TYPICAL BASE MOUNTED END SUCTION PUMP DETAIL

SCALE: NONE



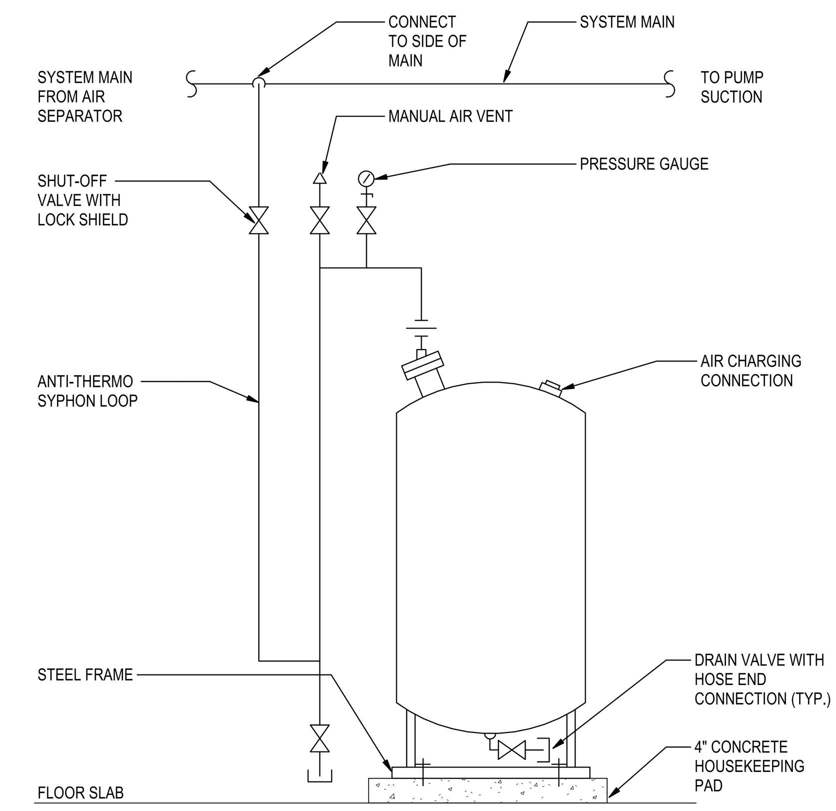
HORIZONTAL PIPE ANCHOR DETAIL

SCALE: NONE



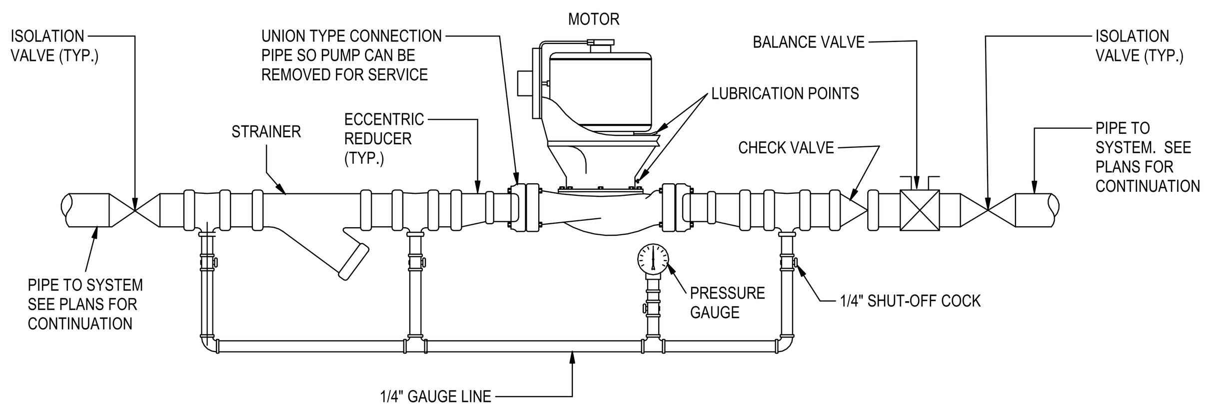
PIPE HANGER DETAIL

SCALE: NONE



DIAPHRAGM EXPANSION TANK PIPING DIAGRAM

SCALE: NONE

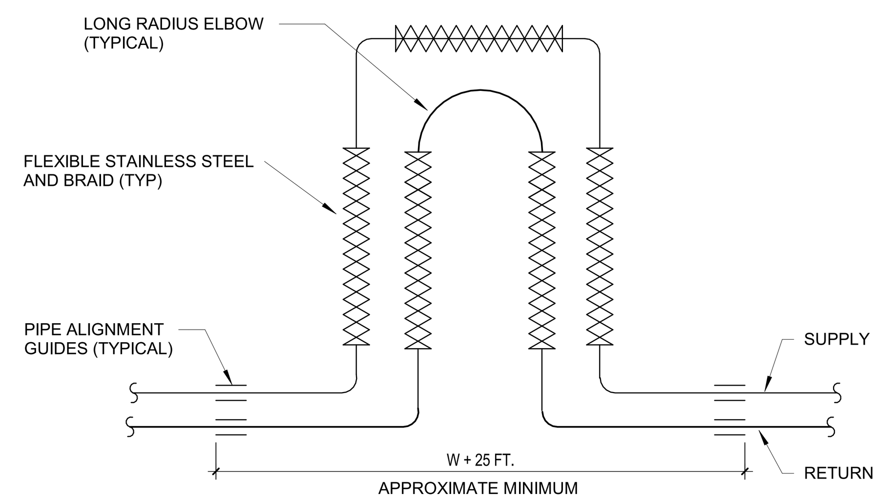


INSTALLATION NOTES:

1. THE PUMP SHALL BE INSTALLED DEAD LEVEL, AND SHALL NOT TOUCH OR REST ON ANY PART OF THE BUILDING STRUCTURE.
2. THE ELECTRICAL CONNECTION TO THE PUMP SHALL BE MADE THROUGH THE USE OF FLEXIBLE CONDUIT (GREENFIELD) AT LEAST 18" LONG.
3. THE PUMP SUPPORTED INDEPENDENTLY OF PIPING AND SHALL BE INSTALLED SUCH THAT THE PUMP CAN BE COMPLETELY REMOVED WITHOUT THE DISMANTLING OR REMOVAL OF ANY PIPING OR VALVES.
4. THE MOTOR & COUPLING SHALL BE CHECKED AND PROPERLY ALIGNED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
5. THE ADJACENT PIPING SHALL BE CAREFULLY FITTED AND ERECTED SO THAT THE PUMP CAN BE INSTALLED OR REMOVED FROM THE PIPE LINE WITHOUT FORCING OR SPRINGING.
6. AFTER THE SYSTEM HAS BEEN COMPLETED AND THE PUMP STARTED THE PUMP AND SYSTEM SHALL BE CHECKED FOR VIBRATION AND EXCESSIVE NOISE AND ANY SUCH NOISE OR VIBRATION SHALL BE IMMEDIATELY CORRECTED.
7. PROVIDE PIPE FLEXIBLE CONNECTION FOR PUMPS WITH MOTORS GREATER THAN 1/2 HORSEPOWER.

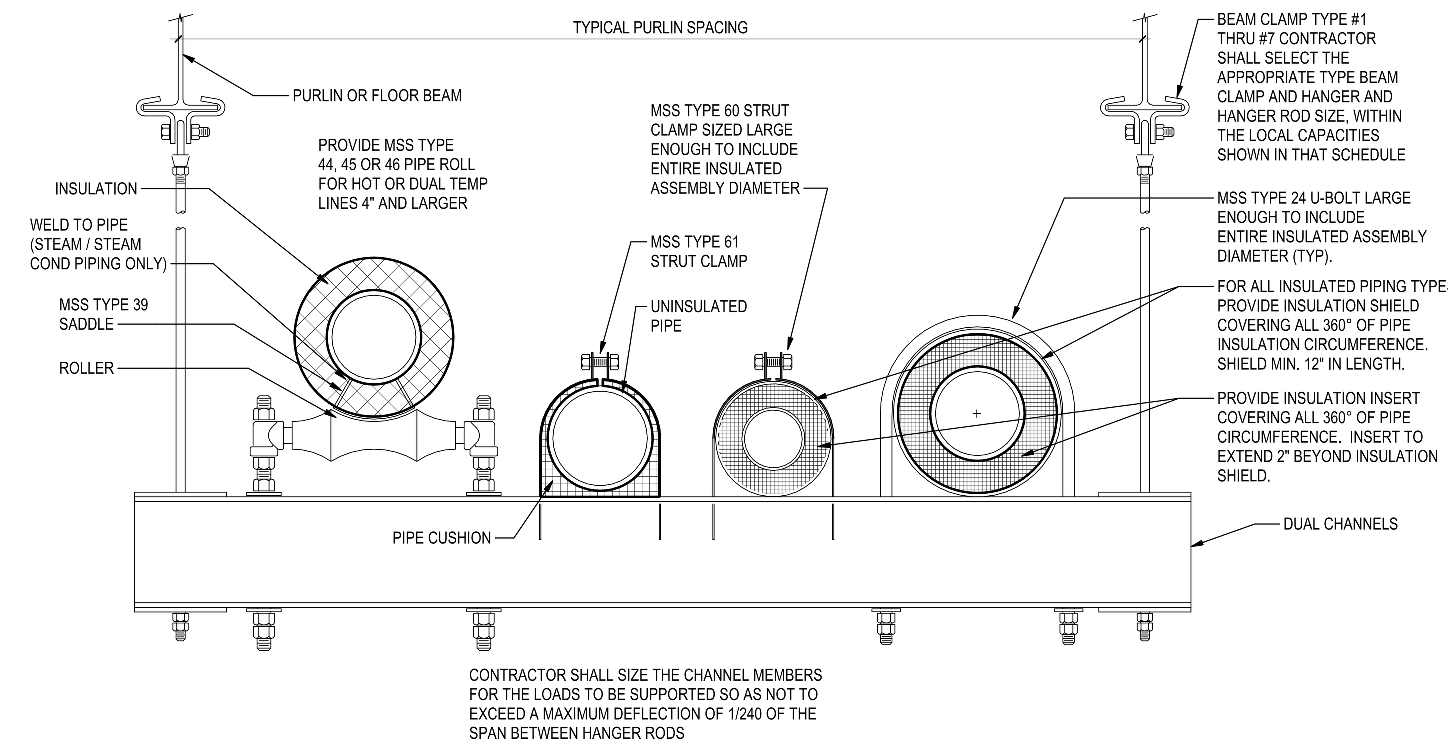
IN-LINE CIRCULATING PUMP PIPING DETAIL

SCALE: NONE



METRA LOOP DETAIL

SCALE: NONE

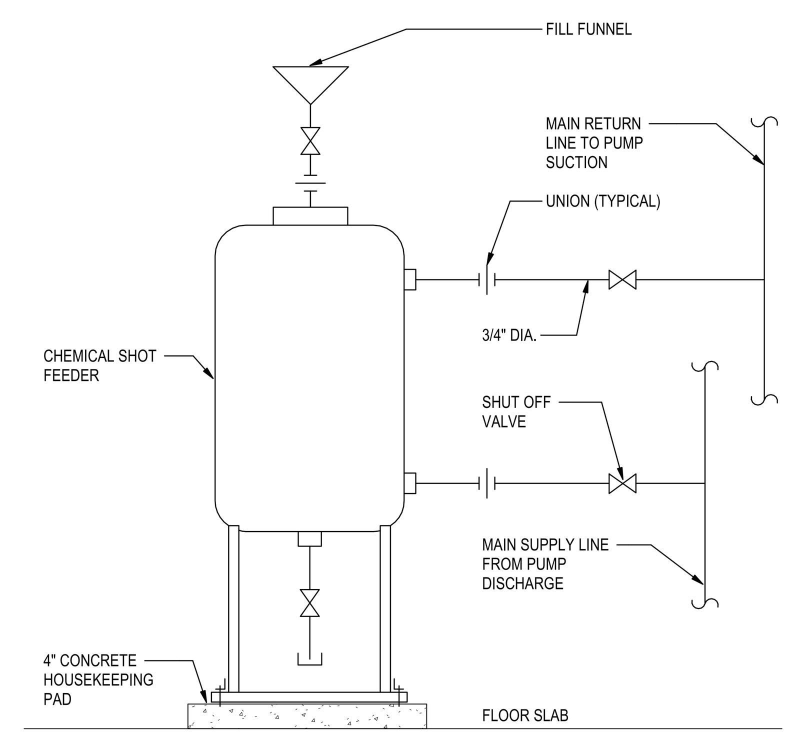


CONTRACTOR SHALL SIZE THE CHANNEL MEMBERS FOR THE LOADS TO BE SUPPORTED SO AS NOT TO EXCEED A MAXIMUM DEFLECTION OF 1/240 OF THE SPAN BETWEEN HANGER RODS

NOTES:
1. FOLLOW THE CONTRACT DOCUMENTS FOR WHERE EACH HANGER TYPE APPLIES.
2. FOLLOW ANY REQUIREMENTS FOR VIBRATION ISOLATION AND SEISMIC AS NOTED IN THE CONTRACT DOCUMENTS.

TRAPEZE SUPPORT DETAIL

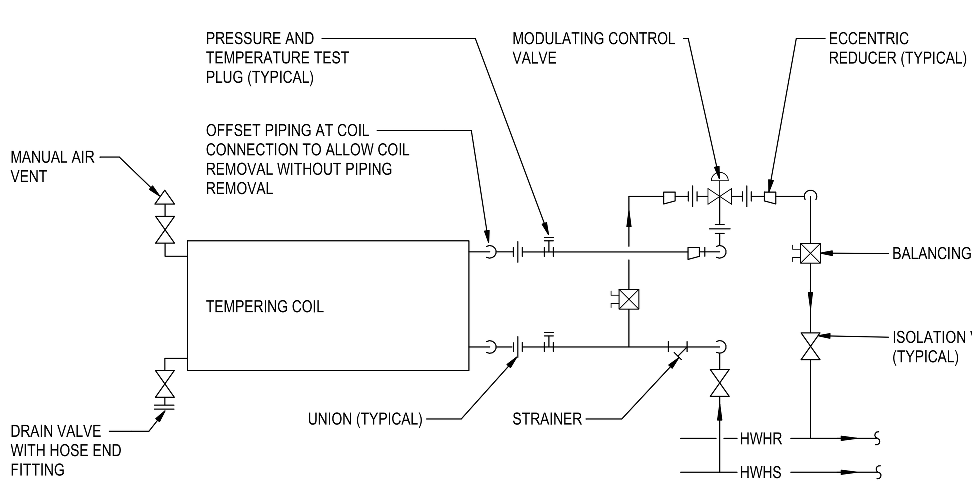
SCALE: NONE



NOTES:
1. MOUNT SHOT FEEDER MAXIMUM 5'-0" ABOVE FINISHED FLOOR.

CHEMICAL SHOT FEEDER PIPING DIAGRAM

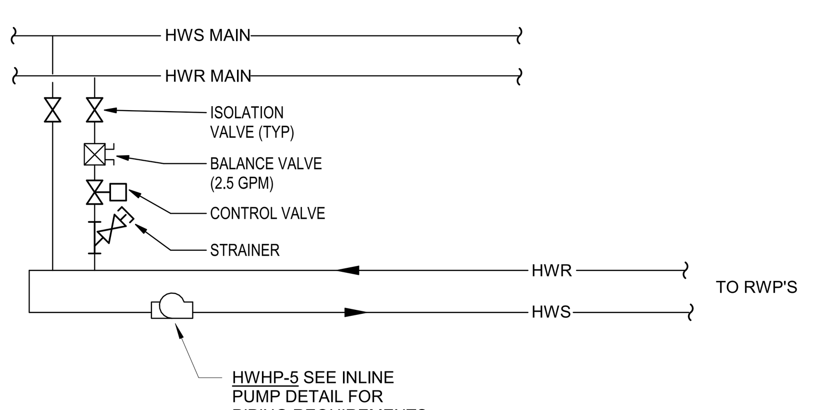
SCALE: NONE



HOT WATER TEMPERING COIL PIPING DIAGRAM WITH THREE-WAY CONTROL VALVE

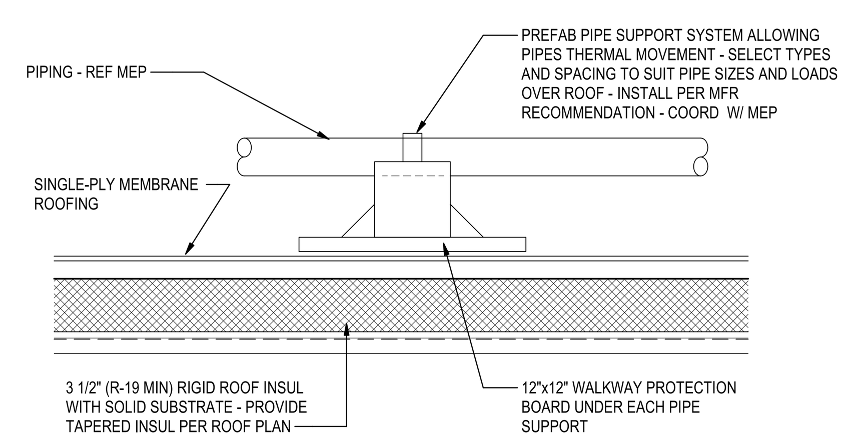
SCALE: NONE

NOTE: FOR USE WITH VAV BOXES, UNIT HEATERS, AND DOOR AIR CURTAIN



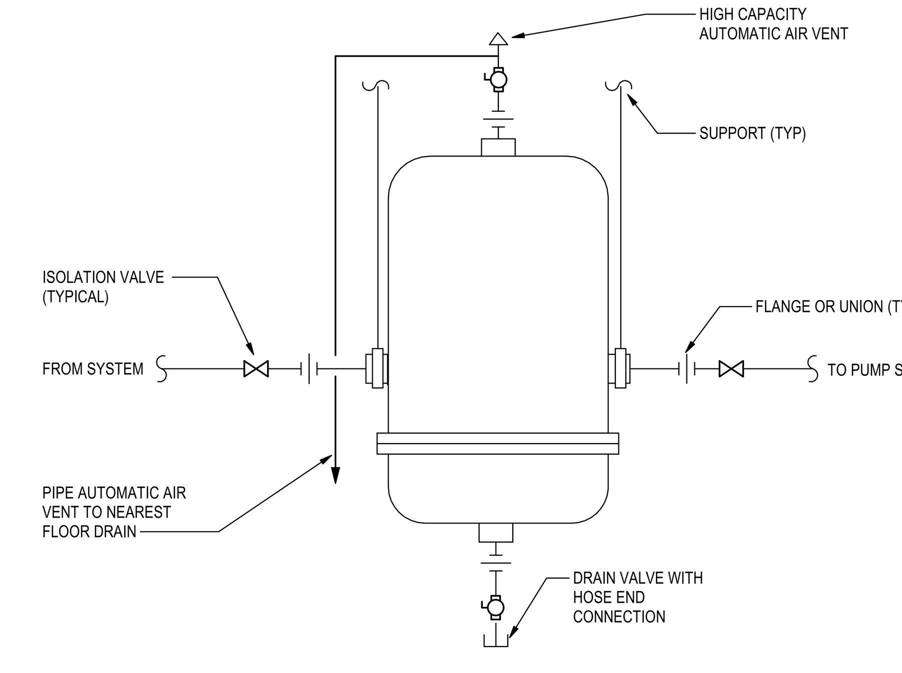
RWP LOOP HEATING HOT WATER PIPING DIAGRAM

SCALE: NONE



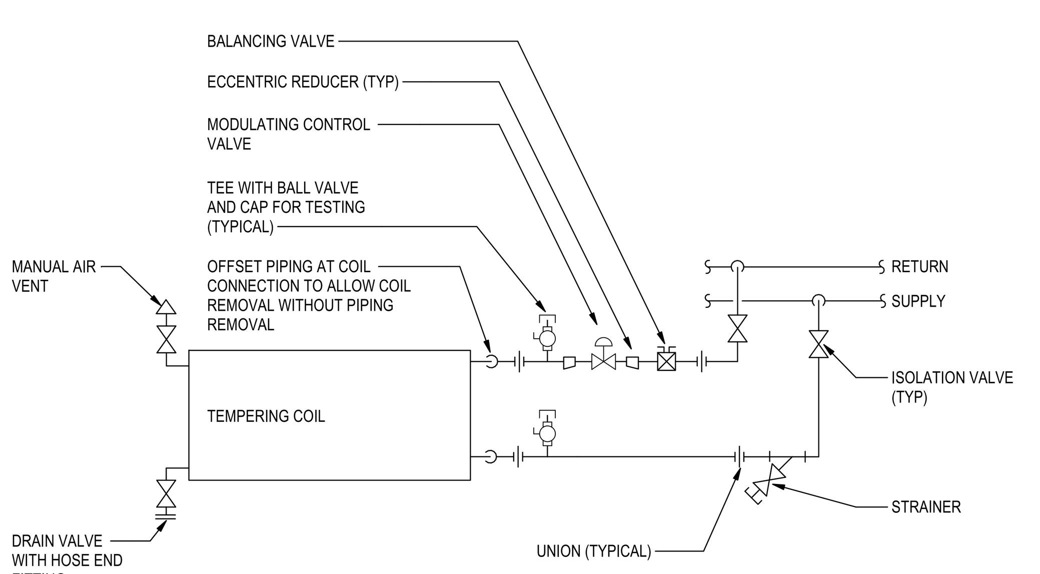
TYPICAL ROOF PIPE SUPPORT DETAIL

SCALE: NONE



AIR AND DIRT SEPARATOR PIPING DIAGRAM

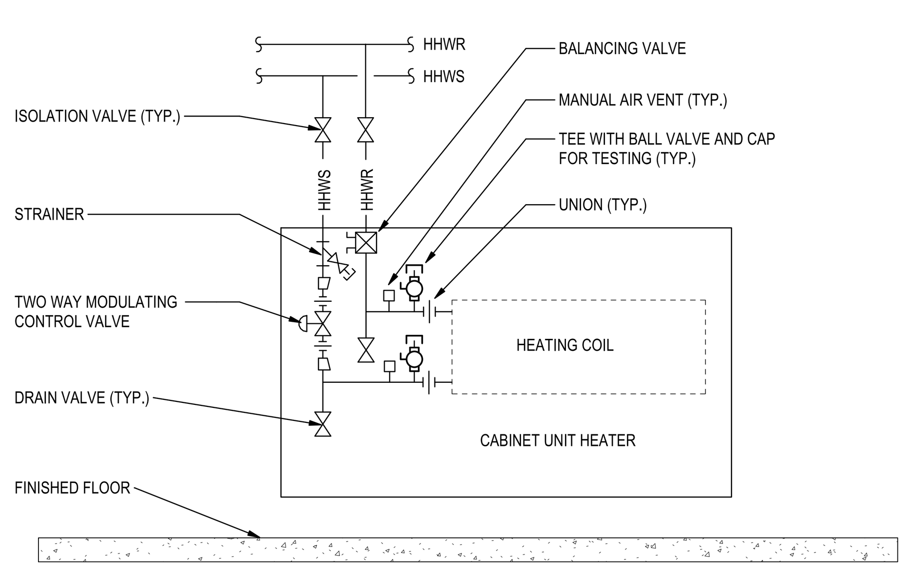
SCALE: NONE



HOT WATER TEMPERING COIL PIPING DIAGRAM WITH TWO-WAY CONTROL VALVE

SCALE: NONE

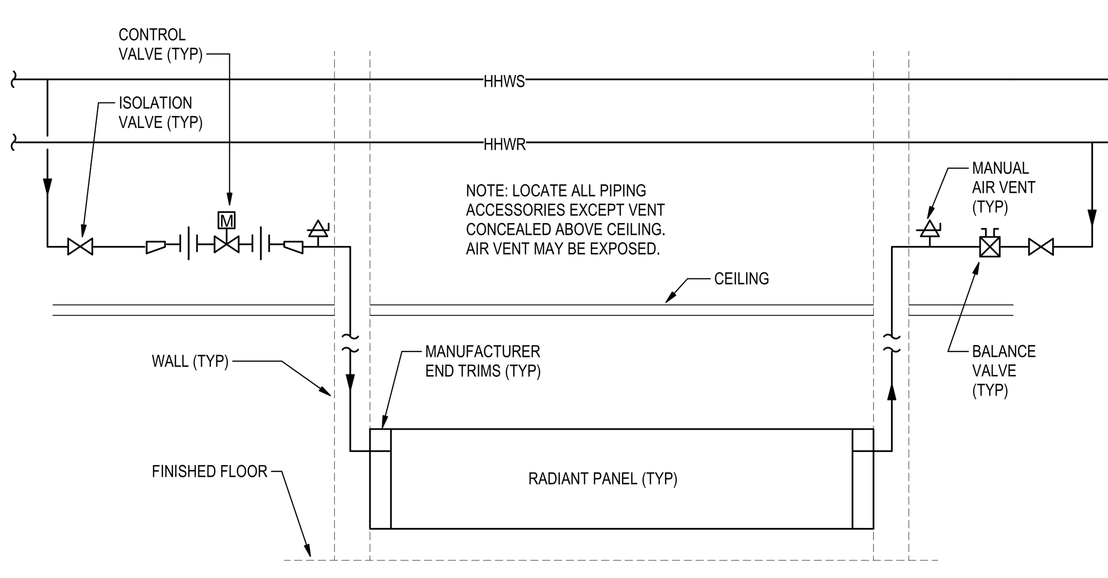
NOTE: FOR USE WITH VAV BOXES AND UNIT HEATERS



NOTE:
1. SIMILAR PIPING ARRANGEMENT FOR HOT WATER CONVECTOR AND UNIT HEATER.

TYPICAL CABINET UNIT HEATER PIPING DIAGRAM WITH TWO-WAY CONTROL VALVE

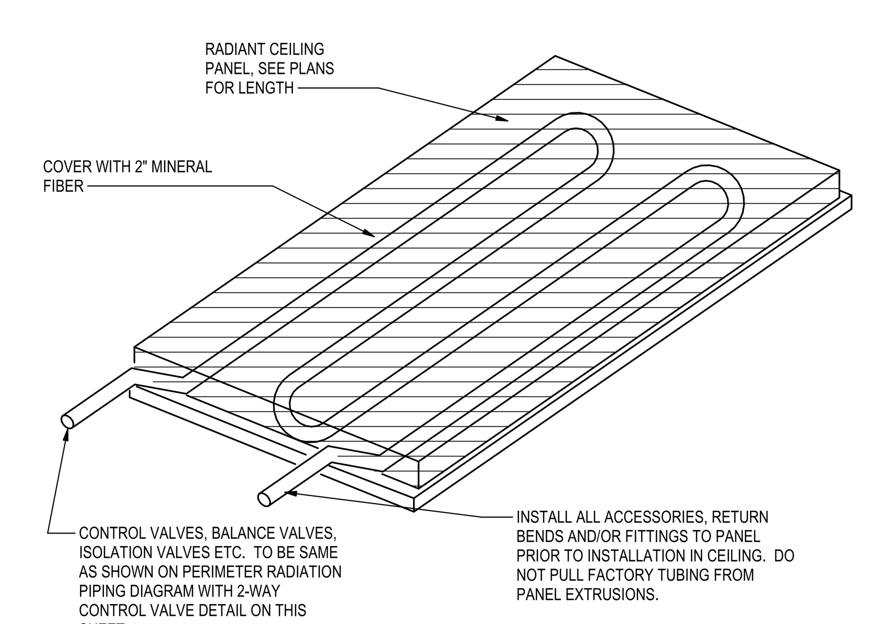
SCALE: NONE



PERIMETER RADIATION PIPING DIAGRAM WITH 2-WAY CONTROL VALVE DETAIL

SCALE: NONE

1. DETAIL SHOWS TYPICAL ARRANGEMENT OF PERIMETER HEAT AND PIPING MAINS AND IS DIAGRAMMATIC. REFER TO FLOOR PLANS FOR ANY PROJECT SPECIFIC PIPING ROUTING OR VALVE LOCATION REQUIREMENTS.



RADIANT CEILING PANEL PIPING DETAIL

NO SCALE

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DESIGNED BY:
CHECKED BY:
APPROVED BY: Approver

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WHITE

ROOF TOP UNIT SCHEDULE - PART A

MARK	NUMBER	TYPE	LOCATION	AREA SERVED	MAX SUPPLY AIR (CFM)	MIN SUPPLY AIR (CFM)	MAX RETURN AIR (CFM)	MIN RETURN AIR (CFM)	MIN-MAX (DESIGN) OUTSIDE AIR (CFM)	MIN-MIN OUTSIDE AIR (CFM)	UNIT OPERATING WEIGHT (LBS)	HEIGHT (IN)	WIDTH (IN)	LENGTH (IN)	FILTER TYPE	MERV RATING	MAX APD (IN-WG)	HEATING AIRFLOW (CFM)	EAT (F)	LAT (F)	INPUT RATING (MBH)	OUTPUT RATING (MBH)	NO OF STAGES	TURN DOWN RATIO	MAX APD (IN-WG)
UNIT IDENTIFICATION					AIRFLOW						PHYSICAL CHARACTERISTICS	MAXIMUM UNIT DIMENSIONS			FILTER			INDIRECT GAS FIRED HEATING SECTION							
RTU	1	VAV-ERU	ROOF - A	NE CLASSROOMS	8,400	5,200	7,700	5,000	2,900	700	4,800	83	77	182	2" PRE 4" FINAL PLEATED	8 / 13	0.29	5,200	31.8	74.3	300.0	240.0	MODULATING	12:1	0.26
RTU	2	VAV-ERU	ROOF - A	CAFETERIA / KITCH	9,600	6,100	7,950	2,100	4,000	1,750	8,500	78	97	317	2" PRE 4" FINAL PLEATED	8 / 13	0.15	6,150	25.0	74.0	400.0	324.0	MODULATING	10:1	0.06
RTU	3	VAV	ROOF - A	NW CLASSROOMS	6,700	4,200	5,700	3,600	2,000	1,000	4,200	83	77	162	2" PRE 4" FINAL PLEATED	8 / 13	0.21	4,200	38.0	90.7	300.0	240.0	MODULATING	12:1	0.21
RTU	4	VAV	ROOF - A	CENTER COMMONS	5,000	2,900	3,850	2,100	1,150	1,150	2,700	57	97	91	2" PRE 4" FINAL PLEATED	8 / 13	0.38	2,900	43.4	94.3	200.0	160.0	MODULATING	10:1	0.06
RTU	5	VAV	ROOF - A	ADMIN AREA	2,300	1,350	1,850	900	350	200	2,300	57	97	91	2" PRE 4" FINAL PLEATED	8 / 13	0.17	1,350	53.3	153.3	200.0	160.0	MODULATING	10:1	0.12
RTU	6	VAV SINGLE ZONE	ROOF - A	GYMNASIUM	11,000	6,100	9,050	5,600	3,000	1,950	8,100	78	97	309	2" PRE 4" FINAL PLEATED	8 / 13	0.18	11,000	52.0	93.0	600.0	480.0	MODULATING	10:1	0.10
RTU	7	VAV	ROOF - B	SE CLASSROOMS	7,500	4,500	6,450	4,000	2,250	1,050	4,200	83	77	162	2" PRE 4" FINAL PLEATED	8 / 13	0.25	4,500	36.0	85.2	300.0	240.0	MODULATING	12:1	0.23
RTU	8	VAV-ERU 100%OA	ROOF - B	ART/SCIENCE LABS	3,700	2,750	3,900	2,950	3,700	2,750	3,000	57	97	111	2" PRE 4" FINAL PLEATED	8 / 13	0.28	2,750	-10.0	74.0	300.0	240.0	MODULATING	10:1	0.21
RTU	9	VAV	ROOF - B	SW CLASSROOMS	7,700	4,750	6,800	4,500	2,300	900	4,200	83	77	162	2" PRE 4" FINAL PLEATED	8 / 13	0.26	4,750	37.0	83.6	300.0	240.0	MODULATING	10:1	0.24

ROOF TOP UNIT SCHEDULE - PART B

MARK	NUMBER	TOTAL CAPACITY (MBH)	SENSIBLE CAPACITY (MBH)	EDB (F)	EWB (F)	LDB (F)	LWB (F)	MAX APD (IN-WG)	CAPACITY (MBH)	MAX APD (IN-WG)	NO. OF COMP.	NO. OF STAGES	TYPE OF COMP.	NO. OF FANS	ESP (IN-WG)	TSP (IN-WG)	BHP	HP	SPEED (RPM)	ESP (IN-WG)	TSP (IN-WG)	BHP	HP	SPEED (RPM)	NOMINAL CAPACITY (TONS)	EER	REFRIG TYPE	REFRIG CHARGE (LBS)	VOLTS	PHASE	MCA	MOP	115V SERVICE REQUIRED	MOUNTING SUPPORT STYLE	MANUFACTURER	MODEL NUMBER	NOTES
UNIT IDENTIFICATION		COMPONENTS: DX COOLING COIL							COMPONENTS: HOT GAS REHEAT		CONDENSER SECTION: COMPRESSORS			CONDENSER SECTION: FANS	FANS: SUPPLY					FANS: EXHAUST					CAPACITY AND PERFORMANCE				ELECTRICAL								
RTU	1	315.7	236.2	76.9	64.0	51.2	51.1	0.46	171.6	0.08	2	MODULATING	INVERTER + FIXED	2	2.3	5.0	10.12	15	1,771	0.5	N/A	3.96	(2) 4	2,950	30.0	10.3	R410A	36	460	3	79.5	100	YES	24" CURB	DAIKIN APPLIED	DPS028A	1,2
RTU	2	347.2	266.7	76.8	63.8	51.4	51.2	0.75	194.1	0.11	4	MODULATING	INVERTER	4	2.0	4.0	9.49	(2) 5.8	2,340	0.5	N/A	3.08	(2) 2.2	1,708	40.0	9.2	R410A	86	460	3	90.8	110	YES	24" CURB	DAIKIN APPLIED	DPSA034	1,2
RTU	3	287.3	203.6	79.3	65.9	51.5	51.4	0.34	134.4	0.06	2	MODULATING	INVERTER + FIXED	2	1.5	3.0	4.88	7.5	1,389	0.5	N/A	2.47	8	2,108	25.0	11.0	R410A	36	460	3	69.4	90	YES	24" CURB	DAIKIN APPLIED	DPS025A	1,2
RTU	4	172.8	134.3	78.3	65.2	53.7	53.7	0.41	88.2	0.10	2	MODULATING	INVERTER + FIXED	2	1.5	3.2	3.83	8	2,195	0.5	N/A	1.16	8	1,611	15.0	10.8	R410A	30	460	3	39.8	50	YES	24" CURB	DAIKIN APPLIED	DPS015A	1,2
RTU	5	86.7	64.9	77.2	64.3	51.4	51.4	0.10	-	-	2	MODULATING	INVERTER + FIXED	2	1.5	2.5	1.38	4	2,371	0.5	N/A	0.43	4	1,705	7.0	12.1	R410A	18	460	3	21.6	25	YES	24" CURB	DAIKIN APPLIED	DPS007A	1,2
RTU	6	444.0	323.3	78.9	65.6	52.0	52.0	0.56	214.5	0.08	4	MODULATING	INVERTER	4	1.5	3.0	8.90	(2) 5.8	1,754	0.5	N/A	3.36	(2) 2.2	1,815	40.0	9.7	R410A	105	460	3	95.3	110	YES	24" CURB	DAIKIN APPLIED	DPSA040	1,2
RTU	7	293.2	215.8	79.3	65.9	53.0	52.9	0.39	138.5	0.07	2	MODULATING	INVERTER + FIXED	2	1.5	3.2	5.77	7.5	1,472	0.5	N/A	3.36	8	2,346	25.0	11.0	R410A	36	460	3	69.4	90	YES	24" CURB	DAIKIN APPLIED	DPS025A	1,2
RTU	8	172.5	113.3	81.3	68.3	53.3	53.3	0.27	66.9	0.06	2	MODULATING	INVERTER + FIXED	2	1.5	3.9	3.65	8	2,128	0.5	N/A	1.14	8	1,477	13.0	10.8	R410A	30	460	3	39.8	50	YES	24" CURB	DAIKIN APPLIED	DPS015A	1,2
RTU	9	294.6	218.9	79.3	65.9	53.3	53.2	0.41	139.4	0.07	2	MODULATING	INVERTER + FIXED	2	1.5	3.3	6.02	7.5	1,493	0.5	N/A	3.61	8	2,406	25.0	11.0	R410A	36	460	3	69.4	90	YES	24" CURB	DAIKIN APPLIED	DPS025A	1,2

NOTES:
1. FILTERS ARE TO BE PROVIDED WITH PRE-FILTER. MAXIMUM PRESSURE DROP SHALL BE BASED ON TOTAL PRESSURE DROP ACROSS THE FILTER BANK WITH DIRTY FILTERS (PRESSURE DROP LISTED PLUS 0.50" ADDITIONAL DIRTY FILTER ALLOWANCE).
2. REFER TO MECHANICAL DETAILS FOR CURB FILLING MATERIAL REQUIREMENTS.

AIR TO AIR HEAT EXCHANGER SCHEDULE

MARK	NUMBER	UNIT SERVED	TYPE	TOTAL CAPACITY (MBH)	MIN TOTAL EFFECTIVE (%)	TOTAL AIRFLOW (CFM)	EDB (F)	EWB (F)	LDB (F)	LWB (F)	MAX APD (IN-WG)	EXHAUST TOTAL AIRFLOW (CFM)	LDB (F)	LWB (F)	TOTAL CAPACITY (MBH)	MIN EFFECTIVE (%)	TOTAL AIRFLOW (CFM)	EDB (F)	EWB (F)	LDB (F)	LWB (F)	MAX APD (IN-WG)	EXHAUST TOTAL AIRFLOW (CFM)	LDB (F)	LWB (F)	FROST CONTROL	PURGE	ECONO BYPASS	RECIRC DAMPER	MANUFACTURER	MODEL NUMBER	NOTES
UNIT IDENTIFICATION				WINTER OPERATION: CAPACITY		WINTER OPERATION: SUPPLY							WINTER: MIXED AIR		SUMMER OPERATION: CAPACITY		SUMMER OPERATION: SUPPLY							SUMMER: MIXED AIR		CONTROLS						
HX	1	RTU-1	SENSIBLE WHEEL	167.9	63.2	2,900	-1.0	-2.0	46.7	35.3	0.54	2,900	63.3	45.3	57.2	52.0	2,900	89.3	72.9	80.5	67.7	0.54	2,900	76.9	64.0	YES	NO	NO	YES	DAIKIN	-	
HX	2	RTU-2	SENSIBLE WHEEL	258.3	72.3	4,000	-1.0	-2.0	51.6	38.8	0.27	4,000	63.5	45.6	100.4	66.6	4,000	89.3	72.9	79.2	66.1	0.27	4,000	76.8	63.8	YES	NO	YES	YES	DAIKIN	-	
HX	8	RTU-8	SENSIBLE WHEEL	198.9	58.4	3,700	-1.0	-2.0	43.4	33.1	0.71	3,700	43.4	33.1	64.9	46.3	3,700	89.3	72.9	81.3	68.3	0.71	3,700	81.3	68.3	YES	NO	NO	NO	DAIKIN	-	

NOTES:

DUCT SILENCER SCHEDULE

MARK	NUMBER	UNIT/AREA SERVED	AIRFLOW (CFM)	DEVICE APD (IN-WG)	MAX APD W/ SYSTEM EFFECT...	VELOCITY (FPM)	TYPE	GEOMETRY	CASING GAUGE	FILL	FILM	DUCT HEIGHT (IN)	DUCT WIDTH (IN)	DUCT LENGTH (IN)	CASING HEIGHT (IN)	CASING WIDTH (IN)	CASING LENGTH (IN)	INLET LEG LENGTH (IN)	OUTLET LEG LENGTH (IN)	63	125	250	500	1K	2K	4K	8K	OPERATING WEIGHT (LBS.)	MANUFACTURER	MODEL NUMBER	NOTES
UNIT IDENTIFICATION			AIRFLOW INFORMATION				PHYSICAL PROPERTIES													DYNAMIC INSERTION LOSSES DB											
DS	1	RTU-1	8,400	0.21	0.27	1,400	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	24	36	84	24	36	84	36	72	9	14	22	33	37	34	29	24	260	PRICE	ERM84/6C	1
DS	2	RTU-2	9,600	0.18	0.19	1,350	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	32	32	82	32	32	82	62	52	8	13	23	35	40	40	34	27	310	PRICE	ERM82/2B	2
DS	3	RTU-3	6,700	0.15	0.20	1,340	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	20	36	80	20	36	80	42	58	8	13	21	32	37	35	30	25	230	PRICE	ERM80/4B	1
DS	4	RTU-4	5,000	0.17	0.22	1,385	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	20	26	96	20	26	96	36	80	10	14	24	39	42	40	34	27	220	PRICE	ERM96/4B	1
DS	5	RTU-5	2,300	0.16	0.21	1,314	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	14	18	72	14	18	72	36	52	7	11	20	29	35	35	30	25	110	PRICE	ERN66/2B	1
DS	6	RTU-6	11,000	0.17	0.17	1,375	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	24	52	96	24	52	96	72	48	9	12	24	40	46	48	39	30	430	PRICE	ERM96/1A	2
DS	7	RTU-7	7,500	0.21	0.27	1,406	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	24	32	66	24	32	66	36	54	7	11	21	31	38	39	33	27	220	PRICE	ERM66/1B	1
DS	8A	RTU-8	1,850	0.25	0.25	1,211	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	22	10	96	22	10	96	42	76	11	17	28	41	46	42	36	29	90	PRICE	ERM96/5D	1
DS	8B	RTU-8	1,850	0.25	0.25	1,211	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	22	10	96	22	10	96	76	42	11	17	28	41	46	42	36	29	90	PRICE	ERM96/5D	1
DS	9	RTU-9	7,700	0.15	0.19	1,444	ABS / DISS	ELBOW	18	FIBERGLASS	NONE	24	32	84	24	32	84	36	72	9	13	20	32	35	32	27	23	190	PRICE	ERM84/6B	1

NOTES:
1. DUCT SILENCERS TO BE EXTERNALLY INSULATED AS INDICATED FOR SUPPLY DUCTWORK ON DUCT SYSTEM APPLICATION SCHEDULE.
2. DUCT SILENCERS TO BE EXTERNALLY INSULATED AND JACKETED AS INDICATED FOR OUTDOOR DUCTWORK IN DETAIL ON M501.

VARIABLE FREQUENCY DRIVE SCHEDULE

MARK	NUMBER	LOCATION	UNIT SERVED	MOTOR HP	MAX RATED HP	OPERATION	OPERATING WEIGHT (LBS.)	NOTES
UNIT IDENTIFICATION								
VFD	HHWP-1	MECHANICAL - 306	HHWP-1	1.5				1,2
VFD	HHWP-2	MECHANICAL - 306	HHWP-2	1.5				1,2
VFD	HHWP-3	MECHANICAL - 306	HHWP-3	5				1
VFD	HHWP-4	MECHANICAL - 306	HHWP-4	5				1
VFD	RTU-1S	ROOF (IN RTU-1)	RTU-1	15				1
VFD	RTU-1E	ROOF (IN RTU-1)	RTU-1	(2) 4.0				1
VFD	RTU-2S	ROOF (IN RTU-2)	RTU-2	(2) 5.8				1
VFD	RTU-2E	ROOF (IN RTU-2)	RTU-2	(2) 2.2				1
VFD	RTU-3S	ROOF (IN RTU-3)	RTU-3	7.5	7.5			1
VFD	RTU-3E	ROOF (IN RTU-3)	RTU-3	8				1
VFD	RTU-4S	ROOF (IN RTU-4)	RTU-4	8				1
VFD	RTU-4E	ROOF (IN RTU-4)	RTU-4	8				1
VFD	RTU-5S	ROOF (IN RTU-5)	RTU-5	4				1
VFD	RTU-5E	ROOF (IN RTU-5)	RTU-5	4				1
VFD	RTU-6S	ROOF (IN RTU-6)	RTU-6	(2) 5.8				1
VFD	RTU-6E	ROOF (IN RTU-6)	RTU-6	(2) 2.2				1
VFD	RTU-7S	ROOF (IN RTU-7)	RTU-7	7.5	7.5			1
VFD	RTU-7E	ROOF (IN RTU-7)	RTU-7	8				1
VFD	RTU-8S	ROOF (IN RTU-8)	RTU-8	8				1
VFD	RTU-8E	ROOF (IN RTU-8)	RTU-8	8				1
VFD	RTU-9S	ROOF (IN RTU-9)	RTU-9	7.5	7.5			1
VFD	RTU-9E	ROOF (IN RTU-9)	RTU-9	8				1

NOTES:
1. PROVIDE VFD AND SHAFT GROUNDING RING FOR LOAD INDICATED.
2. VFD FOR CONSTANT OPERATION LOADS USED FOR BALANCING, SOFT START, AND RUNTIME/CONSUMPTION DATA.

DUCT SYSTEM APPLICATION SCHEDULE

SYSTEM	APPLICATION	LOCATION	MAX VELOCITY (FPM)	MAX FRICTION (IN-WG/100')	DESIGN SYSTEM PRESSURE (IN-WG)	SEAL CLASS	MAX LEAKAGE RATE	SINGLE WALL	DOUBLE WALL UL LISTED	DOUBLE WALL PERF LINER	G90 GALV SHEET STEEL	G90 PVC COATED GALV SHEET STEEL	16 GA CARBON STEEL	ALUMINUM	304 STAINLESS STEEL	316 STAINLESS STEEL	FABRIC	FIBERGLASS	FLEXIBLE ELASTOMERIC	NATURAL FIBER	THICKNESS (IN)	DENSITY (LB/FT³)	FIBERGLASS BLANKET	FIBERGLASS BOARD	FLEXIBLE ELASTOMERIC	FIRE RATED WRAP	INTERSTITIAL CERAMIC	THICKNESS (IN)	DENSITY (LB/FT³)	ASJ	ASJ-SS	FSK	VINYL	FABRIC	PVC	ALUMINUM	STAINLESS STEEL	SELF ADHESIVE	NOTES
			DESIGN CRITERIA		CONSTRUCTION			PRODUCT			MATERIAL							LINER					INSULATION							FACTORY JACKET				FIELD JACKET					NOTES
SUPPLY AIR	LOW PRESSURE SINGLE ZONE	CONCEALED	1,200	0.08	2	B	6	X		*	X												X					1.5	1			X							2
		EXPOSED	1,200	0.08	2	B	6	X		*	X													X				1	2.25			X							2
		OUTSIDE / EXTERIOR	1,200	0.08	2	A	6	X			X													X				1	2.25			X				X			
	LOW PRESSURE (DOWNSTREAM OF ATU)	CONCEALED	1,000	0.08	2	C	6	X			X												X					1.5	1			X							
		EXPOSED	1,000	0.08	2	C	6	X			X													X				1	2.25			X							
	MEDIUM PRESSURE (UPSTREAM OF ATU)	CONCEALED	1,500	0.20	6	B	6	X		*	X												X					1.5	1			X							2
		EXPOSED	1,500	0.20	6	B	6	X		*	X													X				1	2.25			X							2
		OUTSIDE / EXTERIOR	1,500	0.20	6	A	6	X			X													X				1	2.25			X				X			
RETURN AIR	ALL	CONCEALED	1,000	0.10	2	C	6	X		*	X												X					1.5	1			X							3
		EXPOSED	1,000	0.10	2	C	6	X		*	X													X				1	2.25			X							3
GENERAL EXHAUST	ALL	CONCEALED	1,000	0.10	2	B	6	X			X												X					1.5	1			X							
		EXPOSED	1,000	0.10	2	B	6	X			X													X				1	2.25			X							
KITCHEN EXHAUST	LOW PRESSURE (CONSTANT VOLUME)	KITCHEN HOOD	1,200	0.10	6	B	6	X					X													X		2	4			X							1
		KITCHEN HOOD	1,200	0.10	6	B	6		X						X												X												1
		DISHWASHER HOOD	1,200	0.10	2	B	6	X						X																									
OUTSIDE AIR	ALL	ALL	1,500	0.10	2	A	6	X			X													X				1	2.25	X									

NOTES:
1. VERIFY MANUFACTURER CLEARANCE TO COMBUSTIBLES
2. SEE PLANS AND DETAILS FOR LOCATION / EXTENT OF DUCTWORK WITH DOUBLE WALL PERFORATED LINER.
3. SEE PLANS AND DETAILS FOR LOCATION / EXTENT OF LINED DUCTWORK.

GRILLE, REGISTER, DIFFUSER SCHEDULE

MARK	NUMBER	DIFFUSER FACE SIZE (IN)	FLOW RANGE (CFM)	DIFFUSER NECK SIZE (IN)	FLOW PATTERN	BORDER TYPE	MOUNTING TYPE	COLOR	MATERIAL	ACCESSORY	MANUFACTURER	MODEL NUMBER	NOTES
UNIT IDENTIFICATION													
S	1	24x24	SEE PLANS	SEE PLANS	4-WAY	31	LAY-IN	WHITE	STEEL		PRICE	SPD	1,2
S	2	SEE PLANS	SEE PLANS	SEE PLANS	22.5 DBL DEFL	N	DUCT MOUNT	WHITE	STEEL		PRICE	520L	
S	3	SEE PLANS	SEE PLANS	SEE PLANS	VERTICAL	-	DUCT END	WHITE	STEEL	SAFETY CABLE	PRICE	RPD	1
S	4	SEE PLANS	SEE PLANS	22x10	ADJ BLADE	-	SPIRAL DUCT FRAME	WHITE	STEEL	VCS5, POB	PRICE	HCD	
S	5	SEE PLANS	SEE PLANS	18x6	STRAIGHT	-	SPIRAL DUCT FRAME	WHITE	STEEL	VCS5, POB	PRICE	HCD	
R	1	SEE PLANS	SEE PLANS	SEE PLANS	-	F	SURFACE MOUNT	WHITE	STEEL		PRICE	530	
R	2	24x12	SEE PLANS	22x10	-	NF	LAY-IN	WHITE	STEEL		PRICE	80	1
R	3	24x24	SEE PLANS	SEE PLANS	-	NF	LAY-IN	WHITE	STEEL		PRICE	80	1
R	4	SEE PLANS	SEE PLANS	SEE PLANS	-	F	SURFACE MOUNT	WHITE	STEEL		PRICE	93L	
R	5	12x12	SEE PLANS	SEE PLANS	-		SURFACE MOUNT	WHITE	STEEL		PRICE	80	1
E	1	SEE PLANS	SEE PLANS	SEE PLANS	-	F	SURFACE MOUNT	WHITE	STEEL	OBD	PRICE	530	1
E	2	24x24	SEE PLANS	SEE PLANS	-		LAY-IN	WHITE	STEEL		PRICE	PDDR	1
E	3	24x24	SEE PLANS	SEE PLANS	-		LAY-IN	WHITE	ALUMINUM		PRICE	APDDR	1

NOTES:
1. REFER TO REFLECTED CEILING PLANS EXACT LOCATION. PROVIDE ALL FRAMES AND ACCESSORIES AS REQUIRED FOR PROPER INSTALLATION.
2. FLEXIBLE DUCTWORK SHALL BE THE SAME SIZE AS THE DIFFUSER NECK OR AN EQUIVALENT ROUND DUCT. FLEXIBLE DUCTWORK SHALL BE SUPPORTED TO PREVENT KINKS OR BENDS.

POWER VENTILATOR SCHEDULE

MARK	NUMBER	AREA SERVED	AIRFLOW (CFM)	ESP (IN-WG)	CONTROL	TYPE	SPEED (RPM)	MIN WHEEL DIA (IN)	BHP	HP	SPEED (RPM)	DRIVE TYPE	CURB HEIGHT (IN)	DAMPER TYPE	VOLTS	PHASE	FLA	OPERATING WEIGHT (LBS.)	MANUFACTURER	MODEL NUMBER	NOTES
UNIT IDENTIFICATION						FAN WHEEL			FAN MOTOR						ELECTRICAL						
EF	1	312 - KITCHEN (COOK HOOD)	2,200	1.20	TEMP	UPBLAST	1,192	18.5	0.80	1	1,725	BELT	24	NONE	460	3	2.1	160	GREENHECK	CUBE-180HP-10	1,2,3
EF	2	312 - KITCHEN (DISH HOOD)	600	0.75	SWITCH	UPBLAST	1,466	11.188	0.14	1/4	1,725	DIRECT	24	BACKDRAFT	120	1	2.9	80	GREENHECK	CUE-099-VG	1,3
EF	3	312 - KITCHEN (GENERAL)	800	0.50	BMS	CENTRIFUGAL	1,418	11.125	0.16	1/4	1,725	DIRECT	24	MOTORIZED	120	1	2.9	80	GREENHECK	G-100-VG	1,3
EF	4	308 - ELECTRICAL	1,000	0.50	TEMP	CENTRIFUGAL	1,488	11.125	0.18	1/4	1,725	DIRECT	20	MOTORIZED	120	1	2.9	80	GREENHECK	G-100-VG	1
EF	5	105,106,111,322,323,324 - HEALTH/TOILETS/JC	1,025	0.75	BMS	CENTRIFUGAL	1,560	11.125	0.21	1/4	1,725	DIRECT	24	BACKDRAFT	120	1	2.9	60	GREENHECK	G-100-VG	1
EF	6	221,313,314,315,316,318A - TOILETS/JC	700	0.50	BMS	CENTRIFUGAL	1,634	10.875	0.14	1/6	1,725	DIRECT	24	BACKDRAFT	120	1	2.2	70	GREENHECK	G-095-VG	1
EF	7	211,212,213,216,217 - TOILETS/SHOWERS/JC	700	0.50	BMS	CENTRIFUGAL	1,634	10.875	0.14	1/6	1,725	DIRECT	24	BACKDRAFT	120	1	2.2	70	GREENHECK	G-095-VG	1
TF	1	320 - IT	100	0.38	TEMP	INLINE	1,618	8.125	0.03	1/15	1,725	DIRECT	-	NONE	120	1	1.3	50	GREENHECK	SQ-70-VG	1
TF	2	321 - ELECTRICAL	100	0.38	TEMP	INLINE	1,618	8.125	0.03	1/15	1,725	DIRECT	-	NONE	120	1	1.3	50	GREENHECK	SQ-70-VG	1
TF	3	115 - MDF	100	0.38	TEMP	INLINE	1,618	8.125	0.03	1/15	1,725	DIRECT	-	NONE	120	1	1.3	50	GREENHECK	SQ-70-VG	1
VF	1	306 - MECHANICAL	1,200	0.50	TEMP	INLINE	1,398	13.125	0.25	1/2	1,725	DIRECT	-	MOTORIZED	120	1	6.4	80	GREENHECK	SQ-120-VG	1
VF	2	307 - RECEIVING	1,000	0.50	TEMP	INLINE	1,520	11.187	0.17	1/4	1,725	DIRECT	-	MOTORIZED	120	1	2.9	80	GREENHECK	SQ-120-VG	1

NOTES:
1. PROVIDE WITH INTEGRAL DISCONNECT
2. PROVIDE WITH VENTED CURB. MINIMUM CURB HEIGHT LISTED. PROVIDE TALLER CURB AS REQUIRED TO MEET REQUIRED 40" ABOVE FINISHED ROOF SURFACE FOR COOKING APPLICATION.
3. PROVIDE VFD FOR BMS AND/OR FSE SYSTEM CONTROL.

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Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

MECHANICAL SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023

SHEET
M-601

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
BLACK
WHITE
WE RECYCLE

HOT WATER CABINET UNIT HEATER SCHEDULE

UNIT IDENTIFICATION				FAN			AIR			FLUID					CABINET				FILTER		ELECTRICAL								
MARK	NUMBER	ROOM SERVED	CAPACITY (MBH)	SPEED (RPM)	NO OF FANS	HP	AIRFLOW (CFM)	EDB (F)	LDB (F)	FLUID TYPE	FLOW (GPM)	EWT (F)	LWT (F)	MAX WPD (FT)	LENGTH (IN)	HEIGHT (IN)	DEPTH (IN)	RECESS DEPTH (IN)	TYPE	AREA (SQ-FT)	VOLTS	PHASE	FLA	CONTROL VALVE TYPE	CONTROL VALVE MAX PD (FT)	OPERATING WEIGHT (LBS)	MANUFACTURER	MODEL NUMBER	NOTES
CUH	1	100 - VESTIBULE	31.3	1,050	2	1/30, 1/15	810	60.0	95.6	WATER	3.1	140.0	120.0	0.30	68	24	10	8	1" MERV 4	3.5	120	1	1.73	3-WAY	2.3	200.0	RITTLING	RRWI-330-08	1,2,3,4
CUH	2	101 - CORRIDOR	17.5	1,050	2	1/25	420	60.0	98.4	WATER	1.8	140.0	120.0	0.50	50	24	10	9	1" MERV 4	2.3	120	1	0.68	2-WAY	2.3	150.0	RITTLING	RRC-440-04	1,2
CUH	3	201 - CORRIDOR	17.5	1,050	2	1/25	420	60.0	98.4	WATER	1.8	140.0	120.0	0.50	50	24	10	9	1" MERV 4	2.3	120	1	0.68	2-WAY	2.3	150.0	RITTLING	RRC-440-04	1,2
CUH	4	301 - CORRIDOR	17.5	1,050	2	1/25	420	60.0	98.4	WATER	1.8	140.0	120.0	0.50	50	24	10	9	1" MERV 4	2.3	120	1	0.68	2-WAY	2.3	150.0	RITTLING	RRC-440-04	1,2
CUH	5	312 - KITCHEN	17.5	1,050	2	1/25	420	60.0	98.4	WATER	1.8	140.0	120.0	0.50	50	24	10	9	1" MERV 4	2.3	120	1	0.68	2-WAY	2.3	150.0	RITTLING	RRC-440-04	1,2
CUH	6	408 - VESTIBULE	17.5	1,050	2	1/25	420	60.0	98.4	WATER	1.8	140.0	120.0	0.50	50	24	10	9	1" MERV 4	2.3	120	1	0.68	3-WAY	2.3	150.0	RITTLING	RRC-440-04	1,2,3

NOTES:
1. PROVIDE WITH INTEGRAL STARTER WITH OVERLOAD PROTECTION AND SERVICE DISCONNECT SWITCH
2. PROVIDE WITH DDC THERMOSTAT. REFER TO TEMPERATURE CONTROLS FOR ADDITIONAL REQUIREMENTS.
3. PROVIDE MANUFACTURERS WALL OR CEILING TRIM KIT.
4. MOUNT AT 0'-8" AFF

UNIT HEATER SCHEDULE

UNIT IDENTIFICATION					FAN		AIR			HOT WATER					ELECTRICAL									
MARK	NUMBER	ROOM SERVED	TYPE	CAPACITY (MBH)	SPEED (RPM)	HP	AIRFLOW (CFM)	EDB (F)	LDB (F)	FLUID TYPE	FLOW (GPM)	EWT (F)	LWT (F)	MAX WPD (FT)	KW	AMPS	VOLTS	PHASE	CONTROL VALVE TYPE	CONTROL VALVE MAX PD (FT)	OPERATING WEIGHT (LBS.)	MANUFACTURER	MODEL NUMBER	NOTES
UH	1	306 - MECHANICAL	HORIZ	46.3	1,075	1/8	1,550	60.0	87.5	WATER	4.7	140.0	120.0	0.5	-	-	120	1	2-WAY	2.3	125.0	RITTLING	RH-108	1,2
UH	2	306 - MECHANICAL	HORIZ	46.3	1,075	1/8	1,550	60.0	87.5	WATER	4.7	140.0	120.0	0.5	-	-	120	1	2-WAY	2.3	125.0	RITTLING	RH-108	1,2
UH	3	309 - ATS	HORIZ	10.2	N/A	N/A	350	60.0	90.0	-	-	-	-	-	3.0	3.6	480	3	-	-	30.0	Q-MARK	MUH0341	1,2
UH	4	308 - ELECTRICAL	HORIZ	46.3	1,075	1/8	1,550	60.0	87.5	WATER	4.7	140.0	120.0	0.5	-	-	120	1	3-WAY	2.3	125.0	RITTLING	RH-108	1,2
UH	5	307 - RECEIVING	HORIZ	46.3	1,075	1/8	1,550	60.0	87.5	WATER	4.7	140.0	120.0	0.5	-	-	120	1	2-WAY	2.3	125.0	RITTLING	RH-108	1,2

NOTES:
1. PROVIDE WITH INTEGRAL STARTER WITH OVERLOAD PROTECTION AND SERVICE DISCONNECT SWITCH
2. PROVIDE WITH DDC THERMOSTAT. REFER TO TEMPERATURE CONTROLS FOR ADDITIONAL REQUIREMENTS.

AIR TERMINAL UNIT APPLICATION SCHEDULE

UNIT IDENTIFICATION				BOX CHARACTERISTICS			AIRFLOW				HEATING COIL									CONTROL OPTIONS					
MARK	NUMBER	SYSTEM	ROOM(S) SERVED	BOX INLET (IN)	TOTAL BOX APD (IN-WG)	INTEGRAL SOUND ATTEN	MAX COOLING (CFM)	MAX HEATING (CFM)	MIN (CFM)	STANDBY MIN (CFM)	CAPACITY (MBH)	EDB (F)	LDB (F)	MAX APD (IN-WG)	FLUID TYPE	FLOW (GPM)	EWT (F)	LWT (F)	MAX WPD (FT)	OCCUPANCY SENSOR	DEMAND CONTROL VENTILATION	PUSH BUTTON OVERRIDE	CONTROL VALVE TYPE	CONTROL VALVE MAX PD (FT)	NOTES
ATU	1-402	RTU-1	402 - CLASSROOM	14	0.28	NO	1,450	900	900	725	31.3	55.0	87.0	0.27	WATER	1.72	140.0	103.1	0.43	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	1-403	RTU-1	403 - CLASSROOM	14	0.28	NO	1,450	900	900	725	31.3	55.0	87.0	0.27	WATER	1.72	140.0	103.1	0.43	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	1-404	RTU-1	404 - CLASSROOM	14	0.28	NO	1,450	900	900	725	31.3	55.0	87.0	0.27	WATER	1.72	140.0	103.1	0.43	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	1-405	RTU-1	405 - CLASSROOM	14	0.25	NO	1,375	875	875	680	30.4	55.0	87.0	0.24	WATER	1.65	140.0	102.6	0.40	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	1-406	RTU-1	406 - RESOURCE ROOM	12	0.24	NO	925	560	560	465	19.5	55.0	87.0	0.23	WATER	1.07	140.0	102.9	0.41	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	1-407	RTU-1	407/312A - MUSIC STUDIO / KIT OFC	16	0.26	NO	1,750	1,065	1,065	880	37.0	55.0	87.0	0.25	WATER	1.99	140.0	102.2	0.59	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	2-310A	RTU-2	310 - PLATFORM/STORAGE	14	0.27	NO	1,425	860	860	-	29.9	55.0	87.0	0.11	WATER	1.61	140.0	102.3	0.38	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	2-310B	RTU-2	310 - CAFETERIA EAST	14	0.32	NO	1,575	950	950	-	33.0	55.0	87.0	0.13	WATER	1.86	140.0	104.0	0.49	NO	NO	NO	3-WAY	5.0	1,2,3
ATU	2-310C	RTU-2	310 - CAFETERIA CENTER 1	14	0.32	NO	1,575	950	950	-	33.0	55.0	87.0	0.13	WATER	1.86	140.0	104.0	0.49	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	2-310D	RTU-2	310 - CAFETERIA CENTER 2	14	0.32	NO	1,575	950	950	-	33.0	55.0	87.0	0.13	WATER	1.86	140.0	104.0	0.49	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	2-310E	RTU-2	310 - CAFETERIA WEST	14	0.32	NO	1,575	960	960	-	33.0	55.0	87.0	0.13	WATER	1.86	140.0	104.0	0.49	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	2-311	RTU-2	311 - SERVERY	12	0.22	NO	890	750	750	-	21.9	55.0	82.0	0.21	WATER	1.11	140.0	99.7	0.44	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	2-312	RTU-2	312 - KITCHEN / JC OFC	12	0.26	NO	985	740	740	-	25.7	55.0	87.0	0.16	WATER	1.62	140.0	107.9	0.86	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	3-302	RTU-3	302 - CLASSROOM	16	0.25	NO	1,675	1,050	1,050	850	36.4	55.0	87.0	0.24	WATER	1.94	140.0	101.9	0.57	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	3-303	RTU-3	303 - CLASSROOM	16	0.25	NO	1,675	1,050	1,050	850	36.4	55.0	87.0	0.24	WATER	1.94	140.0	101.9	0.57	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	3-304	RTU-3	304 - CLASSROOM	16	0.25	NO	1,675	1,050	1,050	850	36.4	55.0	87.0	0.24	WATER	1.94	140.0	101.9	0.57	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	3-305	RTU-3	305 - CLASSROOM	16	0.25	NO	1,675	1,050	1,050	850	36.4	55.0	87.0	0.24	WATER	1.94	140.0	101.9	0.57	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	4-101A	RTU-4	101 - CORRIDOR WEST	12	0.27	NO	1,000	520	520	-	18.1	55.0	87.0	0.26	WATER	0.96	140.0	101.6	0.34	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	4-101B	RTU-4	101 - CORRIDOR EAST	12	0.27	NO	1,000	520	520	-	18.1	55.0	87.0	0.26	WATER	0.96	140.0	101.6	0.34	NO	NO	NO	2-WAY	5.0	1,2,3
ATU	4-110	RTU-4	110 - MEDIA CENTER	16	0.33	NO	2,000	1,290	1,290	1,000	44.8	55.0	87.0	0.32	WATER	2.64	140.0	105.5	0.97	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	4-219	RTU-4	219,220,317 - OFFICES	6	0.05	NO	230	150	150	115	4.5	55.0	82.0	0.05	WATER	0.50	140.0	121.8	0.19	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	4-318	RTU-4	318 - STAFF WORK / STOR	6	0.06	NO	250	150	150	120	4.5	55.0	82.0	0.06	WATER	0.50	140.0	121.8	0.19	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	4-319	RTU-4	319 - STAFF DINING	8	0.17	NO	520	270	270	260	8.0	55.0	82.0	0.16	WATER	1.15	140.0	125.9	1.21	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	5-102	RTU-5	102 - RECEPTION	10	0.31	NO	805	415	415	300	14.5	55.0	87.0	0.30	WATER	0.81	140.0	103.7	0.20	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	5-103	RTU-5	103 - PRINCIPAL	8	0.15	NO	360	205	205	180	7.2	55.0	87.0	0.14	WATER	0.36	140.0	99.7	0.03	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	5-104	RTU-5	104/107 - BREAK/WORK	8	0.10	NO	370	215	215	-	6.4	55.0	82.0	0.09	WATER	0.72	140.0	122.1	0.54	NO	YES	NO	2-WAY	5.0	1,2,3
ATU	5-105	RTU-5	105 - HEALTH/CLINIC	8	0.14	NO	340	220	220	170	7.7	55.0	87.0	0.13	WATER	0.40	140.0	100.7	0.05	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	5-108	RTU-5	108/109 - MEETING / STORAGE	8	0.20	NO	425	295	295	210	8.8	55.0	82.0	0.19	WATER	0.42	140.0	97.5	0.05	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	7-112	RTU-7	112 - CLASSROOM	14	0.31	NO	1,560	955	955	650	33.2	55.0	87.0	0.30	WATER	1.87	140.0	104.0	0.50	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	7-113	RTU-7	113 - CLASSROOM	14	0.31	NO	1,560	955	955	650	33.2	55.0	87.0	0.30	WATER	1.87	140.0	104.0	0.50	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	7-114	RTU-7	114 - RESOURCE ROOM	12	0.32	NO	1,120	615	615	425	21.4	55.0	87.0	0.31	WATER	1.22	140.0	104.3	0.52	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	7-202	RTU-7	202 - CLASSROOM	16	0.25	NO	1,680	980	980	710	34.1	55.0	87.0	0.24	WATER	1.78	140.0	101.0	0.48	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	7-203	RTU-7	203 - CLASSROOM	14	0.31	NO	1,560	955	955	650	33.2	55.0	87.0	0.30	WATER	1.87	140.0	104.0	0.50	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	8-204	RTU-8	204 - SCIENCE/TECH LAB	16	0.29	NO	1,850	1,375	1,375	925	47.7	55.0	87.0	0.28	WATER	2.92	140.0	106.8	1.15	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	8-205	RTU-8	205 - ART STUDIO	16	0.29	NO	1,850	1,375	1,375	925	47.7	55.0	87.0	0.28	WATER	2.92	140.0	106.8	1.15	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	9-206	RTU-9	206 - CLASSROOM	14	0.25	NO	1,510	950	950	750	33.0	55.0	87.0	0.28	WATER	1.86	140.0	104.0	0.49	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	9-207	RTU-9	207 - CLASSROOM	14	0.25	NO	1,510	950	950	750	33.0	55.0	87.0	0.28	WATER	1.86	140.0	104.0	0.49	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	9-208	RTU-9	208 - CLASSROOM	14	0.25	NO	1,510	950	950	750	33.0	55.0	87.0	0.28	WATER	1.86	140.0	104.0	0.49	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	9-209	RTU-9	209 - CLASSROOM	14	0.25	NO	1,510	950	950	750	33.0	55.0	87.0	0.28	WATER	1.86	140.0	104.0	0.49	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	9-210	RTU-9	210 - RESOURCE ROOM	12	0.21	NO	1,020	620	620	510	21.6	55.0	87.0	0.27	WATER	1.24	140.0	104.5	0.53	YES	YES	NO	2-WAY	5.0	1,2,3
ATU	9-216	RTU-9	216/217 - CHANGING/TOILETS	10	0.21	NO	640	330	330	-	11.5	55.0	87.0	0.20	WATER	0.59	140.0	100.2	0.12	NO	NO	NO	2-WAY	5.0	1,2,3

NOTES:
1. REFER TO AIR TERMINAL UNIT SCHEDULE FOR UNIT MAXIMUM SOUND POWER LEVEL PERFORMANCE.
2. BOXES TO BE PROVIDED WITH INTEGRAL ACCESS PANEL.
3. PROVIDE MULTIPLE COIL ROWS OR HIGH CAPACITY COIL TO ACHIEVE PERFORMANCE AND PD LIMITS LISTED ON SCHEDULE.

RELIEF HOOD SCHEDULE

UNIT IDENTIFICATION						THROAT			HOOD							
MARK	NUMBER	UNIT/ AREA SERVED	AIRFLOW (CFM)	STATIC PRESSURE (IN-WG)	ROOF CURB HEIGHT (IN)	WIDTH (IN)	LENGTH (IN)	THROAT VELOCITY (FPM)	MATERIAL	WIDTH (IN)	LENGTH (IN)	HEIGHT (IN)	OPERATING WEIGHT (LBS.)	MANUFACTURER	MODEL NUMBER	NOTES
RH	1	VF-1	1,200	0.11	20	16	16	675	GALVANIZED	26	36	18	150	GREENHECK	FGR	1
RH	2	VF-2	1,000	0.08	20	16	16	562	GALVANIZED	26	36	18	150	GREENHECK	FGR	1
RH	3	RTU-6	5,500	0.07	20	38	38	548	GALVANIZED	48	60	18	250	GREENHECK	FGR	1
RH	4	RTU-6	5,500	0.07	20	38	38	548	GALVANIZED	48	60	18	250	GREENHECK	FGR	1

NOTES:
1. PROVIDE WITH MANUFACTURERS MOTORIZED DAMPER.

SINGLE DUCT AIR TERMINAL UNIT SCHEDULE

BOX INFORMATION				MAXIMUM DISCHARGE SOUND POWER LEVELS (dB)						MAXIMUM RADIATED SOUND POWER LEVELS (dB)						DIMENSIONS					
BOX INLET (IN)	BOX OUTLET (IN)	MINIMUM AIRFLOW (CFM)	MAXIMUM AIRFLOW (CFM)	125	250	500	1K	2K	4K	125	250	500	1K	2K	4K	HEIGHT (IN)	LENGTH (IN)	OPERATING WEIGHT (LBS.)	MANUFACTURER	MODEL NUMBER	NOTES
6	12x8	65	550	76	71	63	57	52	49	62	57	49	43	38	33	8	22	50	PRICE	SDV	1, 2
8	12x10	125	1,100	76	70	61	57	54	51	61	55	46	39	33	28	10	20	50	PRICE	SDV	1, 2
10	14x12.5	210	1,800	75	69	60	58	55	53	61	55	47	39	32	31	12.5	20	50	PRICE	SDV	1, 2
12	16x15	300	2,600	74	68	63	60	57	56	61	55	52	44	37	35	15	20	50	PRICE	SDV	1, 2
14	20x17.5	430	3,700	74	67	65	59	57	56	62	57	50	41	37	35	17.5	24	50	PRICE	SDV	1, 2
16	24x18	575	5,000	74	67	64	62	60	57	62	59	53	48	44	37	18	24	50	PRICE	SDV	1, 2

NOTES:
1. REFER TO AIR TERMINAL UNIT APPLICATION SCHEDULE FOR INDIVIDUAL UNIT REQUIREMENTS.
2. SOUND POWER LEVELS BASED ON 2.0" WG PRESSURE DROP ACROSS THE AIR TERMINAL UNIT WITH NO EXTERNAL ATTENUATION.

HOT WATER RADIANT CEILING PANEL SCHEDULE

UNIT IDENTIFICATION					WATER		PANEL					CONTROL VALVE				
MARK	NUMBER	AREA SERVED	CAPACITY (BTUH/LF)	AMBIENT (F)	EWT (F)	LWT (F)	TYPE	TUBE DIAMETER (IN)	NO OF PASSES	WIDTH (IN)	FINISH	TYPE	MAX PD (FT)	MANUFACTURER	MODEL NUMBER	NOTES
RCP	1	307A - JAN OFFICE	202.0	65.0	140.0	120.0	LINEAR	0.5	4	24	WHITE	2-WAY	2.3	AEROTECH	AXO	1

NOTES:
1. SIZE LISTED ON PLANS IS THE ACTIVE SECTION. PROVIDE END TRIMS AND FILLER SECTIONS AS REQUIRED FOR COMPLETE WALL TO WALL INSTALLATION.

HOT WATER RADIANT WALL PANEL SCHEDULE

UNIT IDENTIFICATION					WATER			PANEL						CONTROL VALVE				
MARK	NUMBER	AREA SERVED	CAPACITY (BTUH/LF)	AMBIENT (F)	EWT (F)	LWT (F)	GPM	TYPE	ACTIVE LENGTH (FT)	DEPTH (IN)	HEIGHT (IN)	FINISH	CONSTRUCTION	TYPE	MAX PD (FT)	MANUFACTURER	MODEL NUMBER	NOTES
RWP	1	105 - HEALTH/CLINIC	180.0	65.0	130.0	110.0	0.5	RADIANT / CONVECT	8	3.3	9.0	WHITE	WALL MTD STEEL	2-WAY	2.31	RUNTAL	TT-3	1,2
RWP	2	103 - PRINCIPAL	180.0	65.0	130.0	110.0	0.5	RADIANT / CONVECT	11.5	3.3	9.0	WHITE	WALL MTD STEEL	2-WAY	2.31	RUNTAL	TT-3	1,2
RWP	3	102 - RECEPTION	180.0	65.0	130.0	110.0	0.5	RADIANT / CONVECT	17	3.3	9.0	WHITE	WALL MTD STEEL	2-WAY	2.31	RUNTAL	TT-3	1,2
RWP	4	110 - MEDIA CENTER	180.0	65.0	130.0	110.0	0.5	RADIANT / CONVECT	10.5	3.3	9.0	WHITE	WALL MTD STEEL	3-WAY	2.31	RUNTAL	TT-3	1,2
RWP	5	110 - MEDIA CENTER	180.0	65.0	130.0	110.0		RADIANT / CONVECT	7	3.3	9.0	WHITE	WALL MTD STEEL			RUNTAL	TT-3	1,2

NOTES:
1. PROVIDE EXPOSED INTERCONNECTING AND CONNECTING PIPING AS SPECIFIED.
2. PROVIDE WALL TRIMS AND END PANELS FOR FULL WALL TO WALL INSTALLATION BEYOND ACTIVE LENGTH LISTED.

HOT WATER DOOR AIR CURTAIN SCHEDULE

UNIT IDENTIFICATION			FANS			HEATING COIL								PHYSICAL CHARACTERISTICS					ELECTRICAL								
MARK	NUMBER	ROOM SERVED	AIRFLOW (CFM)	NO. OF FANS	HP (EACH)	CAPACITY (MBH)	EDB (F)	LDB (F)	FLUID TYPE	FLOW (GPM)	EWT (F)	LWT (F)	MAX WPD (FT)	MOUNTING	WEIGHT (LBS)	HEIGHT (IN)	WIDTH (IN)	LENGTH (IN)	VOLTS	PHASE	MCA	MOP	CONTROL VALVE TYPE	CONTROL VALVE MAX PD (FT)	MANUFACTURER	MODEL NUMBER	NOTES
DAC	1	307 - RECEIVING	4,200	3	1/2	116.0	65.0	90.0	WATER	12.0	140.0	120.0	5.5	WALL	250	13	22	120	208	1	12.9	20	3-WAY	5	BERNER	AHD10-3120W	

NOTES:

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SPLIT SYSTEM AIR CONDITIONING UNIT SCHEDULE

UNIT IDENTIFICATION			PERFORMANCE			INDOOR UNIT														OUTDOOR UNIT										
															ELECTRICAL									ELECTRICAL						
MARK	NUMBER	ROOM(S) SERVED	EER	REFRIG TYPE	REFRIG CHARGE (LBS)	TOTAL CAPACITY (BTU/H)	SENSIBLE CAPACITY (BTU/H)	AIRFLOW RANGE (CFM)	EDB (F)	EWB (F)	LDB (F)	LWB (F)	FILTER RATING (MERV)	MOUNTING	CONDENSATE PUMP REQUIRED	VOLTS	PHASE	MCA	MOP	OPERATING WEIGHT (LBS.)	MODEL NUMBER	NO. OF COMP	COMP TYPE	AMBIENT DESIGN TEMP (F)	MINIMUM AMBIENT TEMP (F)	VOLTS	PHASE	MCA	MOP	OPERATING WEIGHT (LBS.)	MODEL NUMBER	MANUFACTURER	NOTES
ACU	1	107 - MDF	12.2	R410A	8	24,000.0	N/A	635 - 775	80.0	67.0	55.0	54.0	8	WALL	YES	208	1	1.0	15	60	PKA-A24KA7	1	INVERTER	95.0	-40.0	208	1	19.0	26	200	PUY-A24NHA7	MITSUBISHI	1,2,3,4,5,6

NOTES:
1. PROVIDE ALL INTERCONNECTING WIRING BETWEEN THE INDOOR AND OUTDOOR UNITS.
2. PROVIDE PIPE PORTAL CURB FOR ROOF PIPING PENETRATIONS.
3. PROVIDE ROOF CURB RAILS FOR CONDENSING UNIT MOUNTING.
4. PROVIDE WITH DISCONNECT SWITCH.
5. PROVIDE WITH LINESET OF LENGTH REQUIRED TO ACHIEVE INSTALLATION DISTANCE WITH MINIMAL EXTRA COILED PIPING.
6. PROVIDE WITH BAFFLES REQUIRED TO ACHIEVE LOW AMBIENT LISTED

FUEL FIRED HOT WATER BOILER SCHEDULE

UNIT IDENTIFICATION			BURNER		FUEL				FLUID						PHYSICAL CHARACTERISTICS				ELECTRICAL					
MARK	NUMBER	AREA SERVED	CONTROL	MIN TURN DOWN	TYPE	PRESSURE RANGE (IN-WG)	FIRING RATE INPUT (MBH)	FIRING RATE OUTPUT (MBH)	FLUID TYPE	MIN FLOW (GPM)	DESIGN FLOW (GPM)	EWT (F)	LWT (F)	MAX WPD (FT)	WEIGHT (LBS)	HEIGHT (IN)	WIDTH (IN)	DEPTH (IN)	VOLTS	PHASE	FLA	MANUFACTURER	MODEL NUMBER	NOTES
B	1	BUILDING HEATING	MODULATING	20:1	NAT. GAS	4"-14"	1,000.0	900.0	WATER	12	60.0	110.0	140.0	5.0	900	78	28	25	120	1	13	AERCO	BMK-1000	
B	2	BUILDING HEATING	MODULATING	20:1	NAT. GAS	4"-14"	1,000.0	900.0	WATER	12	60.0	110.0	140.0	5.0	900	78	28	25	120	1	13	AERCO	BMK-1000	

NOTES:

HVAC CIRCULATION PUMP SCHEDULE

UNIT IDENTIFICATION							PERFORMANCE						PUMP MOTOR			ELECTRICAL				
MARK	NUMBER	SYSTEM SERVED	REDUNDANT	PUMP TYPE	COUPLING TYPE	CONTROL	FLUID TYPE	FLUID TEMP (F)	FLOW (GPM)	PUMP HEAD (FT)	MIN EFFICIENCY (%)	PUMP MIN FLOW (GPM)	BHP	HP	SPEED (RPM)	VOLTS	PHASE	MANUFACTURER	MODEL NUMBER	NOTES
HWHP	1	B-1	NO	INLINE	CLOSED	VFD	WATER	140	62.0	35	68	12	0.8	1.5	1,725	460	3	BELL & GOSSETT	E-90-2AB	
HWHP	2	B-2	NO	INLINE	CLOSED	VFD	WATER	140	62.0	35	68	12	0.8	1.5	1,725	460	3	BELL & GOSSETT	E-90-2AB	
HWHP	3	BUILDING LOOP	NO	BASE MOUNTED END SUCTION	CLOSED	VFD	WATER	140	105.0	60	68.1	21	2.3	5	1,750	460	3	BELL & GOSSETT	E-1510-2BD	1
HWHP	4	BUILDING LOOP	YES	BASE MOUNTED END SUCTION	CLOSED	VFD	WATER	140	105.0	60	68.1	21	2.3	5	1,750	460	3	BELL & GOSSETT	E-1510-2BD	1
HWHP	5	RWP LOOP	NO	INLINE	CLOSED	VFD	WATER	140	2.5	20	N/A	-	N/A	1/6	3,300	120	1	BELL & GOSSETT	PL-45B	

NOTES:
1. PROVIDE WITH INERTIA BASE.

HVAC EXPANSION TANK SCHEDULE

UNIT IDENTIFICATION			TANK							SYSTEM							
												OPERATING...		OPERATING PRESSURE			
MARK	NUMBER	SYSTEM SERVED	TYPE	ASME CONSTRUCTION	TANK VOLUME (GAL)	ACCEPTANCE VOLUME (GAL)	DIAMETER (IN)	HEIGHT (IN)	OPERATING WEIGHT (LBS)	ESTIMATED SYSTEM VOLUME...	FLUID TYPE	MIN TEMP (F)	MAX TEMP (F)	MIN PRESS (PSIG)	MAX PRESS (PSIG)	MANUFACTURER	MODEL NUMBER	NOTES
HET	1	BUILDING HEATING	BLADDER	YES	34.4	34.4	20	37	408	600	WATER	40	160	14.0	52.0	BELL & GOSSETT	B-130	

NOTES:

EXPANSION LOOP SCHEDULE

UNIT IDENTIFICATION			PIPE SIZE (IN)	OPERATING...		APPROXIMATE EXPANSION (IN)	CONNECTION TYPE	CONFIGURATION	MANUFACTURER	MODEL NUMBER	NOTES
MARK	NUMBER	SYSTEM SERVED		MIN TEMP (F)	MAX TEMP (F)						
EL	1	BUILDING HEATING LOOP	2-1/2"x2"	40	140	1.5	FLANGED / SOLDER	NESTED	METRAFLEX	MLS30200	1
EL	2	BUILDING HEATING LOOP	2"x2-1/2"	40	140	1.5	SOLDER / FLANGED	NESTED	METRAFLEX	MLS30250	1

NOTES:
1. REFER TO DRAWINGS AND FIELD CONDITIONS FOR SPECIFIC CONFIGURATION.

AIR AND DIRT SEPARATOR SCHEDULE

UNIT IDENTIFICATION			TYPE	CONNECTION SIZE (IN)	DIAMETER (IN)	HEIGHT (IN)	WEIGHT (LBS)	FLOW (GPM)	MAX WPD (FT)	MANUFACTURER	MODEL NUMBER	NOTES
MARK	NUMBER	SYSTEM SERVED										
ADS	1	BUILDING HEAT LOOP	COALESCING	3	8.6	31.4	225	105.0	1.0	SPIROTHERM	VDN300FA	

NOTES:

PIPING SYSTEM APPLICATION SCHEDULE

SYSTEM	PIPE SIZE (IN)	DESIGN		CONSTRUCTION					LOCATION	MATERIAL							JOINTS					INSULATION			FACTORY JACKET				FIELD JACKET				NOTES
		MAX VELOCITY (FPS)	MAX FRICTION (FT/100')	OPERATING TEMP (F)	MIN WORKING PRESSURE (PSIG)	MIN TEMP RATING (F)	TEST PRESSURE (PSIG)	TES DURATION (HRS)		COPPER TYPE K	COPPER TYPE L	SCH 40 STEEL	SCH 80 STEEL	SCH 10 TYPE 316 STAINLESS STEEL	SCH 10 TYPE 304 STAINLESS STEEL	HDPE	PEX-A	SOLDERED	BRAZED	THREATED	WELDED	PRESSURE FITTINGS	GROOVED	MINERAL FIBER, PREFORMED	FLEXIBLE ELASTOMERIC	THICKNESS (IN)	ASJ	ASJ-SS	FSK	VINYL	PVC - ALL	PVC - FITTINGS	PVC - TO 10 FEET AFF	ALUMINUM	STAINLESS STEEL	
HOT WATER HEATING	1-1/4 AND LESS	4	4.0	110-140	125	200	125	2.5	CONCEALED		X							X	X					X		1		X			X				1
									EXPOSED		X							X	X					X		1		X			X	X			1
									MECHANICAL ROOM		X							X	X					X		1		X			X	X			1
									UNDERGROUND		X							X	X					X		1		X						X	1
	1-1/2 & 2								CONCEALED		X							X	X					X		1.5		X			X				1
									EXPOSED		X							X	X					X		1.5		X			X	X			1
									MECHANICAL ROOM		X							X	X					X		1.5		X			X	X			1
	2-1/2 TO 4	8	4.0	110-140	125	200	125	2.5	CONCEALED			X									X			X		1.5		X			X				1
									EXPOSED			X									X			X		1.5		X			X	X			1
									MECHANICAL ROOM			X									X			X		1.5		X			X	X			1

NOTES:
1. PIPE INSULATION THICKNESS BASED ON ASHRAE 90.1-2013.

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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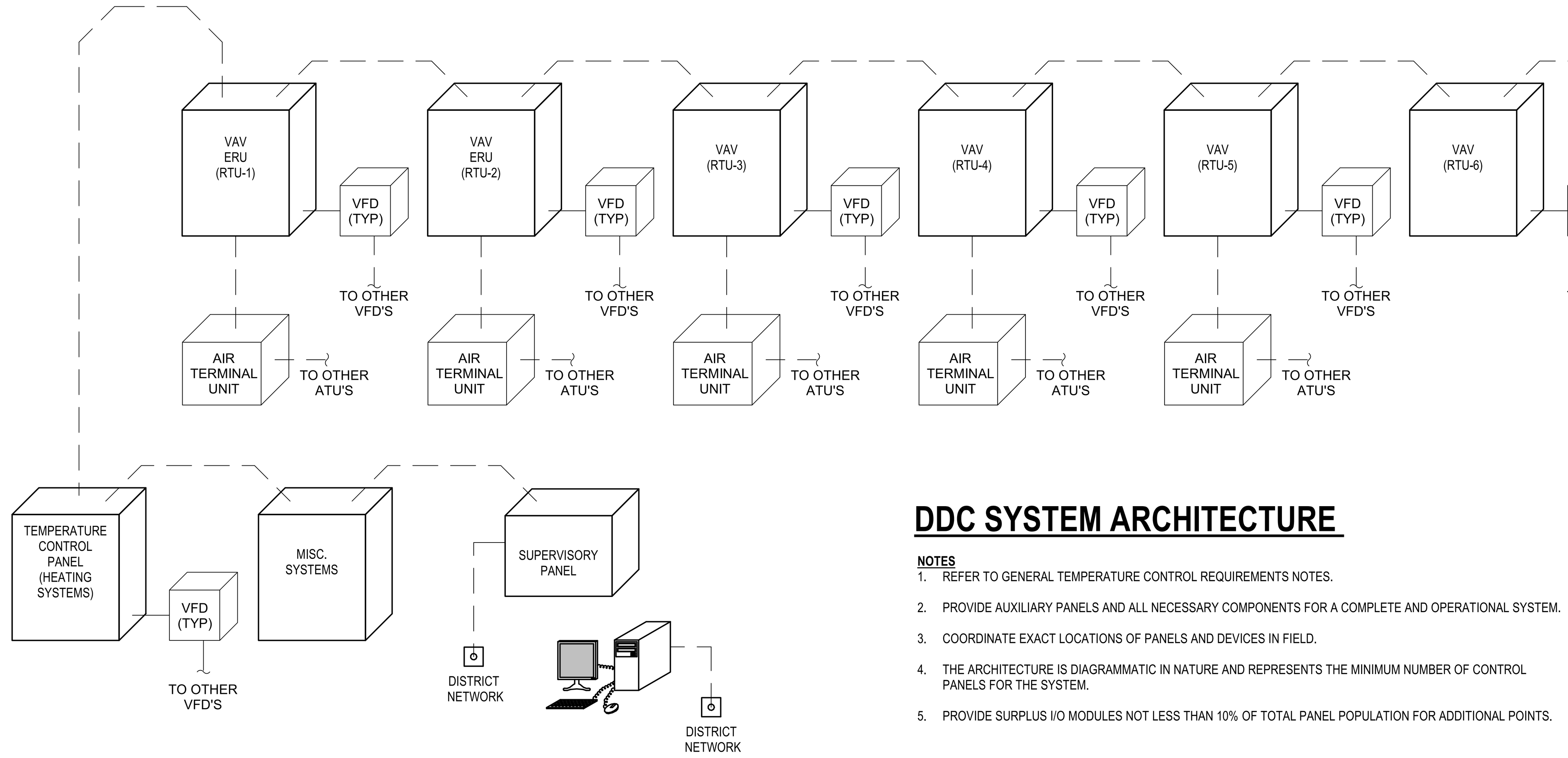


DDC SYSTEM ARCHITECTURE

NOTES

1. REFER TO GENERAL TEMPERATURE CONTROL REQUIREMENTS NOTES.
2. PROVIDE AUXILIARY PANELS AND ALL NECESSARY COMPONENTS FOR A COMPLETE AND OPERATIONAL SYSTEM.
3. COORDINATE EXACT LOCATIONS OF PANELS AND DEVICES IN FIELD.
4. THE ARCHITECTURE IS DIAGRAMMATIC IN NATURE AND REPRESENTS THE MINIMUM NUMBER OF CONTROL PANELS FOR THE SYSTEM.
5. PROVIDE SURPLUS I/O MODULES NOT LESS THAN 10% OF TOTAL PANEL POPULATION FOR ADDITIONAL POINTS.

TEMPERATURE CONTROLS GENERAL NOTES

1 PROVIDE ALL POWER, INTERCONNECTING WIRING, TRANSFORMERS, AUTOMATIC VOLTAGE REGULATION, UNINTERUPTABLE POWER SYSTEMS, ENCLOSURES, RACEWAYS, CONDUITS, HANGERS, AND SUPPORTS FOR A COMLETE AND OPERATIONAL SYSTEM.

2 ROUTE POWER FROM ELECTRICAL PANELS. COORDINATE WITH ELECTRICAL CONTRACTOR FOR ALLOWABLE PANEL LOADING REQUIREMENTS AND CIRCUIT NUMBERS. SPARE CIRCUITS MAY BE USED WHEN AVAILABLE. IN PANELBOARDS THAT DO NOT HAVE SPARE CIRCUIT BREAKERS, PROVIDE NEW BREAKERS TO MATCH EXISTING BREAKERS IN OPEN SPACES. LOW VOLTAGE WIRINIG WILL BE ROUTED SEPARATELY FROM 120 V WIRING.

3 PROVIDE ALL WIRING AND CONDUIT, RACEWAYS AND BACK BOXES IN COMPLIANCE WITH THE NATIONAL ELECTRICAL CODE, MANUFACTURER REQUIRMENTS, AND PROJECT SPECIFICATION REQUIREMENTS.

4 PROVIDE INDIVIDUAL GRAPHICS FOR EACH SYSTEM/DEVICE IDENTIFIED IN THE CONTRACT DOCUMENTS. REFER TO ALL CONTROL DRAWINGS.

5 PROVIDE ALL SET POINTS AND DEAD BANDS TO BE ADJUSTABLE THROUGH A GRAPHICAL USER INTERFACE.

6 PROVIDE ALL NECESSARY VIRTUAL POINTS, CONTROLLERS, RELAYS, CONTACTORS, INTERFACE MODUALS, COMMUNICATION CARDS, AND OTHER DEVICES TO MEET THE SPECIFIED SEQUENCE OF OPERATION FOR EACH DEVICE. EQUIPMENT MANUFACTURERS PROVIDES NECESSARY COMMUNICATION DEVICES. TEMPERATURE CONTROL CONTRACTOR COORDINATES REQUIREMENTS, INSTALLS, AND PROGRAM DEVICES.

7 COORDINATE EXACT LOCATIONS OF ALL FIELD MOUNTED COMPONENTS.

8 MOUNT ALL RELAYS, TRANSFORMERS, TRANSDUCERS, AND OTHER DEVICES ASSOCIATED WITH THE CONTROL SYSTEM WITHIN STANDARD ENCLOSURES OR AUXILARY PANELS. PROVIDE ENCLOSURES FOR ENVIRONMENT OR AS SPECIFIED.

9 COORDINATE DAMPER, VALVE, AND CONTROL DEVICE LOCATIONS AND SIZES WITH MECHANICAL TRADES. UNLESS OTHERWISE NOTED, CONTROL DEVICES ARE PROVIDED BY CONTROLS CONTRACTOR, INSTALLED BY MECHANCIAL CONTRACTOR, POWERD BY THE ELECTRICAL CONTRACTOR, AND COMMUNICATED BY CONTROLS CONTRACTOR.

10 CONTROL SYSTEM INCLUDES ALL COMPONENTS IDENTIFIED OR DESCRIBED IN CONTRACT DOCUMENTS. PROVIDE ALL NECESSARY INTEGRATION AND LICENSING TO VIEW NEW COMPONENTS FROM THE EXISTING CAMPUS GRAPHIC USER INTERFACE. COORDINATE ACCESS TO FACILITIES NETWORK WITH CAMPUS IT PERSONEL.

11 PROVIDE ALL INTERCONNECTING WIRING, REMOTE SENSORS, AND OTHER COMPONENTS FOR A COMPLETE AND OPERATIONAL SYSTEM FOR ALL SYSTEMS AND EQUIPMENT FURNISHED WITH PACKAGED CONTROLS.

12 REFER TO CONTRACT DOCUMENTS FOR ALL FIRE ALARM COMPONENTS AND INSTALLATION REQUIREMENTS. UNLESS OTHERWISE NOTED, REFER TO ELECTRICAL SPECIFICATIONS FOR FIRE ALARM COMPONENT PRODUCT DATA AND INSTALLATION REQUIREMENTS, MECHANICAL FLOOR PLANS AND TEMPERATURE CONTROL DIAGRAMS OR SEQUENCES OF OPERATION FOR LIFE SAFETY DAMPER LOCATIONS AND DUCT DETECTOR REQUIREMENTS, AND BUILDING AUTOMATION FIRE ALARM MONITORING REQUIREMENTS.

13 UNLESS OTHERWISE NOTED, ALL SPACE TEMPERATURE SENSORS AND OTHER TEMPERATURE CONTROL DEVICES ARE TO BE ROUGHED IN WITH CONCEALED CONDUIT AND BACK BOXES BY THE TEMPERATURE CONTROLS CONTRACTOR. WHERE CONCEALED IS NOT POSSIBLE, CONTRACTOR MAY PROVIDE LOW PROFILE SURFACE MOUNTED RACEWAY WITH ARCHITECT/ENGINEER PRIOR APPROVAL. TEMPERATURE CONTROLS CONTRACTOR TO PROVIDE ALL NECESSARY 120V POWER FOR CONTROL DEVICES. REFER TO APPLICATION SCHEDULES. CONTROL CONTRACTOR TO PROVIDE ALL LOW VOLTAGE POWER, COMMUNICATION WIRING, AND CONDUIT.

14 THE BUILDING SUPERVISORY PANEL TO BE PROVIDED WITH UNITERRUPTIBLE POWER SUPPLY OF FULL RATED LOAD OF CONTROL PANEL FOR 10 MINUTES OF LOADING. ALL CONTROL PANELS TO CONNECTED TO STANDBY POWER WHEN A GENERATOR AND STANDBY PANEL ARE AVAILABLE.

15 ANY UPGRADES REQUIRED OF THE CAMPUS BMS, SERVER, HARDWARE, TRAINING, SOFTWARE WILL BE PROVIDED BY THE CONTROLS CONTRACTOR.

16 NO GLOBAL CAMPUS SHARING OF DDC FOR CONTROL WILL BE PERMITED, SUCH AS OUTSIDE AIR TEMPERATURE AND HUMIDITY.

17 ALL CRITICAL ALARMS MUST BE ON BINARY INPUT. NO VIRTUAL POINTS ALLOWED.

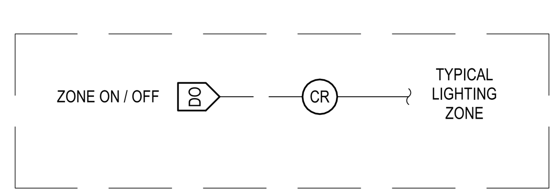
18 PROVIDE AS-BUILT DOCUMENTS OF FINAL SEQUENCE OF OPERATIONS AFTER COMPLETION OF THE COMMISSIONING PROCESS.

CONTROLS

Symbol	Description
PG	AIR PRESSURE GAGE
S	AIR SAMPLING POINT
CO2	CARBON DIOXIDE SENSOR
CO	CARBON MONXIDE SENSOR
CT	CURRENT TRANSMITTER
CT	CURRENT TRANSMITTER WITH LEAD
D	DEWPOINT SENSOR
DPS	DIFFERENTIAL PRESSURE SENSOR
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
FM	FLOW METER
FS	FLOW SWITCH
FT	FLOW TRANSMITTER
FZ	FREEZE STAT
HOA	HAND SWITCH
H	HUMIDITY SENSOR
LC	LEVEL CONTROL
LS	LIMIT SWITCH
LPI	LOOP POWERED INDICATOR
O	OCCUPANCY SENSOR
PB	PUSH BUTTON
PI	POSITION INDICATOR
PS	PRESSURE SENSOR
RH	RELATIVE HUMIDITY SENSOR
R	RELAY
SP	STATIC PRESSURE SENSOR
T	THERMOSTAT
VIB	VIBRATION SENSOR
AFS	AIR FLOW SWITCH
I / P	CURRENT TO PRESSURE
SCR	SILICON CONTROLLED RECITIFIER
TCP	TEMPERATURE CONTROL PANEL
TEC	TERMINAL EQUIPMENT CONTROLLER
	SENSOR WELL
	ALARM HORN
	ALARM BEACON
AI	ANALOG INPUT
AO	ANALOG OUTPUT
DI	DIGITAL INPUT
DI	DIGITAL OUTPUT
EC	ELECTRICALLY COMMUTED MOTOR
STR	STARTER
HOA	HAND OFF AUTO
VFD	VARIABLE FREQUENCY DRIVE
	NON MOTORIZED VALVE
M	TWO WAY MOTORIZED VALVE
M	THREE WAY MOTORIZED VALVE

CONTROLS

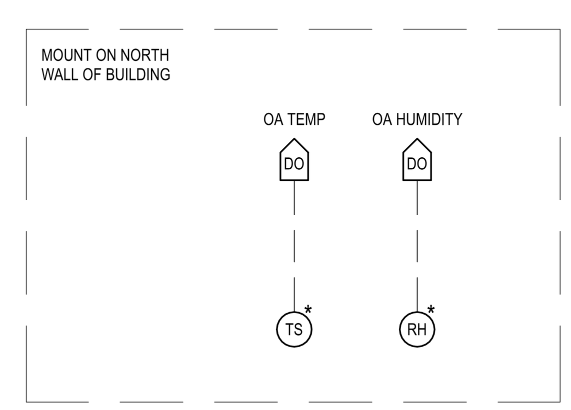
Symbol	Description
S	TWO WAY SOLENOID VALVE
NC / NO / O	THREE WAY SOLENOID VALVE
	TWO WAY PNEUMATIC VALVE
NC / NO / O	THREE WAY PNEUMATIC VALVE
	PUMP
	MOTOR
S	DUCT SMOKE DETECTOR
H	HEAT DETECTOR
	LABORATORY AIR VALVE
H / C	UNITARY HEATING COIL
C / C	UNITARY COOLING COIL
	FILTER
	ENERGY WHEEL
	AIR FLOW MEASURING STATION
	AIR FLOW PROBE
	BACKDRAFT DAMPER
	MOTORIZED DAMPER - PARALLEL BLADE
	MOTORIZED DAMPER - OPPOSED BLADE
NC	DAMPER ACTUATOR - ELECTRIC
NC	DAMPER ACTUATOR - PNEUMATIC
	CENTRIFUGAL FAN
	PROP FAN
	PLENUM FAN
	HUMIDIFIER
	ETHERNET CONNECTION
	PILOT LIGHT
	ELECTRICAL CONNECTION
©	CONTACTOR
	CONTACT
DDC_XXX	DDC PANEL
	COMPUTER



SEQUENCE OF OPERATION
GENERAL

1. DDC SHALL HAVE TIME OF DAY SCHEDULING CAPABILITY OVER LIGHTING CIRCUITS THROUGH BMS CONTACTOR PROVIDED WITH LIGHTING CONTROL SYSTEM. REFER TO ELECTRICAL FLOOR PLANS FOR QUANTITY OF ZONES.
2. REFER TO ELECTRICAL DRAWINGS FOR CONTACTOR LOCATIONS.

5 / M-701 **LIGHTING CONTROL**
NOT TO SCALE

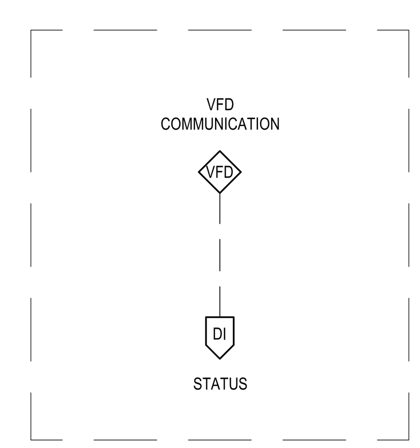


* FIELD MOUNTED DEVICE

SEQUENCE OF OPERATION
GENERAL

1. THE DDC MONITORS OUTSIDE AIR TEMPERATURE AND HUMIDITY AND MAKES THESE VALUES AVAILABLE TO ALL CONTROLLERS WHICH REQUIRE THEM.
2. OUTSIDE AIR CONDITIONS ARE AVAILABLE ON THE GRAPHIC USER INTERFACE.
3. OUTSIDE AIR CONDITIONS ARE TRENDED FOR DIAGNOSTIC PURPOSES AND FOR COMPARATIVE ENERGY USAGE.

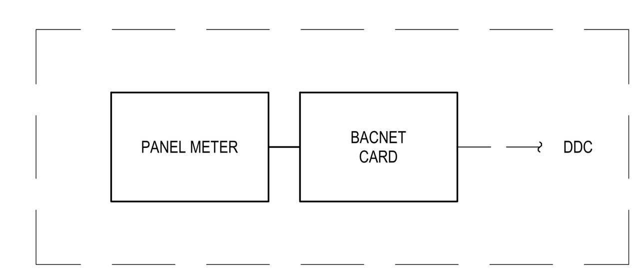
4 / M-701 **OUTSIDE AIR TEMPERATURE AND HUMIDITY MONITORING**
NOT TO SCALE



SEQUENCE OF OPERATION
GENERAL

1. DDC SHALL MONITOR POWER USAGE FROM EACH PUMP AND FAN VFD.
2. USAGE SHALL BE DISPLAYED ON GRAPHIC USER INTERFACE BY INDIVIDUAL DRIVE.
   A. CURRENT
   B. MONTHLY
   C. YEAR TO DATE
3. COMPARATIVE USAGE FROM PREVIOUS YEAR SHALL BE DISPLAYED ON GRAPHIC USER INTERFACE

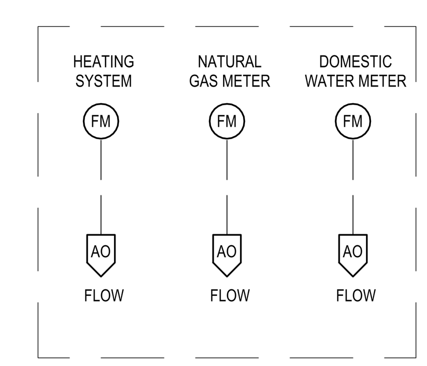
3 / M-701 **VFD POWER MONITORING**
NOT TO SCALE



SEQUENCE OF OPERATION
GENERAL

1. DDC SHALL MONITOR POWER USAGE.
2. USAGE SHALL BE DISPLAYED ON GRAPHIC USER INTERFACE.
   A. CURRENT
   B. MONTHLY
   C. YEAR TO DATE
3. COMPARATIVE USAGE FROM PREVIOUS YEAR SHALL BE DISPLAYED ON GRAPHIC USER INTERFACE

2 / M-701 **UTILITY MONITORING**
NOT TO SCALE



SEQUENCE OF OPERATION
GENERAL

1. DDC SHALL MONITOR USAGE.
2. USAGE SHALL BE DISPLAYED ON GRAPHIC USER INTERFACE.
   A. CURRENT
   B. MONTHLY
   C. YEAR TO DATE
3. COMPARATIVE USAGE FROM PREVIOUS YEAR SHALL BE DISPLAYED ON GRAPHIC USER INTERFACE

1 / M-701 **UTILITY MONITORING**
NOT TO SCALE

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TEMPERATURE CONTROLS LEGEND

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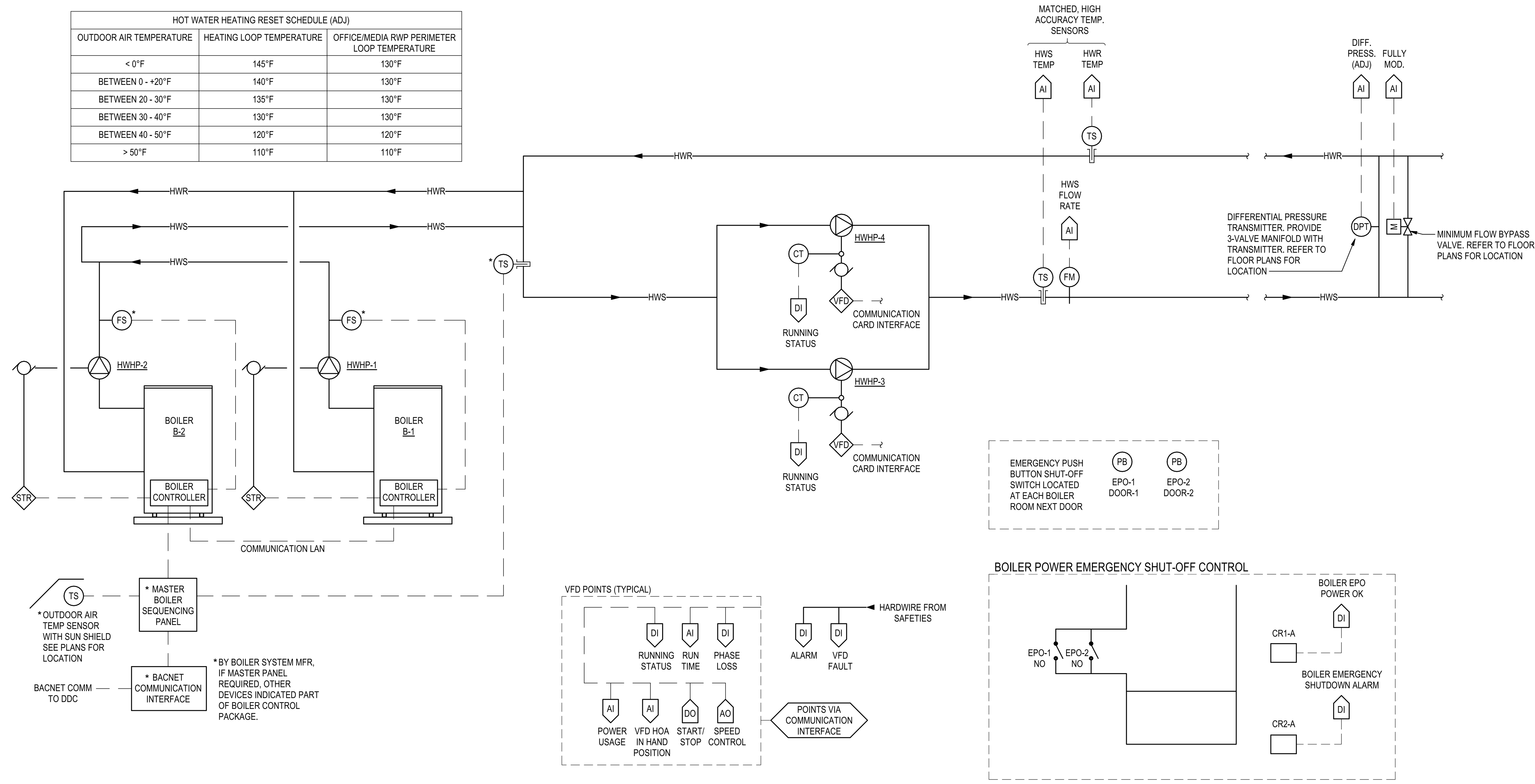
CHECKED BY: Checker APPROVED BY: Approver

HOT WATER HEATING RESET SCHEDULE (ADJ)		
OUTDOOR AIR TEMPERATURE	HEATING LOOP TEMPERATURE	OFFICE/MEDIA RWP PERIMETER LOOP TEMPERATURE
< 0°F	145°F	130°F
BETWEEN 0 - +20°F	140°F	130°F
BETWEEN 20 - 30°F	135°F	130°F
BETWEEN 30 - 40°F	130°F	130°F
BETWEEN 40 - 50°F	120°F	120°F
> 50°F	110°F	110°F



HOT WATER HEATING SYSTEM CONTROL SEQUENCE OF OPERATION

GENERAL

1. THE BOILERS WILL BE PROVIDED WITH A BOILER MANAGEMENT SYSTEM. THE BOILER MANAGEMENT SYSTEM WILL BE PROVIDED EITHER INTEGRAL TO EACH BOILER'S FACTORY CONTROLLER OR WILL BE PROVIDED AS A SEPARATE PANEL THAT COMMUNICATES WITH EACH BOILER'S CONTROLLER. IN THE EVENT OF A FAILURE OR LOSS OF POWER TO THE MASTER BOILER CONTROLLER, A SECONDARY PANEL BECOMES THE MASTER CONTROL. UPON A FAILURE OF THE PRIMARY BOILER MANAGEMENT CONTROLLER, AN ALARM WILL BE ISSUED TO THE FACILITY DDC SYSTEM.
2. ALL FIELD DEVICES SHALL BE PROVIDED AND INSTALLED FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, EMERGENCY SHUTDOWN PUSH BUTTONS, PUMPS, GATEWAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.
3. THE BOILER MANAGEMENT SYSTEM SHALL COMMUNICATE WITH THE FACILITY'S DDC SYSTEM AS DESCRIBED THROUGHOUT THE SEQUENCE. PROVIDE THE NECESSARY GATEWAYS AND PROGRAMMING TO FACILITATE THE COMMUNICATION DESCRIBED AND DEPICTED.

PRIMARY LOOP CONTROL

1. WHEN THE BOILER SYSTEM IS ENABLED THROUGH THE FACILITY'S DDC SYSTEM OR MANUALLY THROUGH THE BOILER MANAGEMENT SYSTEM, THE BOILER MANAGEMENT SYSTEM SHALL OPERATE THE BOILERS AND BOILER PRIMARY PUMPS TO MAINTAIN THE HOT WATER HEATING SET POINT DETERMINED BY THE DDC SYSTEM. UPON LOSS OF COMMUNICATION WITH THE DDC SYSTEM, THE BOILER MANAGEMENT SYSTEM SHALL OPERATE THE BOILERS AND PUMPS TO MAINTAIN THE BOILER MANAGEMENT SYSTEM'S STANDBY SET POINT OF 140°F(ADJ.).
2. THE BOILER MANAGEMENT SYSTEM SHALL ENERGIZE THE QUANTITY OF BOILERS AND PUMPS AND SHALL CONTROL THE FIRING RATE OF ALL BOILERS TO MAINTAIN THE HOT WATER TEMPERATURE SET POINT IN THE MOST EFFICIENT METHOD.
3. THE BOILER MANAGEMENT SYSTEM SHALL SET A BOILER AS THE LEAD BOILER. THIS BOILER AND ITS ASSOCIATED PRIMARY PUMP WILL BE THE FIRST BOILER TO BE ENERGIZED TO MAINTAIN THE HOT WATER HEATING LOOP TEMPERATURE SET POINT. THE BOILER MANAGEMENT SYSTEM WILL EQUALIZE LEAD BOILER BASED ON TOTAL RUN TIME AND FIRING CYCLES ON A MONTHLY BASIS. THE SWITCH OVER SHALL OCCUR THE SECOND TUESDAY OF THE MONTH AT 10:00 AM (ADJ.).
4. IF A BOILER OR BOILER PRIMARY PUMP FAILS, THE BOILER MANAGEMENT SYSTEM SHALL ISSUE AN ALARM TO THE DDC SYSTEM AND SHALL REMOVE THAT BOILER AND PUMP FROM ROTATION AND SHALL ENERGIZE THE APPROPRIATE NEXT BOILER AND PUMP.
5. THE BOILER MANAGEMENT SYSTEM SHALL MONITOR AND REPORT THE FOLLOWING TO THE DDC SYSTEM:
   A. BOILER STATUS
   B. BOILER FIRING RATE
   C. CURRENT HOT WATER HEATING LOOP CONTROL TEMPERATURE SET POINT
   D. ALARM NOTIFICATIONS
   E. BOILER RUN TIME
   F. BOILER FIRING CYCLES
   G. LEAD BOILER
   H. PUMP STATUS

SECONDARY LOOP CONTROL

1. THE HOT WATER HEATING PUMPS SHALL HAVE START/STOP CAPABILITY THROUGH THE DDC SYSTEM.
2. ALL VARIABLE FREQUENCY DRIVE (VFD) HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITIONS.
3. DDC MONITORS ALL VFD INFORMATION THROUGH A COMBINATION OF HARD WIRE POINTS AND THE VFD COMMUNICATION INTERACE CARD. PROVIDE ALL NECESSARY CONNECTIONS AND PROGRAMMING TO MONITOR, REPORT, AND CONTROL THE FOLLOWING INFORMATION FROM EACH PUMP VFD.
   A. RUNNING STATUS
   B. START/STOP
   C. SPEED CONTROL
   D. ALARM
   E. VFD HAND OFF AUTO IN HAND
   F. POWER USAGE
   G. RUN TIME
   H. PHASE LOSS
   I. VFD FAULT
4. DDC SHALL DETERMINE WHICH CIRCULATING PUMP SHALL BE THE LEAD PUMP AND THE STANDBY PUMP. THE LEAD PUMP SHALL BE ENERGIZED AND ITS RESPECTIVE VFD SHALL MODULATE TO MAINTAIN THE DIFFERENTIAL SET POINT.
5. UPON THE LEAD PUMP'S FAILURE, THE STANDBY PUMP SHALL BE ENERGIZED AND THE DDC SYSTEM SHALL ISSUE AN ALARM. THE DDC SYSTEM WILL ROTATE WHICH PUMP IS THE LEAD AND STANDBY PUMP EVERY MONTH (ADJ.) BASED ON TOTAL RUN TIME. THE SWITCH OVER SHALL OCCUR THE SECOND TUESDAY OF THE MONTH AT 11:00 AM (ADJ.).
6. THE HOT WATER HEATING SYSTEM LOOP SHALL BE CONTROLLED TO MAINTAIN A DIFFERENTIAL PRESSURE SET POINT. THIS MEASUREMENT IS TAKEN FROM THE SYSTEM DIFFERENTIAL PRESSURE TRANSMITTER LOCATED APPROXIMATELY 2/3 OF THE DISTANCE AWAY FROM THE PUMPS IN THE MOST HYDRAULICALLY DEMANDING LOOP. THE SYSTEM BALANCER SHALL VERIFY THE INITIAL SET POINT BASED ON THE BALANCING PROCEDURES IDENTIFIED IN THE PROJECT SPECIFICATION.
7. DDC SHALL MODULATE THE LEAD PUMP VFD TO MAINTAIN THE SYSTEM'S DIFFERENTIAL SET POINT. IF LEAD PUMP CANNOT MAINTAIN THE SYSTEM'S DIFFERENTIAL SET POINT AFTER 30 MINUTES (ADJ), THE STANDBY PUMP IS ENERGIZED AND BROUGHT UP TO THE LEAD PUMP'S SPEED. DDC COMMANDS EACH PUMP'S VFD TO SLOW IN PARALLEL TO MAINTAIN SYSTEM DIFFERENTIAL SET POINT. IF BOTH THE LEAD AND LAG PUMPS REDUCE TO 40% (ADJ) OF THEIR RESPECTIVE DRIVE SPEED MAXIMUMS FOR 30 MINUTES (ADJ), THE STANDBY PUMP IS DE-ENERGIZED.

SECONDARY LOOP DIFFERENTIAL PRESSURE RESET

1. DDC SHALL POLL ALL HEATING VALVE POSITIONS EVERY 5 MINUTES (ADJ). THE SYSTEM DIFFERENTIAL PRESSURE SET POINT SHALL RESET DOWN 1 FT (ADJ) IF ALL HEATING VALVES ARE LESS THAN 80% OPEN (ADJ) FOR 15 MINUTES (ADJ). THE SYSTEM DIFFERENTIAL PRESSURE SET POINT SHALL RESET UP 1 FT (ADJ) IF 10% OF ALL HEATING VALVES ARE MORE THAN 95% OPEN (ADJ) FOR 15 MINUTES (ADJ).

SECONDARY LOOP MINIMUM FLOW CONTROL

1. DDC MONITORS SYSTEM FLOW. IF SYSTEM FLOW FALLS BELOW THE LEAD PUMP'S MINIMUM FLOW, THE MINIMUM FLOW BYPASS VALVE IS MODULATED TO MAINTAIN THE LEAD PUMPS MINIMUM FLOW.
2. THE MINIMUM FLOW BYPASS SHALL NOT BE USED FOR DIFFERENTIAL PRESSURE CONTROL. THE BYPASS VALVE SHALL NOT BE OPEN UNLESS THE LEAD PUMP VFD IS AT MINIMUM.

RWP PERIMETER HEATING SYSTEM CONTROL

1. THE PERIMETER SYSTEM IS ENABLED ANYTIME OUTSIDE AIR TEMPERATURE IS BELOW 60 DEGREES (ADJ).
2. THE HOT WATER HEATING PUMP SHALL HAVE START/STOP CAPABILITY THROUGH THE DDC SYSTEM.

RWP PERIMETER SYSTEM TEMPERATURE AND RESET CONTROL

1. THE PERIMETER HEATING SYSTEM CONTROL VALVE MODULATES TO MAINTAIN LOOP TEMPERATURE SET POINT.
2. THE PERIMETER LOOP TEMPERATURE SET POINT SHALL BE RESET BASED ON THE PERIMETER OUTDOOR AIR RESET SCHEDULE.

SAFETY CONTROL

1. DDC MONITORS SYSTEM PRESSURE. IF SYSTEM PRESSURE FALLS BELOW 10 PSI (ADJ), DDC ISSUES AN ALARM.
2. DDC MONITORS SYSTEM LOOP TEMPERATURE. IF THE SYSTEM RISES 10 DEGREES (ADJ) ABOVE OR FALLS 10

SET POINTS

1.	HEATING SYSTEM ENABLE	60 °F OA
2.	SUPPLY WATER TEMPERATURE	SEE RESET SCHEDULE
3.	INITIAL DIFFERENTIAL	15 FEET
4.	PERIMETER SUPPLY WATER TEMPERATURE	SEE RESET SCHEDULE

EMERGENCY SHUTDOWN

1. AN EMERGENCY POWER SHUT OFF (EPO) PUSH BUTTON SWITCH SHALL BE PROVIDED AT EACH EXIT DOOR FROM THE BOILER ROOM (REFER TO FLOOR PLANS FOR QUANTITY OF DOORS). THE EPO SHALL BE MOUNTED ADJACENT TO THE INTERIOR OF THE EXIT DOOR. PRESSING THE EPO SHALL SHUT OFF ELECTRICAL POWER TO ALL BOILERS AND SHALL ISSUE AN ALARM TO THE DDC SYSTEM. DDC SHALL MONITOR THE POWER CIRCUIT OF THE EPO RELAY AND UPON LOSS OF POWER SHALL ISSUE A SIGNAL TO THE DDC SYSTEM.
2. THE SECONDARY PUMP(S) CONTINUE TO CIRCULATE FOR 5 MINUTES (ADJ), AND THEN DE-ENERGIZE.

VFD POWER MONITORING

1 DDC MONITORS PUMP VFD'S. DDC REPORTS KWH CONSUMPTION. CONSUMPTION SHALL BE DISPLAYED AS:
   1 INSTANTANEOUS ENERGY USAGE (KW)
   2 WEEKLY ENERGY USAGE (KWH)
   3 YEARLY ENERGY USAGE (KWH)
   4 WEEKLY COMPARATIVE USAGE AFTER FIRST YEAR OF OPERATION (KWH)

2 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

TREND DATA

1 TRENDING FUNCTIONS TO BE AVAILABLE FOR ALL CONTROL AND MONITORING POINTS.
2 SPECIFIC TRENDS TO BE SET UP AS DEFINED BY USER DURING SYSTEM TRAINING
   1 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.
3 PROVIDE TRENDS TO SUPPORT COMMISSIONING ACTIVITIES AS DEFINED BY COMMISSIONING PLAN. REFER TO COMMISSIONING SPECIFICATIONS AND COMMISSIONING PLAN FOR REQUIREMENTS.

1 / M-702 **HOT WATER HEATING SYSTEM CONTROL DIAGRAM**
NOT TO SCALE

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
BLACK
WHITE

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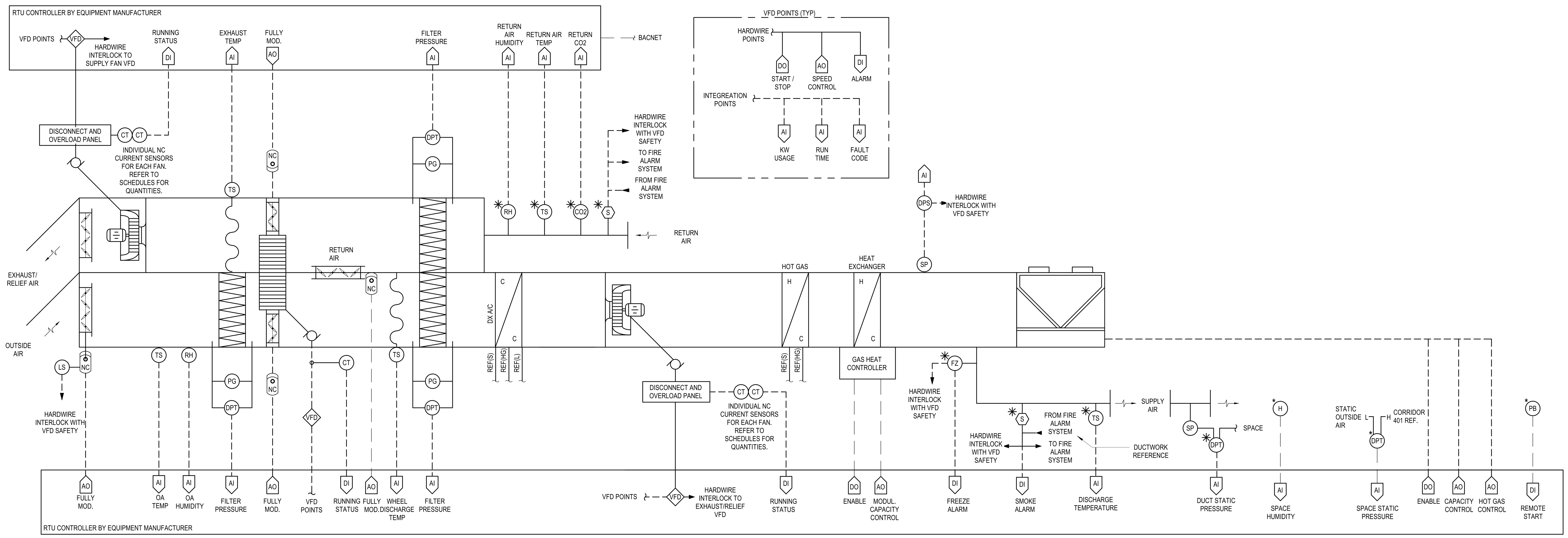
TEMPERATURE CONTROL DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-702
100% CONSTRUCTION DOCUMENTS



= FIELD MOUNTED DEVICE

SEQUENCE OF OPERATION

GENERAL
1 THE UNIT WILL BE PROVIDED WITH PACKAGED DDC CONTROLS PROGRAMMED TO THE SEQUENCE OF OPERATION DESCRIBED WITHIN THE CONTRACT DOCUMENTS. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, GATEWAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.
2 ALL FIELD WIRED OR INSTALLED DEVICES WILL BE PROCURRED AND INSTALLED BY THE CONTRACTOR. DEVICES MAY BE PROVIDED BY UNIT MANUFACTURER. CONTRACTOR SHALL COORDINATE AND PROVIDE ALL ADDITIONAL COMPONENTS OR LABOR FOR A COMPLETE AND OPERATIONAL SYSTEM COMPLYING WITH THE OPERATING INTENT OF THE DOCUMENTS.
3 ALL POINTS IDENTIFIED IN THE CONSTRUCTION DOCUMENTS WILL BE DISPLAYED ON THE USER'S GRAPHIC INTERFACE. ALARMS AND OTHER SYSTEM NOTIFICATIONS WILL BE REPORTED TO SYSTEM USERS. PROVIDE ALL NECESSARY INTEGRATION FROM PACKAGED CONTROLLER TO FACILITY CONTROL SYSTEM.
4 ALL HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITION AND THE HAND AND OFF POSITIONS ARE USED FOR MAINTENANCE SITUATIONS. ALL SET POINTS, DEAD BANDS, AND TIME DELAY INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEAD BANDS AND TIME DELAYS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.

SCHEDULING
1. THE RTU RUNS CONTINUOUSLY DURING THE OCCUPIED MODE UNLESS DEACTIVATED FOR MAINTENANCE, SCHEDULED SHUTDOWNS, OR IF A SAFETY TRIPS.
2. THE RTU SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM. OCCUPIED AND UNOCCUPIED SCHEDULE TO BE PROGRAMMED DURING SYSTEM COMMISSIONING OR OWNER TRAINING. CONTRACTOR TO SET UP SCHEDULES WITH OWNER'S PERSONNEL.

OPTIMUM START
1 THE UNIT WILL BE COMMANDED TO START PRIOR TO SCHEDULED OCCUPANCY TO MEET OCCUPIED HEATING OR COOLING SET POINTS BY SCHEDULED OCCUPANCY. CONTROL ALGORYTHM SHALL MINIMIZE RUN TIME PRIOR TO OCCUPANCY.
2 DURING THE OPTIMUM START, THE UNIT SHALL OPERATE IN A RECIRCULATION MODE.
3 THE UNIT HEATING DISCHARGE AIR TEMPERATURE SET POINT FOR WARMUP MAY RESET UP TO A HIGH LIMIT OF 85 DEGREES (ADJ).

PRE AND POST OCCUPANCY VENTILATION MODES
1 THE FUNCTIONALITY OF PRE AND POST OCCUPANCY VENTILATION MODE SHALL BE ABLE TO BE DEACTIVATED THROUGH THE USER GRAPHICAL INTERFACE. THE STATUS OF THE PRE AND POST OCCUPANCY VENTILATION MODE WILL BE VISIBLE ON THE GRAPHICS.
2 WHEN ACTIVE THE UNIT WILL OPERATE AS OCCUPIED MODE WITH REDUCED TEMPERATURE SET POINTS TO PROVIDE SPACE PURGE.
3 THE PRE OCCUPANCY VENTILATION MODE WILL INITIALLY BE SET TO 1 HOURS (ADJ) AND THE POST OCCUPANCY VENTILATION MODE WILL BE SET TO 2 HOURS (ADJ).

START UP MODE - OCCUPIED
1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS, RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL SEQUENCE.
3. AFTER THE SUPPLY FAN HAS COMPLETED ITS START UP MODE, THE OUTSIDE AIR DAMPER SHALL MODULATE TO THE DAMPER MIN-MIN POSITION SET DURING BALANCING.

START UP MODE - UNOCCUPIED
1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL.
3. THE OUTSIDE AIR DAMPER REMAINS CLOSED.

VARIABLE FREQUENCY DRIVE OPERATION
1. DDC SHALL COMMUNICATE WITH THE VARIABLE FREQUENCY DRIVES TO PROVIDE THE CONTROL SEQUENCES DESCRIBED.
2. THE DRIVES SHALL BE PROGRAMMED TO AUTOMATICALLY RESTART BASED ON A LOSS OF POWER OR AN ALARM CLEARED. REFER TO THE SPECIFICATION AND THE MANUFACTURER'S INSTALLATION AND OPERATION MANUAL FOR THE MINIMUM AND MAXIMUM QUANTITIES OF RESTARTS BEFORE REQUIRING A MANUAL RESET.

SUPPLY FAN CONTROL
1 THE SUPPLY FAN SHALL BE CONTROLLED TO MAINTAIN A DUCT STATIC SET POINT OF 1.0 INCH (ADJ). THIS MEASUREMENT IS TAKEN FROM THE SYSTEM STATIC PRESSURE SENSOR LOCATED APPROXIMATELY 2/3 OF THE DISTANCE WITHIN THE DUCT DISTRIBUTION SYSTEM. THE SYSTEM BALANCER SHALL VERIFY THE INITIAL SET POINT BASED ON THE BALANCING PROCEDURES IDENTIFIED IN THE PROJECT SPECIFICATION.
2 UPON A COMMAND TO START, THE UNIT CONTROLLER RAMPS THE SUPPLY FAN VFD TO THE SUPPLY FAN MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.
3 THE RTU UNIT CONTROLLER RAMPS THE SUPPLY FAN ARRAY VFD TO MAINTAIN DUCT STATIC SET POINT.

BUILDING PRESSURE / EXHAUST FAN CONTROL
1 THE EXHAUST FAN IS CONTROLLED TO MAINTAIN A SCHEDULED OFFSET (ADJ) FROM THE SUPPLY AIRFLOW. REFER TO MECHANICAL SCHEDULES FOR OFFSET REQUIREMENTS.
2 THE EXHAUST FAN SHALL BE INTERLOCKED TO THE SUPPLY FAN AND ONLY ALLOWED TO RUN WHEN THE SUPPLY FAN IS ENERGIZED AND THE EXHAUST AND RETURN DAMPERS ARE OPEN.
3 UPON A COMMAND TO START, THE ENERGY RECOVERY UNIT CONTROLLER RAMPS THE EXHAUST FAN VFD TO THE EXHAUST FAN'S MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.
4 THE UNIT CONTROLLER SHALL MONITOR BUILDING PRESSURE THROUGH THE REMOTE SPACE STATIC PRESSURE SENSOR LOCATED ABOVE THE CORRIDOR.
5 A POSITIVE PRESSURE OF 0.05" SHOULD BE MAINTAINED IN THE BUILDING. IF PRESSURE FALLS BELOW THIS LEVEL, EXHAUST VFD SHALL DECREASE SPEED OF EXHAUST FAN TO LEVEL REQUIRED TO MAINTAIN POSITIVE PRESSURE.

FILTER MONITORING
1 DDC SHALL MONITOR AND DISPLAY THE AIR FILTER PRESSURE DROPS AND ISSUE A DIRTY FILTER ALARM UPON HIGH DIFFERENTIAL PRESSURE.

HEATING MODE
1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES OUTPUT OF THE GAS HEATING SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

COOLING MODE
1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES THE UNIT'S REFRIGERATION SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

DEHUMIDIFICATION MODE
1 THE UNIT'S PACKAGED CONTROLLER SHALL MONITOR SPACE HUMIDITY (SEE PLANS FOR SENSOR LOCATION IN CORRIDOR)
2 IF HUMIDITY RISES ABOVE SETPOINT AND THE REFRIGERATION SYSTEM IS ACTIVE, THE UNIT SHALL ENABLE THE HOT GAS REHEAT COIL.
3 THE UNIT CONTROLLER SHALL COMMAND THE UNITS REFRIGERATION SYSTEM TO DEHUMIDIFY THE AIR BY MODULATING THE DX AND HOT GAS REHEAT SYSTEMS.

VENTILATION CONTROL
1 DURING THE OCCUPIED MODE, THE UNIT'S PACKAGED CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO THE MIN-MIN OA DAMPER POSITION.
2 THE CONTROLLER SHALL MONITOR RETURN AIR CO2 LEVELS AND MODULATE THE OA DAMPER OPEN TO THE MIN-MAX OA DAMPER POSITION IF THE RETURN CO2 LEVEL RISES ABOVE 1000 PPM (ADJ).
3 THE CONTROLLER SHALL MODULATE THE OA DAMPER BACK TO MIN-MIN OA AFTER A READING OF BELOW 800 PPM FOR 15 MINUTES (ADJ).
4 DURING ECONOMIZER, THE OA DAMPER SHALL BE ALLOWED TO OPEN FULLY AND RECIRC DAMPER CLOSES FULLY.

ENERGY RECOVERY DEVICE
1 DDC SHALL HAVE START/STOP CAPABILITY ON THE ENERGY WHEEL'S MOTOR STARTER/VFD.
2 THE WHEEL SHALL RUN CONTINUOUSLY WHENEVER THE RTU IS ENERGIZED.
3 WHENEVER THE ECONOMIZER IS NOT ACTIVE, THE FACE AND BYPASS DAMPERS WILL MODULATE TO ALLOW AIR TO FLOW THROUGH THE ENERGY WHEEL.
4 THE DIFFERENTIAL PRESSURE ACROSS THE DEVICE SHALL BE MONITORED. UPON REACHING 0.5" ABOVE THE SCHEDULED AIR PRESSURE DROP, AN ALARM SHALL BE ISSUED.

FROST CONTROL
1 WHENEVER ENERGY RECOVERY IS ACTIVE, DDC SHALL MODULATE THE WHEEL FACE AND BYPASS DAMPERS TO MAINTAIN A MINIMUM ADJUSTABLE EXHAUST LEAVING AIR TEMPERATURE SETPOINT TO PREVENT FROST FORMATION.

ECONOMIZER
1 WHENEVER OUTSIDE AIR TEMPERATURE IS BETWEEN 50 DEGREES (ADJ) AND 70 DEGREES (ADJ), THE FACE AND BYPASS DAMPERS SHALL MODULATE OVER 120 SECONDS (ADJ) TO BYPASS THE ENERGY RECOVERY DEVICE.

REMOTE START
1 THE UNIT SHALL HAVE CAPABILITY TO START VIA A REMOTE OVERRIDE PUSHBUTTON. SEE PLANS FOR LOCATION.

TEMPORARY OCCUPANCY
1 UPON ACTIVATION OF THE OVERRIDE PUSH BUTTON OVER RIDE, THE UNIT SHALL ENTER A TEMPORARY OCCUPIED MODE FOR 2 HOURS (ADJ).
2 THE UNIT SHALL ENTER ITS OCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED VENTILATION, HEATING, OR COOLING MODE.

NIGHT CYCLE
1 UPON ACHIEVING AN AIR TERMINAL ZONE TEMPERATURE BELOW UNOCCUPIED HEATING, THE UNIT SHALL ENTER A TEMPORARY OPERATION MODE.
2 THE UNIT WILL ENTER ITS UNOCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED HEATING OR COOLING MODE. IF ENTERING A COOLING MODE, THE COOLING SYSTEM WILL UNDERGO ITS OPTIMUM START FOR SYSTEM COOL DOWN.

SAFETY CONTROL
1 IF SMOKE IS DETECTED IN THE AIRSTREAM BY A DUCT SMOKE DETECTOR OR THE FIRE ALARM ZONE MODULE INDICATES A ZONE ALARM, THE UNIT SHALL BE SHUTDOWN. REFER TO SHUTDOWN MODE.
2 IF A DISCHARGE TEMPERATURE OF 45 DEGREES (ADJ) IS REACHED, THE CONTROLLER SHALL ISSUE AN ALARM.
3 IF A DISCHARGE TEMPERATURE OF 35 DEEGREES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE. SYSTEM TO BE ABLE TO BE RESET FROM BMS, MECHANICAL FREEZESTAT NOT PERMITTED.
4 IF A CONTROLLING SENSOR IS DETERMINED TO HAVE FAILED THAT WOULD DAMAGE THE EQUIPMENT OR CAUSE INAPPROPRIATE CONDITIONS IN THE SPACE, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.
5 IF A STATIC PRESSURE HIGH LIMIT OF 5.5 INCHES (ADJ) OR LOW PRESSURE LIMIT OF NEGATIVE 3.5 INCHES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.

SHUTDOWN MODE CONTROL
1. UPON A SHUTDOWN COMMAND FROM THE DDC SYSTEM OR A SAFETY CONTROL DEVICE COMMAND, THE UNIT SHALL COMMENCE A SHUT DOWN MODE.
2. THE HEATING SYSTEM SHALL CYCLE OFF.
3. THE SUPPLY AND EXHAUST FANS ARE COMMANDED OFF.
4. THE RECIRCULATION DAMPER SHALL OPEN FULLY AND THE OUTSIDE AIR DAMPER SHALL CLOSE.

SET POINTS

1	OCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	60°F
2	OCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
3	UNOCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	65°F
4	UNOCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
5	DEHUMIDIFICATION RETURN RH SETPOINT	55%
5	INITIAL DUCT STATIC SET POINT	1.0 IN WC
6	SPACE PRESSURE SET POINT	0.05 IN WC

FAN POWER MONITORING
1 DDC MONITORS SUPPLY AND EXHAUST FAN VFD'S. DDC REPORTS KWH CONSUMPTION. CONSUMPTION SHALL BE DISPLAYED AS:
   1 INSTANTANEOUS ENERGY USAGE (KW)
   2 WEEKLY ENERGY USAGE (KWH)
   3 YEARLY ENERGY USAGE (KWH)
   4 WEEKLY COMPARATIVE USAGE AFTER FIRST YEAR OF OPERATION (KWH)
2 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

TREND DATA
1 TRENDING FUNCTIONS TO BE AVAILABLE FOR ALL CONTROL AND MONITORING POINTS.
2 SPECIFIC TRENDS TO BE SET UP AS DEFINED BY USER DURING SYSTEM TRAINING
   1 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.
3 PROVIDE TRENDS TO SUPPORT COMMISSIONING ACTIVITIES AS DEFINED BY COMMISSIONING PLAN. REFER TO COMMISSIONING SPECIFICATIONS AND COMMISSIONING PLAN FOR REQUIREMENTS.

1 / M-703 **VAV ENERGY RECOVERY UNIT WITH RECIRC CONTROL DIAGRAM (CLASSROOM RTU-1)**
NOT TO SCALE

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TEMPERATURE CONTROL DIAGRAMS

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REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-703

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
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WHITE BLACK

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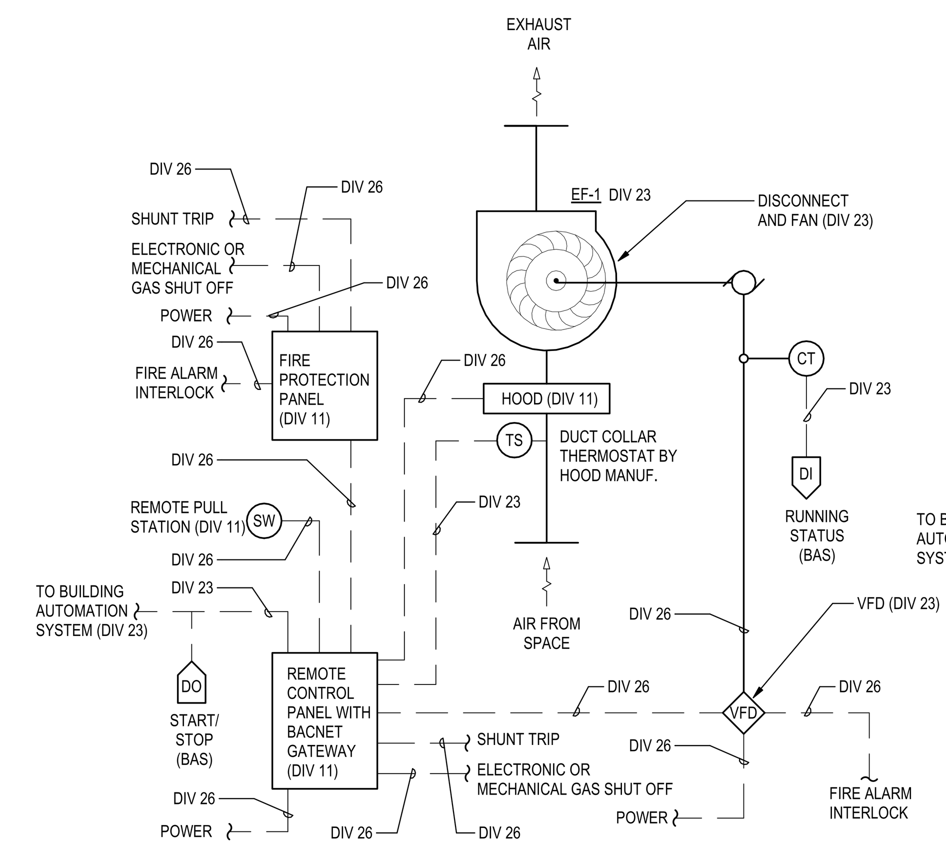
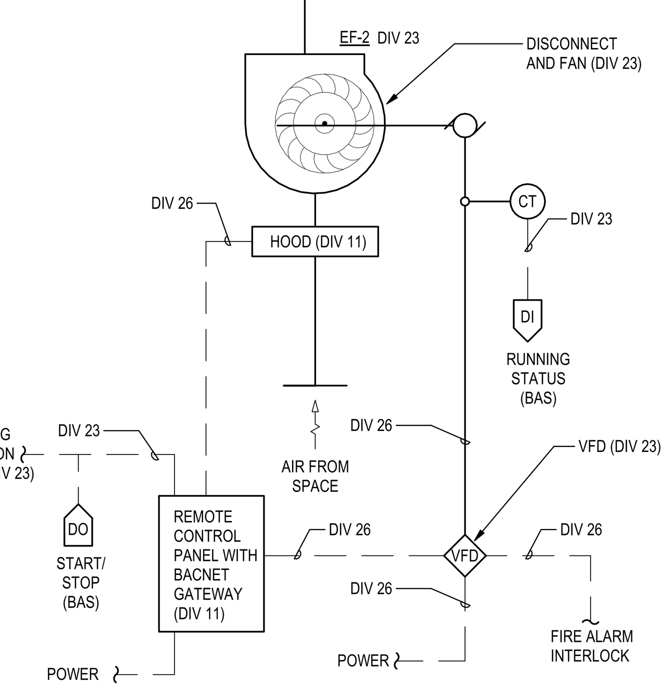
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



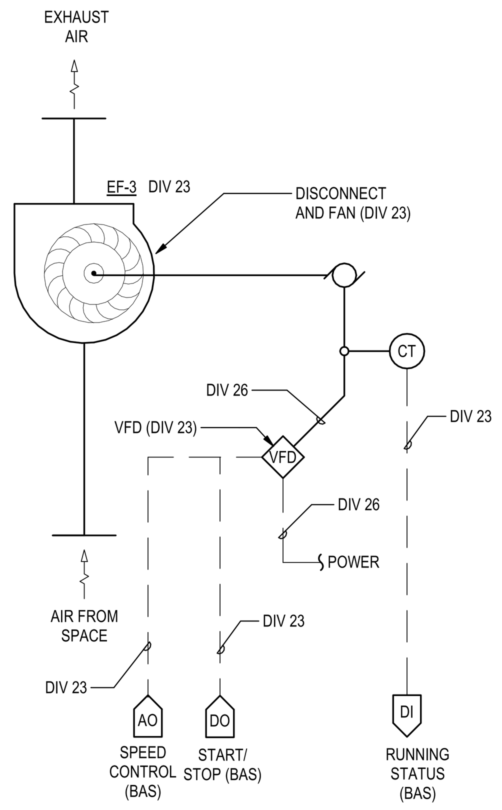
SEQUENCE OF OPERATION
GENERAL
1. ALL HAND-OFF-AUTO (H-O-A) SWITCHES NORMALLY REMAIN IN THE "AUTO" POSITION AND THE "HAND" AND "OFF" POSITIONS ARE USED FOR MAINTENANCE SITUATIONS.
2. AN EXHAUST FAN START REQUEST MAY BE ACTIVATED BY:
A. LOCAL PUSH BUTTON (THROUGH CONTROLLER)
B. HEAT SENSOR IN DUCT (FSE PROVIDED HOOD CONTROLLER).
C. FIRE ALARM SYSTEM / HOOD SUPPRESSION SYSTEM.
THE DDC SYSTEM ALSO HAS THE ABILITY TO START AND STOP THE FAN VFD.
3. UPON ACTIVATION FROM THE HOOD CONTROLLER / DUCT COLLAR TEMP SENSOR, THE VFD, RAMPS UP TO THE POSITION INDICATED BY THE HOOD CONTROLLER. (0-10V SIGNAL WILL CYCLE VFD BETWEEN 80% AND 100% BASED ON HEAT).
4. UPON ACTIVATION FROM THE PUSHBUTTON OR OTHER INTERLOCKS, THE VFD RAMPS UP TO THE MAX POSITION SET BY THE BALANCER.
5. EXHAUST FAN DOES NOT RUN DURING UNOCCUPIED PERIODS, UNLESS ANY OF THE MANUAL SWITCHES OR HOOD CONTROLLER CALLS FOR OPERATION.
6. ALL EXHAUST FAN MOTORS ARE MONITORED WITH CURRENT SENSORS. WHEN THE EXHAUST FAN IS COMMANDED TO RUN, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), AND STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL FAN FAILURE ALARM.
7. WHEN THE EXHAUST FAN IS COMMANDED TO STOP, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL FAN FAILURE ALARM.

COOKING HOOD EXHAUST



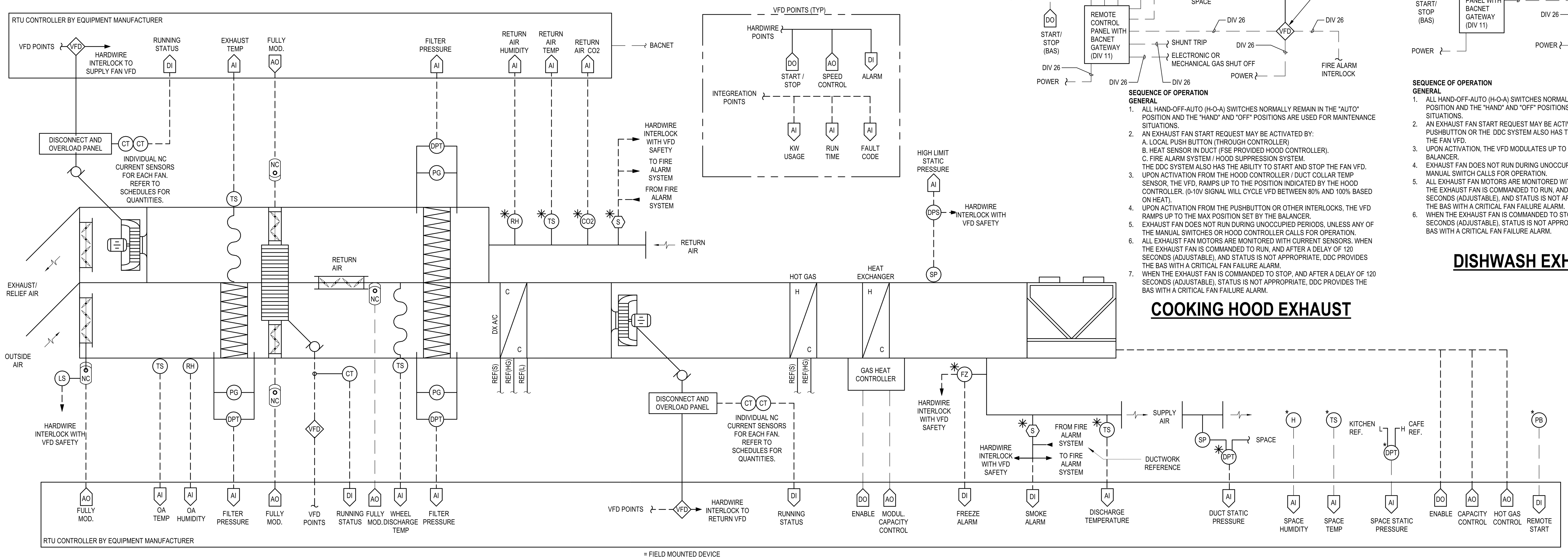
SEQUENCE OF OPERATION
GENERAL
1. ALL HAND-OFF-AUTO (H-O-A) SWITCHES NORMALLY REMAIN IN THE "AUTO" POSITION AND THE "HAND" AND "OFF" POSITIONS ARE USED FOR MAINTENANCE SITUATIONS.
2. AN EXHAUST FAN START REQUEST MAY BE ACTIVATED BY A LOCAL PUSHBUTTON OR THE DDC SYSTEM ALSO HAS THE ABILITY TO START AND STOP THE FAN VFD.
3. UPON ACTIVATION, THE VFD MODULATES UP TO THE MAX POSITION SET BY THE BALANCER.
4. EXHAUST FAN DOES NOT RUN DURING UNOCCUPIED PERIODS, UNLESS THE MANUAL SWITCH CALLS FOR OPERATION.
5. ALL EXHAUST FAN MOTORS ARE MONITORED WITH CURRENT SENSORS. WHEN THE EXHAUST FAN IS COMMANDED TO RUN, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), AND STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL FAN FAILURE ALARM.
6. WHEN THE EXHAUST FAN IS COMMANDED TO STOP, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL FAN FAILURE ALARM.

DISHWASH EXHAUST



SEQUENCE OF OPERATION
GENERAL
1. ALL HAND-OFF-AUTO (H-O-A) SWITCHES NORMALLY REMAIN IN THE "AUTO" POSITION AND THE "HAND" AND "OFF" POSITIONS ARE USED FOR MAINTENANCE SITUATIONS.
2. UPON ACTIVATION, THE VFD RAMPS UP TO THE MAX POSITION SET BY THE BALANCER.
3 EXHAUST FAN DOES NOT RUN DURING UNOCCUPIED PERIODS, UNLESS THE RTU OPERATION OVERRIDE HAS BEEN ACTIVATED.
4 ALL EXHAUST FAN MOTORS ARE MONITORED WITH CURRENT SENSORS. WHEN THE EXHAUST FAN IS COMMANDED TO RUN, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), AND STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL FAN FAILURE ALARM.
5 WHEN THE EXHAUST FAN IS COMMANDED TO STOP, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL FAN FAILURE ALARM.

KITCHEN GENERAL EXHAUST



= FIELD MOUNTED DEVICE

SEQUENCE OF OPERATION
GENERAL
1 THE UNIT WILL BE PROVIDED WITH PACKAGED DDC CONTROLS PROGRAMMED TO THE SEQUENCE OF OPERATION DESCRIBED WITHIN THE CONTRACT DOCUMENTS. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, GATEWAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.
2 ALL FIELD WIRED OR INSTALLED DEVICES WILL BE PROCURRED AND INSTALLED BY THE CONTRACTOR. DEVICES MAY BE PROVIDED BY UNIT MANUFACTURER. CONTRACTOR SHALL COORDINATE AND PROVIDE ALL ADDITIONAL COMPONENTS OR LABOR FOR A COMPLETE AND OPERATIONAL SYSTEM COMPLYING WITH THE OPERATING INTENT OF THE DOCUMENTS.
3 ALL POINTS IDENTIFIED IN THE CONSTRUCTION DOCUMENTS WILL BE DISPLAYED ON THE USER'S GRAPHIC INTERFACE. ALARMS AND OTHER SYSTEM NOTIFICATIONS WILL BE REPORTED TO SYSTEM USERS. PROVIDE ALL NECESSARY INTEGRATION FROM PACKAGED CONTROLLER TO FACILITY CONTROL SYSTEM.
4 ALL HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITION AND THE HAND AND OFF POSITIONS ARE USED FOR MAINTENANCE SITUATIONS. ALL SET POINTS, DEAD BANDS, AND TIME DELAY INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEAD BANDS AND TIME DELAYS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.

SCHEDULING
1. THE RTU RUNS CONTINUOUSLY DURING THE OCCUPIED MODE UNLESS DEACTIVATED FOR MAINTENANCE, SCHEDULED SHUTDOWNS, OR IF A SAFETY TRIPS.
2. THE RTU SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM. OCCUPIED AND UNOCCUPIED SCHEDULE TO BE PROGRAMMED DURING SYSTEM COMMISSIONING OR OWNER TRAINING. CONTRACTOR TO SET UP SCHEDULES WITH OWNER'S PERSONNEL.

OPTIMUM START
1 THE UNIT WILL BE COMMANDED TO START PRIOR TO SCHEDULED OCCUPANCY TO MEET OCCUPIED HEATING OR COOLING SET POINTS BY SCHEDULED OCCUPANCY. CONTROL ALGORYTHM SHALL MINIMIZE RUN TIME PRIOR TO OCCUPANCY.
2 DURING THE OPTIMUM START, THE UNIT SHALL OPERATE IN A RECIRCULATION MODE.
3 THE UNIT HEATING DISCHARGE AIR TEMPERATURE SET POINT FOR WARMUP MAY RESET UP TO A HIGH LIMIT OF 85 DEGREES (ADJ).

PRE AND POST OCCUPANCY VENTILATION MODES
1 THE FUNCTIONALITY OF PRE AND POST OCCUPANCY VENTILATION MODE SHALL BE ABLE TO BE DEACTIVATED THROUGH THE USER GRAPHICAL INTERFACE. THE STATUS OF THE PRE AND POST OCCUPANCY VENTILATION MODE WILL BE VISIBLE ON THE GRAPHICS.
2 WHEN ACTIVE THE UNIT WILL OPERATE AS OCCUPIED MODE WITH REDUCED TEMPERATURE SET POINTS TO PROVIDE SPACE PURGE.
3 THE PRE OCCUPANCY VENTILATION MODE WILL INITIALLY BE SET TO 1 HOURS (ADJ) AND THE POST OCCUPANCY VENTILATION MODE WILL BE SET TO 2 HOURS (ADJ).

START UP MODE - OCCUPIED
1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS, RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL SEQUENCE.
3. AFTER THE SUPPLY FAN HAS COMPLETED ITS START UP MODE, THE OUTSIDE AIR DAMPER SHALL MODULATE TO THE DAMPER MIN-MIN POSITION SET DURING BALANCING.

START UP MODE - UNOCCUPIED
1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL.
3. THE OUTSIDE AIR DAMPER REMAINS CLOSED.

VARIABLE FREQUENCY DRIVE OPERATION
1. DDC SHALL COMMUNICATE WITH THE VARIABLE FREQUENCY DRIVES TO PROVIDE THE CONTROL SEQUENCES DESCRIBED.
2. THE DRIVES SHALL BE PROGRAMMED TO AUTOMATICALLY RESTART BASED ON A LOSS OF POWER OR AN ALARM CLEARED. REFER TO THE SPECIFICATION AND THE MANUFACTURER'S INSTALLATION AND OPERATION MANUAL FOR THE MINIMUM AND MAXIMUM QUANTITIES OF RESTARTS BEFORE REQUIRING A MANUAL RESET.

SUPPLY FAN CONTROL
1 THE SUPPLY FAN SHALL BE CONTROLLED TO MAINTAIN A DUCT STATIC SET POINT OF 1.0 INCH (ADJ). THIS MEASUREMENT IS TAKEN FROM THE SYSTEM STATIC PRESSURE SENSOR LOCATED APPROXIMATELY 2/3 OF THE DISTANCE WITHIN THE DUCT DISTRIBUTION SYSTEM. THE SYSTEM BALANCER SHALL VERIFY THE INITIAL SET POINT BASED ON THE BALANCING PROCEDURES IDENTIFIED IN THE PROJECT SPECIFICATION.
2 UPON A COMMAND TO START, THE UNIT CONTROLLER RAMPS THE SUPPLY FAN VFD TO THE SUPPLY FAN MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.
3 THE RTU UNIT CONTROLLER RAMPS THE SUPPLY FAN ARRAY VFD TO MAINTAIN DUCT STATIC SET POINT.

BUILDING PRESSURE / EXHAUST FAN CONTROL
1 THE EXHAUST FAN IS CONTROLLED TO MAINTAIN A SCHEDULED OFFSET (ADJ) FROM THE SUPPLY AIRFLOW. REFER TO MECHANICAL SCHEDULES FOR OFFSET REQUIREMENTS.
2 THE EXHAUST FAN SHALL BE INTERLOCKED TO THE SUPPLY FAN AND ONLY ALLOWED TO RUN WHEN THE SUPPLY FAN IS ENERGIZED AND THE EXHAUST AND RETURN DAMPERS ARE OPEN.
3 UPON A COMMAND TO START, THE ENERGY RECOVERY UNIT CONTROLLER RAMPS THE EXHAUST FAN VFD TO THE EXHAUST FAN'S MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.
4 THE UNIT CONTROLLER SHALL MONITOR BUILDING PRESSURE THROUGH THE REMOTE SPACE STATIC PRESSURE SENSOR LOCATED ABOVE THE CORRIDOR.
5 A POSITIVE PRESSURE OF 0.05" SHOULD BE MAINTAINED IN THE CAFETERIA. IF PRESSURE FALLS BELOW THIS LEVEL, RETURN VFD SHALL DECREASE SPEED OF RETURN FAN TO LEVEL REQUIRED TO MAINTAIN POSITIVE PRESSURE.

FILTER MONITORING
1 DDC SHALL MONITOR AND DISPLAY THE AIR FILTER PRESSURE DROPS AND ISSUE A DIRTY FILTER ALARM UPON HIGH DIFFERENTIAL PRESSURE.

HEATING MODE
1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES OUTPUT OF THE GAS HEATING SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

COOLING MODE
1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES THE UNIT'S REFRIGERATION SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

DEHUMIDIFICATION MODE
1 THE UNIT'S PACKAGED CONTROLLER SHALL MONITOR SPACE HUMIDITY (SEE PLANS FOR SENSOR LOCATION IN CAFETERIA)
2 IF HUMIDITY RISES ABOVE SETPOINT AND THE REFRIGERATION SYSTEM IS ACTIVE, THE UNIT SHALL ENABLE THE HOT GAS REHEAT COIL.
3 THE UNIT CONTROLLER SHALL COMMAND THE UNITS REFRIGERATION SYSTEM TO DEHUMIDIFY THE AIR BY MODULATING THE DX AND HOT GAS REHEAT SYSTEMS.

VENTILATION CONTROL
1 DURING THE OCCUPIED MODE, THE UNIT'S PACKAGED CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO THE MIN-MIN OA DAMPER POSITION.
2 THE CONTROLLER SHALL MONITOR RETURN AIR CO2 LEVELS AND MODULATE THE OA DAMPER OPEN TO THE MIN-MAX OA DAMPER POSITION IF THE RETURN CO2 LEVEL RISES ABOVE 1000 PPM (ADJ).
3 THE CONTROLLER SHALL MODULATE THE OA DAMPER BACK TO MIN-MIN OA AFTER A READING OF BELOW 800 PPM FOR 15 MINUTES (ADJ).
4 DURING ECONOMIZER, THE OA DAMPER SHALL BE ALLOWED TO OPEN FULLY AND RECIRC DAMPER CLOSES FULLY.

VENTILATION OVERRIDE
1 THE CONTROLLER SHALL MODULATE THE OA DAMPER OPEN TO THE MIN-MAX OA DAMPER POSITION UPON ACTIVATION OF EF-1.

ENERGY RECOVERY DEVICE
1 DDC SHALL HAVE START/STOP CAPABILITY ON THE ENERGY WHEEL'S MOTOR STARTER/VFD.
2 THE WHEEL SHALL RUN CONTINUOUSLY WHENEVER THE RTU IS ENERGIZED.
3 WHENEVER THE ECONOMIZER IS NOT ACTIVE, THE FACE AND BYPASS DAMPERS WILL MODULATE TO ALLOW AIR TO FLOW THROUGH THE ENERGY WHEEL.
4 THE DIFFERENTIAL PRESSURE ACROSS THE DEVICE SHALL BE MONITORED. UPON REACHING 0.5" ABOVE THE SCHEDULED AIR PRESSURE DROP, AN ALARM SHALL BE ISSUED.

FROST CONTROL
1 WHENEVER ENERGY RECOVERY IS ACTIVE, DDC SHALL MODULATE THE WHEEL FACE AND BYPASS DAMPERS TO MAINTAIN A MINIMUM ADJUSTABLE EXHAUST LEAVING AIR TEMPERATURE SETPOINT TO PREVENT FROST FORMATION.

INTERLOCKED EXHAUST FAN CONTROL
1 KITCHEN GENERAL EXHAUST FAN (EF-3) VFD SHALL MODULATE UP AND RUN AT MAX CFM AS SET BY BALANCER WHENEVER THE RTU IS ENERGIZED.
2 WHEN THE KITCHEN COOKING HOOD EXHAUST FAN (EF-1) OR THE DISHWASHER HOOD EXHAUST FAN (EF-2) IS ENERGIZED, THE KITCHEN GENERAL EXHAUST FAN (EF-3) VFD SHALL MODULATE DOWN TO MINIMUM SPEED.

ECONOMIZER
1 WHENEVER OUTSIDE AIR TEMPERATURE IS BETWEEN 50 DEGREES (ADJ) AND 70 DEGREES (ADJ), THE FACE AND BYPASS DAMPERS SHALL MODULATE OVER 120 SECONDS (ADJ) TO BYPASS THE ENERGY RECOVERY DEVICE.

REMOTE START
1 THE UNIT SHALL HAVE CAPABILITY TO START VIA A REMOTE OVERRIDE PUSHBUTTON. SEE PLANS FOR LOCATION.

TEMPORARY OCCUPANCY
1 UPON ACTIVATION OF THE OVERRIDE PUSH BUTTON OVER RIDE, THE UNIT SHALL ENTER A TEMPORARY OCCUPIED MODE FOR 2 HOURS (ADJ).
2 THE UNIT SHALL ENTER ITS OCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED VENTILATION, HEATING, OR COOLING MODE.

NIGHT CYCLE
1 UPON ACHIEVING AN AIR TERMINAL ZONE TEMPERATURE BELOW UNOCCUPIED HEATING, THE UNIT SHALL ENTER A TEMPORARY OPERATION MODE.
2 THE UNIT WILL ENTER ITS UNOCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED HEATING OR COOLING MODE. IF ENTERING A COOLING MODE, THE COOLING SYSTEM WILL UNDERGO ITS OPTIMUM START FOR SYSTEM COOL DOWN.

SAFETY CONTROL
1 IF SMOKE IS DETECTED IN THE AIRSTREAM BY A DUCT SMOKE DETECTOR OR THE FIRE ALARM ZONE MODULE INDICATES A ZONE ALARM, THE UNIT SHALL BE SHUTDOWN. REFER TO SHUTDOWN MODE.
2 IF A DISCHARGE TEMPERATURE OF 45 DEGREES (ADJ) IS REACHED, THE CONTROLLER SHALL ISSUE AN ALARM.
3 IF A DISCHARGE TEMPERATURE OF 35 DEEGREES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE. SYSTEM TO BE ABLE TO BE RESET FROM BMS, MECHANICAL FREEZESTAT NOT PERMITTED.
4 IF A CONTROLLING SENSOR IS DETERMINED TO HAVE FAILED THAT WOULD DAMAGE THE EQUIPMENT OR CAUSE INAPPROPRIATE CONDITIONS IN THE SPACE, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.
5 IF A STATIC PRESSURE HIGH LIMIT OF 5.5 INCHES (ADJ) OR LOW PRESSURE LIMIT OF NEGATIVE 3.5 INCHES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.

SHUTDOWN MODE CONTROL
1. UPON A SHUTDOWN COMMAND FROM THE DDC SYSTEM OR A SAFETY CONTROL DEVICE COMMAND, THE UNIT SHALL COMMENCE A SHUT DOWN MODE.
2. THE HEATING SYSTEM SHALL CYCLE OFF.
3. THE SUPPLY AND EXHAUST FANS ARE COMMANDED OFF.
4. THE RECIRCULATION DAMPER SHALL OPEN FULLY AND THE OUTSIDE AIR DAMPER SHALL CLOSE.
5. AFTER A 5 MINUTE DELAY (ADJ), THE DISCHARGE AIR DAMPER SHALL CLOSE.

SET POINTS

1	OCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	60°F
2	OCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
3	UNOCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	65°F
4	UNOCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
5	DEHUMIDIFICATION SPACE RH SETPOINT	55%
5	INITIAL DUCT STATIC SET POINT	1.0 IN WC
6	SPACE PRESSURE SET POINT	0.1 IN WC

FAN POWER MONITORING
1 DDC MONITORS SUPPLY AND RETURN FAN VFD'S. DDC REPORTS KWH CONSUMPTION. CONSUMPTION SHALL BE DISPLAYED AS:
1 INSTANTANEOUS ENERGY USAGE (KW)
2 WEEKLY ENERGY USAGE (KWH)
3 YEARLY ENERGY USAGE (KWH)
4 WEEKLY COMPARATIVE USAGE AFTER FIRST YEAR OF OPERATION (KWH)
2 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

TREND DATA
1 TRENDING FUNCTIONS TO BE AVAILABLE FOR ALL CONTROL AND MONITORING POINTS.
2 SPECIFIC TRENDS TO BE SET UP AS DEFINED BY USER DURING SYSTEM TRAINING
1 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.
3 PROVIDE TRENDS TO SUPPORT COMMISSIONING ACTIVITIES AS DEFINED BY COMMISSIONING PLAN. REFER TO COMMISSIONING SPECIFICATIONS AND COMMISSIONING PLAN FOR REQUIREMENTS.

1 M-704 VAV ENERGY RECOVERY WITH RECIRC CONTROL DIAGRAM (CAFETERIA / KITCHEN RTU-2)

NOT TO SCALE

NATURAL GAS SHUT OFF INTERLOCKED TO KITCHEN FIRE SUPPRESSION SYSTEM. (SEE FOOD SERVICE DRAWINGS FOR QUANTITIES.

SEQUENCE OF OPERATION
GENERAL
1. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL

2. UPON ACTIVATION OF THE FIRE ALARM OR A LOCAL EMERGENCY PUSH BUTTON, DDC SHALL CLOSE THE EMERGENCY GAS VALVES.

3. UPON ACTIVATION, DDC SHALL ISSUE AN ALARM.

EMERGENCY GAS SHUT-OFF

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Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

TEMPERATURE CONTROL DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-704

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK WHITE
WE RECYCLE

6/28/2023 9:34:33 AM
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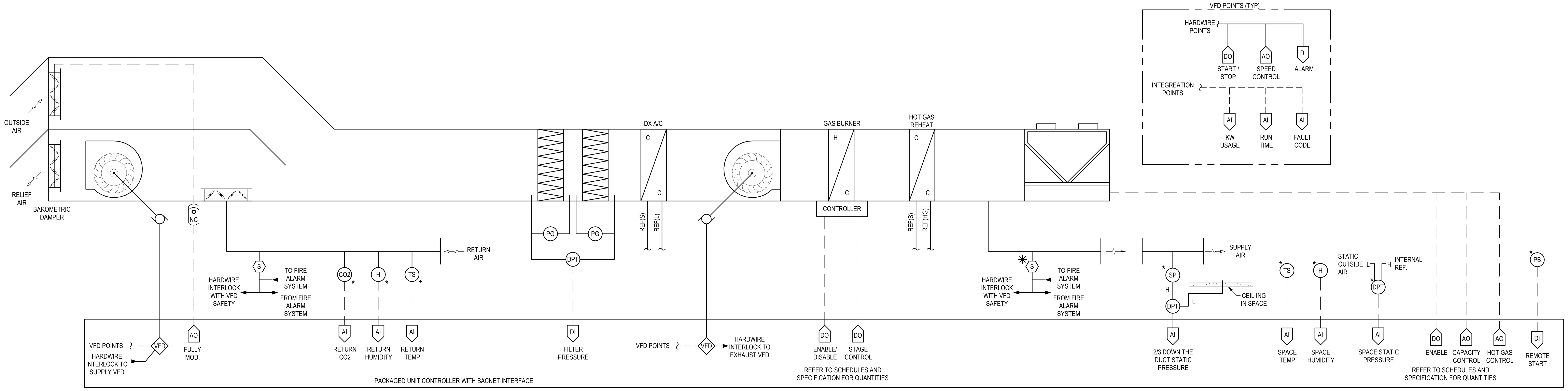
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



✳ FIELD INSTALLED DEVICE

SEQUENCE OF OPERATION
GENERAL
1 THE UNIT WILL BE PROVIDED WITH PACKAGED DDC CONTROLS PROGRAMMED TO THE SEQUENCE OF OPERATION DESCRIBED WITHIN THE CONTRACT DOCUMENTS. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, GATEWAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.
2 ALL FIELD WIRED OR INSTALLED DEVICES WILL BE PROCURRED AND INSTALLED BY THE CONTRACTOR. DEVICES MAY BE PROVIDED BY UNIT MANUFACTURER. CONTRACTOR SHALL COORDINATE AND PROVIDE ALL ADDITIONAL COMPONENTS OR LABOR FOR A COMPLETE AND OPERATIONAL SYSTEM COMPLYING WITH THE OPERATING INTENT OF THE DOCUMENTS.
3 ALL POINTS IDENTIFIED IN THE CONSTRUCTION DOCUMENTS WILL BE DISPLAYED ON THE USER'S GRAPHIC INTERFACE. ALARMS AND OTHER SYSTEM NOTIFICATIONS WILL BE REPORTED TO SYSTEM USERS. PROVIDE ALL NECESSARY INTEGRATION FROM PACKAGED CONTROLLER TO FACILITY CONTROL SYSTEM.
4 ALL HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITION AND THE HAND AND OFF POSITIONS ARE USED FOR MAINTENANCE SITUATIONS. ALL SET POINTS, DEAD BANDS, AND TIME DELAY INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEAD BANDS AND TIME DELAYS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.

SCHEDULING
1. THE RTU RUNS CONTINUOUSLY DURING THE OCCUPIED MODE UNLESS DEACTIVATED FOR MAINTENANCE, SCHEDULED SHUTDOWNS, OR IF A SAFETY TRIPS.
2. THE RTU SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM. OCCUPIED AND UNOCCUPIED SCHEDULE TO BE PROGRAMMED DURING SYSTEM COMMISSIONING OR OWNER TRAINING. CONTRACTOR TO SET UP SCHEDULES WITH OWNER'S PERSONNEL.

OPTIMUM START
1 THE UNIT WILL BE COMMANDED TO START PRIOR TO SCHEDULED OCCUPANCY TO MEET OCCUPIED HEATING OR COOLING SET POINTS BY SCHEDULED OCCUPANCY. CONTROL ALGORYTHM SHALL MINIMIZE RUN TIME PRIOR TO OCCUPANCY.
2 DURING THE OPTIMUM START, THE UNIT SHALL OPERATE IN A RECIRCULATION MODE.
3 THE UNIT HEATING DISCHARGE AIR TEMPERATURE SET POINT FOR WARMUP MAY RESET UP TO A HIGH LIMIT OF 85 DEGREES (ADJ).

PRE AND POST OCCUPANCY VENTILATION MODES
1 THE FUNCTIONALITY OF PRE AND POST OCCUPANCY VENTILATION MODE SHALL BE ABLE TO BE DEACTIVATED THROUGH THE USER GRAPHICAL INTERFACE. THE STATUS OF THE PRE AND POST OCCUPANCY VENTILATION MODE WILL BE VISIBLE ON THE GRAPHICS.
2 WHEN ACTIVE THE UNIT WILL OPERATE AS OCCUPIED MODE WITH REDUCED TEMPERATURE SET POINTS TO PROVIDE SPACE PURGE.
3 THE PRE OCCUPANCY VENTILATION MODE WILL INITIALLY BE SET TO 1 HOURS (ADJ) AND THE POST OCCUPANCY VENTILATION MODE WILL BE SET TO 2 HOURS (ADJ).

START UP MODE - OCCUPIED
1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS, RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL SEQUENCE.
3. AFTER THE SUPPLY FAN HAS COMPLETED ITS START UP MODE, THE OUTSIDE AIR DAMPER SHALL MODULATE TO THE DAMPER MIN-MIN POSITION SET DURING BALANCING.

START UP MODE - UNOCCUPIED
1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL.
3. THE OUTSIDE AIR DAMPER REMAINS CLOSED.

VARIABLE FREQUENCY DRIVE OPERATION
1. DDC SHALL COMMUNICATE WITH THE VARIABLE FREQUENCY DRIVES TO PROVIDE THE CONTROL SEQUENCES DESCRIBED.
2. THE DRIVES SHALL BE PROGRAMMED TO AUTOMATICALLY RESTART BASED ON A LOSS OF POWER OR AN ALARM CLEARED. REFER TO THE SPECIFICATION AND THE MANUFACTURER'S INSTALLATION AND OPERATION MANUAL FOR THE MINIMUM AND MAXIMUM QUANTITIES OF RESTARTS BEFORE REQUIRING A MANUAL RESET.

SUPPLY FAN CONTROL
1 THE SUPPLY FAN SHALL BE CONTROLLED TO MAINTAIN A DUCT STATIC SET POINT OF 1.0 INCH (ADJ). THIS MEASUREMENT IS TAKEN FROM THE SYSTEM STATIC PRESSURE SENSOR LOCATED APPROXIMATELY 2/3 OF THE DISTANCE WITHIN THE DUCT DISTRIBUTION SYSTEM. THE SYSTEM BALANCER SHALL VERIFY THE INITIAL SET POINT BASED ON THE BALANCING PROCEDURES IDENTIFIED IN THE PROJECT SPECIFICATION.
2 UPON A COMMAND TO START, THE UNIT CONTROLLER RAMPS THE SUPPLY FAN VFD TO THE SUPPLY FAN MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.
3 THE RTU UNIT CONTROLLER RAMPS THE SUPPLY FAN ARRAY VFD TO MAINTAIN DUCT STATIC SET POINT.

RELIEF FAN CONTROL - OCCUPIED MODE
1 THE POWER EXHAUST FAN IS CONTROLLED TO MAINTAIN THE SPACE PRESSURE SETPOINT.
2 THE EHXUAST FAN SHALL BE INTERLOCKED TO THE SUPPLY FAN AND ONLY ALLOWED TO RUN WHEN THE SUPPLY FAN IS ENERGIZED.
3 UPON A COMMAND TO START, DDC MODULATES THE EXHAUST FAN'S VFD TO THE EXHAUST FAN'S MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD MODULATES THE SPEED OF THE FAN SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH SPACE PRESSURE SET POINT.

FILTER MONITORING
1 DDC SHALL MONITOR AND DISPLAY THE AIR FILTER PRESSURE DROPS AND ISSUE A DIRTY FILTER ALARM UPON HIGH DIFFERENTIAL PRESSURE.

HEATING MODE
1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES OUTPUT OF THE GAS HEATING SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

COOLING MODE
1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES THE UNIT'S REFRIGERATION SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

DEHUMIDIFICATION MODE
1 THE UNIT'S PACKAGED CONTROLLER SHALL MONITOR SPACE HUMIDITY (SEE PLANS FOR SENSOR LOCATION IN CORRIDOR)
2 IF HUMIDITY RISES ABOVE SETPOINT AND THE REFRIGERATION SYSTEM IS ACTIVE, THE UNIT SHALL ENABLE THE HOT GAS REHEAT COIL.
3 THE UNIT CONTROLLER SHALL COMMAND THE UNITS REFRIGERATION SYSTEM TO DEHUMIDIFY THE AIR BY MODULATING THE DX AND HOT GAS REHEAT SYSTEMS.
4 OMIT DEHUMIDIFICATION MODE FOR RTU-5. UNIT WILL NOT HAVE HOT GAS REHEAT COIL.

VENTILATION CONTROL
1 DURING THE OCCUPIED MODE, THE UNIT'S PACKAGED CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO THE MIN-MIN OA DAMPER POSITION.
2 THE CONTROLLER SHALL MONITOR RETURN AIR CO2 LEVELS AND MODULATE THE OA DAMPER OPEN TO THE MIN-MAX OA DAMPER POSITION IF THE RETURN CO2 LEVEL RISES ABOVE 1000 PPM (ADJ).
3 THE CONTROLLER SHALL MODULATE THE OA DAMPER BACK TO MIN-MIN OA AFTER A READING OF BELOW 800 PPM FOR 15 MINUTES (ADJ).
4 DURING ECONOMIZER, THE OA DAMPER SHALL BE ALLOWED TO OPEN FULLY AND RECIRC DAMPER CLOSES FULLY.
5 OMIT CO2 SENSOR AND MIN-MIN, MIN-MAX SEQUENCE FOR RTU-4. OCCUPIED MODE OPENS THE OA DAMPER TO A SINGLE DESIGN POSITION AND REMAINS THERE.

ECONOMIZER MODE
1 WHEN THE OUTSIDE ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY, OUTSIDE AIR WILL STAGE AS THE FIRST STAGE OF COOLING.
2 THE UNIT'S PACKAGED CONTROLLER WILL MODULATE THE OUTSIDE AIR DAMPER AND THE POWER EXHAUST.

INTERLOCKED EXHAUST FAN CONTROL
1 DDC SHALL OPEN THE ASSOCIATED MOTORIZED DAMPER. AFTER A 60 SECOND DELAY (ADJ), DDC SHALL ENERGIZE THE EXHAUST FAN AND IT SHALL RUN CONTINUOUSLY.
2 DDC SHALL MONITOR THE EXHAUST FAN STATUS THROUGH THE CURRENT SENSOR. SHOULD THE STATUS NOT BE PROPER FOR THE OPERATION, AN ALARM SHALL BE ISSUED.
3 WHEN COMMANDED TO SHUT DOWN, DDC SHALL DE-ENERGIZE THE EXHAUST FAN. AFTER A 60 SECOND DELAY (ADJ), DDC SHALL CLOSE THE ASSOCIATED MOTORIZED DAMPER.

REMOTE START
1 THE UNIT SHALL HAVE CAPABILITY TO START VIA A REMOTE OVERRIDE PUSHBUTTON. SEE PLANS FOR LOCATION.

TEMPORARY OCCUPANCY
1 UPON ACTIVATION OF THE OVERRIDE PUSH BUTTON OVER RIDE, THE UNIT SHALL ENTER A TEMPORARY OCCUPIED MODE FOR 2 HOURS (ADJ).
2 THE UNIT SHALL ENTER ITS OCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED VENTILATION, HEATING, OR COOLING MODE.

NIGHT CYCLE
1 UPON ACHIEVING AN AIR TERMINAL ZONE TEMPERATURE BELOW UNOCCUPIED HEATING, THE UNIT SHALL ENTER A TEMPORARY OPERATION MODE.
2 THE UNIT WILL ENTER ITS UNOCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED HEATING OR COOLING MODE. IF ENTERING A COOLING MODE, THE COOLING SYSTEM WILL UNDERGO ITS OPTIMUM START FOR SYSTEM COOL DOWN.

SAFETY CONTROL
1 IF SMOKE IS DETECTED IN THE AIRSTREAM BY A DUCT SMOKE DETECTOR OR THE FIRE ALARM ZONE MODULE INDICATES A ZONE ALARM, THE UNIT SHALL BE SHUTDOWN. REFER TO SHUTDOWN MODE.
2 IF A DISCHARGE TEMPERATURE OF 45 DEGREES (ADJ) IS REACHED, THE CONTROLLER SHALL ISSUE AN ALARM.
3 IF A DISCHARGE TEMPERATURE OF 35 DEEGREES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE. SYSTEM TO BE ABLE TO BE RESET FROM BMS, MECHANICAL FREEZESTAT NOT PERMITTED.
4 IF A CONTROLLING SENSOR IS DETERMINED TO HAVE FAILED THAT WOULD DAMAGE THE EQUIPMENT OR CAUSE INAPPROPRIATE CONDITIONS IN THE SPACE, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.
5 IF A STATIC PRESSURE HIGH LIMIT OF 5.5 INCHES (ADJ) OR LOW PRESSURE LIMIT OF NEGATIVE 3.5 INCHES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.

SHUTDOWN MODE CONTROL
1. UPON A SHUTDOWN COMMAND FROM THE DDC SYSTEM OR A SAFETY CONTROL DEVICE COMMAND, THE UNIT SHALL COMMENCE A SHUT DOWN MODE.
2. THE HEATING SYSTEM SHALL CYCLE OFF.
3. THE SUPPLY AND EXHAUST FANS ARE COMMANDED OFF.
4. THE RECIRCULATION DAMPER SHALL OPEN FULLY AND THE OUTSIDE AIR DAMPER SHALL CLOSE.
5. AFTER A 5 MINUTE DELAY (ADJ), THE DISCHARGE AIR DAMPER SHALL CLOSE.

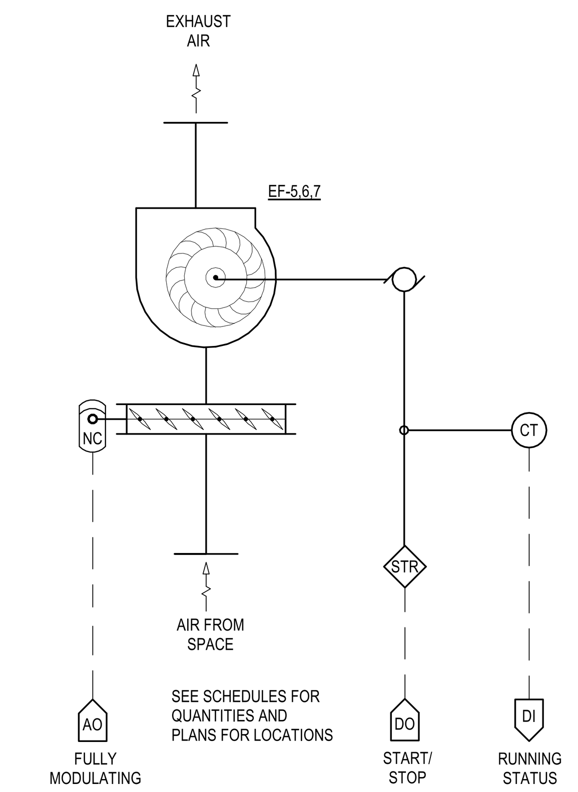
SET POINTS

1	OCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	60°F
2	OCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
3	UNOCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	65°F
4	UNOCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
5	DEHUMIDIFICATION RETURN RH SETPOINT	55%
5	INITIAL DUCT STATIC SET POINT	1.0 IN WC
6	SPACE PRESSURE SET POINT	0.1 IN WC

FAN POWER MONITORING
1 DDC MONITORS SUPPLY AND RETURN FAN VFD'S. DDC REPORTS KWH CONSUMPTION. CONSUMPTION SHALL BE DISPLAYED AS:
   1 INSTANTANEOUS ENERGY USAGE (KW)
   2 WEEKLY ENERGY USAGE (KWH)
   3 YEARLY ENERGY USAGE (KWH)
   4 WEEKLY COMPARATIVE USAGE AFTER FIRST YEAR OF OPERATION (KWH)
2 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

TREND DATA
1 TRENDING FUNCTIONS TO BE AVAILABLE FOR ALL CONTROL AND MONITORING POINTS.
2 SPECIFIC TRENDS TO BE SET UP AS DEFINED BY USER DURING SYSTEM TRAINING
   1 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.
3 PROVIDE TRENDS TO SUPPORT COMMISSIONING ACTIVITIES AS DEFINED BY COMMISSIONING PLAN. REFER TO COMMISSIONING SPECIFICATIONS AND COMMISSIONING PLAN FOR REQUIREMENTS.

1 / M-705 **TYPICAL ROOFTOP UNIT CONTROL DIAGRAM (RTU-3,4,5,7,9)**
12" = 1'-0"



SEQUENCE OF OPERATION
GENERAL
1. THE DDC SYSTEM SHALL HAVE START/STOP CAPABILITY OF THE EXHAUST FAN.
2. DDC SHALL MONITOR FAN STATUS. UPON A FAILURE, AN ALARM WILL BE ISSUED.
3. THE EXHAUST FAN WILL RUN CONTINUOUSLY WHENEVER ITS RESPECTIVE RTU IS ENERGIZED (RTU-5 / EF-5, RTU-4 / EF-6, RTU-7 / EF-7)
4. THE MOTORIZED DAMPER WILL OPEN FIRST ON A CALL TO START.

INTERLOCK EXHAUST FANS

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TEMPERATURE CONTROL DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-705

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
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BLACK
WHITE

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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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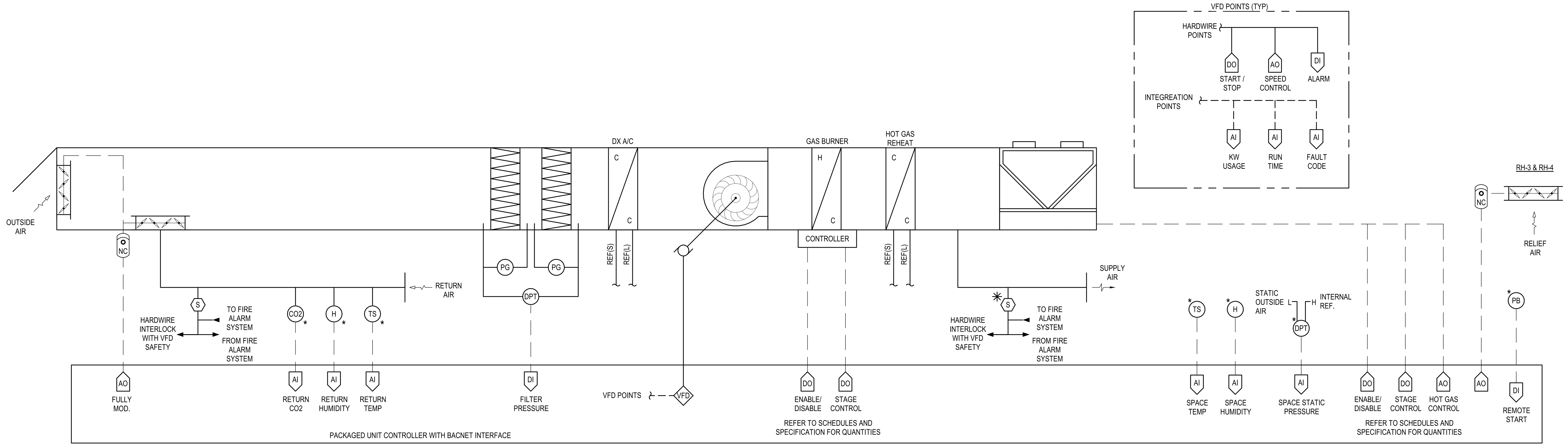

SEQUENCE OF OPERATION

GENERAL

1 THE UNIT WILL BE PROVIDED WITH PACKAGED DDC CONTROLS PROGRAMMED TO THE SEQUENCE OF OPERATION DESCRIBED WITHIN THE CONTRACT DOCUMENTS. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, GATEWAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.
2 ALL FIELD WIRED OR INSTALLED DEVICES WILL BE PROCURRED AND INSTALLED BY THE CONTRACTOR. DEVICES MAY BE PROVIDED BY UNIT MANUFACTURER. CONTRACTOR SHALL COORDINATE AND PROVIDE ALL ADDITIONAL COMPONENTS OR LABOR FOR A COMPLETE AND OPERATIONAL SYSTEM COMPLYING WITH THE OPERATING INTENT OF THE DOCUMENTS.
3 ALL POINTS IDENTIFIED IN THE CONSTRUCTION DOCUMENTS WILL BE DISPLAYED ON THE USER'S GRAPHIC INTERFACE. ALARMS AND OTHER SYSTEM NOTIFICATIONS WILL BE REPORTED TO SYSTEM USERS. PROVIDE ALL NECESSARY INTEGRATION FROM PACKAGED CONTROLLER TO FACILITY CONTROL SYSTEM.
4 ALL HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITION AND THE HAND AND OFF POSITIONS ARE USED FOR MAINTENANCE SITUATIONS. ALL SET POINTS, DEAD BANDS, AND TIME DELAY INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEAD BANDS AND TIME DELAYS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.

SCHEDULING

1. THE RTU RUNS CONTINUOUSLY DURING THE OCCUPIED MODE UNLESS DEACTIVATED FOR MAINTENANCE, SCHEDULED SHUTDOWNS, OR IF A SAFETY TRIPS.
2. THE RTU SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM. OCCUPIED AND UNOCCUPIED SCHEDULE TO BE PROGRAMMED DURING SYSTEM COMMISSIONING OR OWNER TRAINING. CONTRACTOR TO SET UP SCHEDULES WITH OWNER'S PERSONNEL.

OPTIMUM START

1 THE UNIT WILL BE COMMANDED TO START PRIOR TO SCHEDULED OCCUPANCY TO MEET OCCUPIED HEATING OR COOLING SET POINTS BY SCHEDULED OCCUPANCY. CONTROL ALGORYTHM SHALL MINIMIZE RUN TIME PRIOR TO OCCUPANCY.
2 DURING THE OPTIMUM START, THE UNIT SHALL OPERATE IN A RECIRCULATION MODE.
3 THE UNIT HEATING DISCHARGE AIR TEMPERATURE SET POINT FOR WARMUP MAY RESET UP TO A HIGH LIMIT OF 85 DEGREES (ADJ).

PRE AND POST OCCUPANCY VENTILATION MODES

1 THE FUNCTIONALITY OF PRE AND POST OCCUPANCY VENTILATION MODE SHALL BE ABLE TO BE DEACTIVATED THROUGH THE USER GRAPHICAL INTERFACE. THE STATUS OF THE PRE AND POST OCCUPANCY VENTILATION MODE WILL BE VISIBLE ON THE GRAPHICS.
2 WHEN ACTIVE THE UNIT WILL OPERATE AS OCCUPIED MODE WITH REDUCED TEMPERATURE SET POINTS TO PROVIDE SPACE PURGE.
3 THE PRE OCCUPANCY VENTILATION MODE WILL INITIALLY BE SET TO 1 HOURS (ADJ) AND THE POST OCCUPANCY VENTILATION MODE WILL BE SET TO 2 HOURS (ADJ).

START UP MODE - OCCUPIED

1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL SEQUENCE.
3. AFTER THE SUPPLY FAN HAS COMPLETED ITS START UP MODE, THE OUTSIDE AIR DAMPER SHALL MODULATE TO THE DAMPER MIN-MIN POSITION SET DURING BALANCING.

START UP MODE - UNOCCUPIED

1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS RETURN AIR DAMPER.
2. THE SUPPLY FAN IS ENERGIZED AND CONTROLLED PER THE SUPPLY FAN CONTROL.
3. THE OUTSIDE AIR DAMPER REMAINS CLOSED.

VARIABLE FREQUENCY DRIVE OPERATION

1. DDC SHALL COMMUNICATE WITH THE VARIABLE FREQUENCY DRIVES TO PROVIDE THE CONTROL SEQUENCES DESCRIBED.
2. THE DRIVES SHALL BE PROGRAMMED TO AUTOMATICALLY RESTART BASED ON A LOSS OF POWER OR AN ALARM CLEARED. REFER TO THE SPECIFICATION AND THE MANUFACTURER'S INSTALLATION AND OPERATION MANUAL FOR THE MINIMUM AND MAXIMUM QUANTITIES OF RESTARTS BEFORE REQUIRING A MANUAL RESET.

SUPPLY FAN CONTROL

1 THE SUPPLY FAN SHALL BE CONTROLLED TO MAINTAIN THE HEATING OR COOLING SPACE TEMPERATURE SETPOINT. THIS MEASUREMENT IS TAKEN FROM THE SPACE TEMPERATURE SENSOR LOCATED WITHIN THE GYMNASIUM.
2 UPON A COMMAND TO START, THE UNIT CONTROLLER RAMPS THE SUPPLY FAN VFD TO THE SUPPLY FAN MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.
3 THE RTU UNIT CONTROLLER RAMPS THE SUPPLY FAN ARRAY VFD TO MAINTAIN DUCT STATIC SET POINT.

BUILDING PRESSURE / RELIEF HOOD DAMPER CONTROL.

1 THE RELIEF HOOD MOTORIZED DAMPERS ARE CONTROLLED BY THE BAS TO MAINTAIN THE SPACE PRESSURE SETPOINT.
2 UPON A POSITIVE SPACE PRESSURE READING OF OVER 0.15 IN WC, THE MOTORIZED DAMPERS SHALL MODULATE OPEN.

FILTER MONITORING

1 DDC SHALL MONITOR AND DISPLAY THE AIR FILTER PRESSURE DROPS AND ISSUE A DIRTY FILTER ALARM UPON HIGH DIFFERENTIAL PRESSURE.

HEATING MODE

1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES OUTPUT OF THE GAS HEATING SYSTEM TO MAINTAIN THE SPACE TEMPERATURE SET POINT.

COOLING MODE

1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES THE UNIT'S REFRIGERATION SYSTEM TO MAINTAIN THE SPACE TEMPERATURE SET POINT.

DEHUMIDIFICATION MODE

1 THE UNIT'S PACKAGED CONTROLLER SHALL MONITOR SPACE HUMIDITY (SEE PLANS FOR SENSOR LOCATION IN GYMNASIUM)
2 IF HUMIDITY RISES ABOVE SETPOINT AND THE REFRIGERATION SYSTEM IS ACTIVE, THE UNIT SHALL ENABLE THE HOT GAS REHEAT COIL.
3 THE UNIT CONTROLLER SHALL COMMAND THE UNITS REFRIGERATION SYSTEM TO DEHUMIDIFY THE AIR BY MODULATING THE DX AND HOT GAS REHEAT SYSTEMS.

VENTILATION CONTROL

1 DURING THE OCCUPIED MODE, THE UNIT'S PACKAGED CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO THE MIN-MIN OA DAMPER POSITION.
2 THE CONTROLLER SHALL MONITOR RETURN AIR CO2 LEVELS AND MODULATE THE OA DAMPER OPEN TO THE MIN-MAX OA DAMPER POSITION IF THE RETURN CO2 LEVEL RISES ABOVE 1000 PPM (ADJ).
3 THE CONTROLLER SHALL MODULATE THE OA DAMPER BACK TO MIN-MIN OA AFTER A READING OF BELOW 800 PPM FOR 15 MINUTES (ADJ).
4 DURING ECONOMIZER, THE OA DAMPER SHALL BE ALLOWED TO OPEN FULLY AND RECIRC DAMPER CLOSES FULLY.

ECONOMIZER MODE

1 WHEN THE OUTSIDE ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY, OUTSIDE AIR WILL STAGE AS THE FIRST STAGE OF COOLING.
2 THE UNIT'S PACKAGED CONTROLLER WILL MODULATE THE OUTSIDE AIR DAMPER FULLY OPEN.

REMOTE START

1 THE UNIT SHALL HAVE CAPABILITY TO START VIA A REMOTE OVERRIDE PUSHBUTTON. SEE PLANS FOR LOCATION.

TEMPORARY OCCUPANCY

1 UPON ACTIVATION OF THE OVERRIDE PUSH BUTTON OVER RIDE, THE UNIT SHALL ENTER A TEMPORARY OCCUPIED MODE FOR 2 HOURS (ADJ).
2 THE UNIT SHALL ENTER ITS OCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED VENTILATION, HEATING, OR COOLING MODE.

NIGHT CYCLE

1 UPON ACHIEVING AN AIR TERMINAL ZONE TEMPERATURE BELOW UNOCCUPIED HEATING, THE UNIT SHALL ENTER A TEMPORARY OPERATION MODE.
2 THE UNIT WILL ENTER ITS UNOCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED HEATING OR COOLING MODE. IF ENTERING A COOLING MODE, THE COOLING SYSTEM WILL UNDERGO ITS OPTIMUM START FOR SYSTEM COOL DOWN.

SAFETY CONTROL

1 IF SMOKE IS DETECTED IN THE AIRSTREAM BY A DUCT SMOKE DETECTOR OR THE FIRE ALARM ZONE MODULE INDICATES A ZONE ALARM, THE UNIT SHALL BE SHUTDOWN. REFER TO SHUTDOWN MODE.
2 IF A DISCHARGE TEMPERATURE OF 45 DEGREES (ADJ) IS REACHED, THE CONTROLLER SHALL ISSUE AN ALARM.
3 IF A DISCHARGE TEMPERATURE OF 35 DEEGREES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE. SYSTEM TO BE ABLE TO BE RESET FROM BMS, MECHANICAL FREEZESTAT NOT PERMITTED.
4 IF A CONTROLLING SENSOR IS DETERMINED TO HAVE FAILED THAT WOULD DAMAGE THE EQUIPMENT OR CAUSE INAPPROPRIATE CONDITIONS IN THE SPACE, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.
5 IF A STATIC PRESSURE HIGH LIMIT OF 5.5 INCHES (ADJ) OR LOW PRESSURE LIMIT OF NEGATIVE 3.5 INCHES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.

SHUTDOWN MODE CONTROL

1. UPON A SHUTDOWN COMMAND FROM THE DDC SYSTEM OR A SAFETY CONTROL DEVICE COMMAND, THE UNIT SHALL COMMENCE A SHUT DOWN MODE.
2. THE HEATING SYSTEM SHALL CYCLE OFF.
3. THE SUPPLY AND EXHAUST FANS ARE COMMANDED OFF.
4. THE RECIRCULATION DAMPER SHALL OPEN FULLY AND THE OUTSIDE AIR DAMPER SHALL CLOSE.
5. AFTER A 5 MINUTE DELAY (ADJ), THE DISCHARGE AIR DAMPER SHALL CLOSE.

SET POINTS

1	OCCUPIED HEATING SPACE TEMPERATURE SET POINT	70°F
2	OCCUPIED COOLING SPACE TEMPERATURE SET POINT	75°F
3	UNOCCUPIED HEATING SPACE TEMPERATURE SET POINT	62°F
4	UNOCCUPIED COOLING SPACE TEMPERATURE SET POINT	80°F
5	DEHUMIDIFICATION SPACE RH SETPOINT	55%
6	SPACE PRESSURE SET POINT	0.1 IN WC

FAN POWER MONITORING

1 DDC MONITORS SUPPLY AND RETURN FAN VFD'S. DDC REPORTS KWH CONSUMPTION. CONSUMPTION SHALL BE DISPLAYED AS:
   1 INSTANTANEOUS ENERGY USAGE (KW)
   2 WEEKLY ENERGY USAGE (KWH)
   3 YEARLY ENERGY USAGE (KWH)
   4 WEEKLY COMPARATIVE USAGE AFTER FIRST YEAR OF OPERATION (KWH)
2 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

TREND DATA

1 TRENDING FUNCTIONS TO BE AVAILABLE FOR ALL CONTROL AND MONITORING POINTS.
2 SPECIFIC TRENDS TO BE SET UP AS DEFINED BY USER DURING SYSTEM TRAINING
   1 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.
3 PROVIDE TRENDS TO SUPPORT COMMISSIONING ACTIVITIES AS DEFINED BY COMMISSIONING PLAN. REFER TO COMMISSIONING SPECIFICATIONS AND COMMISSIONING PLAN FOR REQUIREMENTS.

1 / M-706 VAV SINGLE ZONE CONTROL DIAGRAM (GYMNASIUM RTU-6)

12" = 1'-0"

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TEMPERATURE CONTROL DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-706
100% CONSTRUCTION DOCUMENTS
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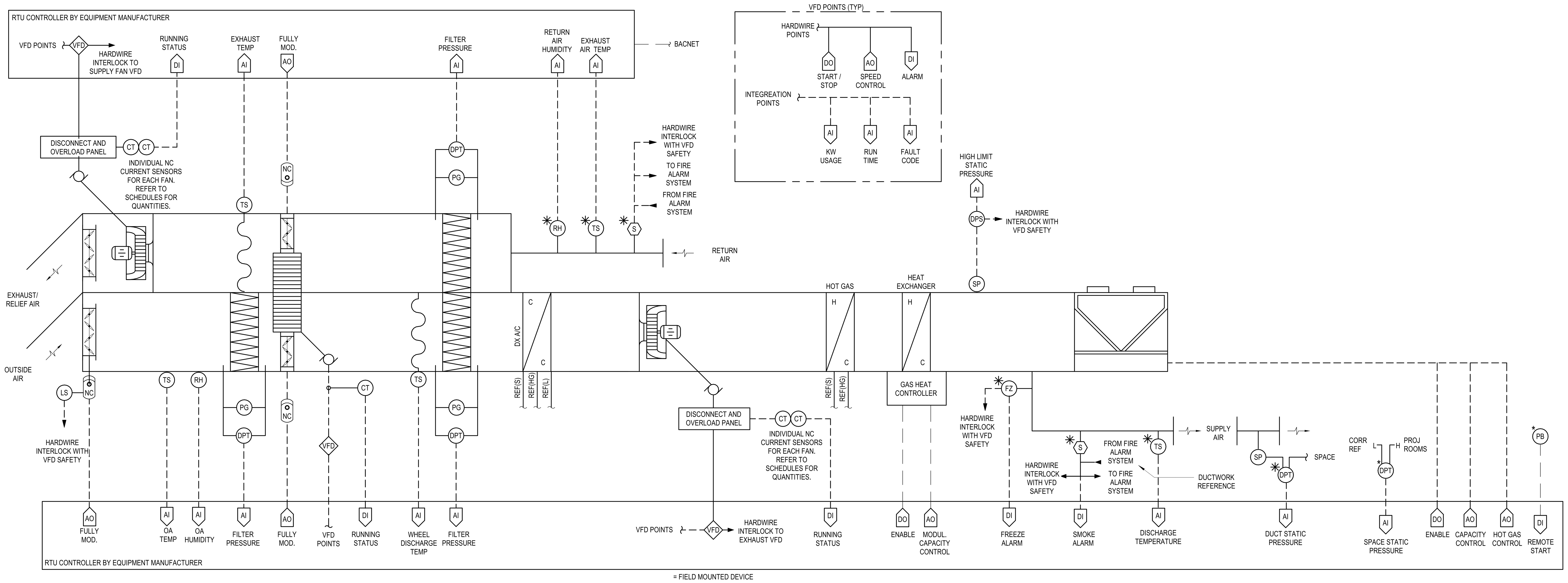
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



SEQUENCE OF OPERATION

GENERAL

1 THE UNIT WILL BE PROVIDED WITH PACKAGED DDC CONTROLS PROGRAMMED TO THE SEQUENCE OF OPERATION DESCRIBED WITHIN THE CONTRACT DOCUMENTS. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, GATEWAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.

2 ALL FIELD WIRED OR INSTALLED DEVICES WILL BE PROCURRED AND INSTALLED BY THE CONTRACTOR. DEVICES MAY BE PROVIDED BY UNIT MANUFACTURER. CONTRACTOR SHALL COORDINATE AND PROVIDE ALL ADDITIONAL COMPONENTS OR LABOR FOR A COMPLETE AND OPERATIONAL SYSTEM COMPLYING WITH THE OPERATING INTENT OF THE DOCUMENTS.

3 ALL POINTS IDENTIFIED IN THE CONSTRUCTION DOCUMENTS WILL BE DISPLAYED ON THE USER'S GRAPHIC INTERFACE. ALARMS AND OTHER SYSTEM NOTIFICATIONS WILL BE REPORTED TO SYSTEM USERS. PROVIDE ALL NECESSARY INTEGRATION FROM PACKAGED CONTROLLER TO FACILITY CONTROL SYSTEM.

4 ALL HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITION AND THE HAND AND OFF POSITIONS ARE USED FOR MAINTENANCE SITUATIONS. ALL SET POINTS, DEAD BANDS, AND TIME DELAY INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEAD BANDS AND TIME DELAYS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.

SCHEDULING

1. THE RTU RUNS CONTINUOUSLY DURING THE OCCUPIED MODE UNLESS DEACTIVATED FOR MAINTENANCE, SCHEDULED SHUTDOWNS, OR IF A SAFETY TRIPS.
2. THE RTU SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM. OCCUPIED AND UNOCCUPIED SCHEDULE TO BE PROGRAMMED DURING SYSTEM COMMISSIONING OR OWNER TRAINING. CONTRACTOR TO SET UP SCHEDULES WITH OWNER'S PERSONNEL.

OPTIMUM START

1 THE UNIT WILL BE COMMANDED TO START PRIOR TO SCHEDULED OCCUPANCY TO MEET OCCUPIED HEATING OR COOLING SET POINTS BY SCHEDULED OCCUPANCY. CONTROL ALGORYTHM SHALL MINIMIZE RUN TIME PRIOR TO OCCUPANCY.

2 DURING THE OPTIMUM START, THE UNIT SHALL OPERATE IN MINIMUM SUPPLY / EXHAUST FAN SPEED MODE PER SCHEDULE.

3 THE UNIT HEATING DISCHARGE AIR TEMPERATURE SET POINT FOR WARMUP MAY RESET UP TO A HIGH LIMIT OF 85 DEGREES (ADJ).

PRE AND POST OCCUPANCY VENTILATION MODES

1 THE FUNCTIONALITY OF PRE AND POST OCCUPANCY VENTILATION MODE SHALL BE ABLE TO BE DEACTIVATED THROUGH THE USER GRAPHICAL INTERFACE. THE STATUS OF THE PRE AND POST OCCUPANCY VENTILATION MODE WILL BE VISIBLE ON THE GRAPHICS.

2 WHEN ACTIVE THE UNIT WILL OPERATE AS OCCUPIED MODE WITH REDUCED TEMPERATURE SET POINTS TO PROVIDE SPACE PURGE.

3 THE PRE OCCUPANCY VENTILATION MODE WILL INITIALLY BE SET TO 1 HOURS (ADJ) AND THE POST OCCUPANCY VENTILATION MODE WILL BE SET TO 2 HOURS (ADJ).

START UP MODE - OCCUPIED

1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS OUTSIDE AIR AND RETURN AIR DAMPERS.
2. THE SUPPLY AND EXHAUST FANS ARE ENERGIZED AND OPERATED IN MINIMUM FAN SPEED MODE PER SCHEDULE.

START UP MODE - UNOCCUPIED

1. UPON A CALL TO START, THE UNIT SHALL OPEN ITS OUTSIDE AIR AND RETURN AIR DAMPERS.
2. THE SUPPLY AND EXHAUST FANS ARE ENERGIZED AND OPERATED IN MINIMUM FAN SPEED MODE PER SCHEDULE.

VARIABLE FREQUENCY DRIVE OPERATION

1. DDC SHALL COMMUNICATE WITH THE VARIABLE FREQUENCY DRIVES TO PROVIDE THE CONTROL SEQUENCES DESCRIBED.
2. THE DRIVES SHALL BE PROGRAMMED TO AUTOMATICALLY RESTART BASED ON A LOSS OF POWER OR AN ALARM CLEARED. REFER TO THE SPECIFICATION AND THE MANUFACTURER'S INSTALLATION AND OPERATION MANUAL FOR THE MINIMUM AND MAXIMUM QUANTITIES OF RESTARTS BEFORE REQUIRING A MANUAL RESET.

SUPPLY FAN CONTROL

1 THE SUPPLY FAN SHALL BE CONTROLLED TO MAINTAIN A DUCT STATIC SET POINT OF 1.0 INCH (ADJ). THIS MEASUREMENT IS TAKEN FROM THE SYSTEM STATIC PRESSURE SENSOR LOCATED APPROXIMATELY 2/3 OF THE DISTANCE WITHIN THE DUCT DISTRIBUTION SYSTEM. THE SYSTEM BALANCER SHALL VERIFY THE INITIAL SET POINT BASED ON THE BALANCING PROCEDURES IDENTIFIED IN THE PROJECT SPECIFICATION.

2 UPON A COMMAND TO START, THE UNIT CONTROLLER RAMPS THE SUPPLY FAN VFD TO THE SUPPLY FAN MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.

3 THE RTU UNIT CONTROLLER RAMPS THE SUPPLY FAN ARRAY VFD TO MAINTAIN DUCT STATIC SET POINT.

BUILDING PRESSURE / EXHAUST FAN CONTROL

1 THE EXHAUST FAN IS CONTROLLED TO MAINTAIN A SCHEDULED OFFSET (ADJ) FROM THE SUPPLY AIRFLOW. REFER TO MECHANICAL SCHEDULES FOR OFFSET REQUIREMENTS.

2 THE EXHAUST FAN SHALL BE INTERLOCKED TO THE SUPPLY FAN AND ONLY ALLOWED TO RUN WHEN THE SUPPLY FAN IS ENERGIZED AND THE EXHAUST AND RETURN DAMPERS ARE OPEN.

3 UPON A COMMAND TO START, THE ENERGY RECOVERY UNIT CONTROLLER RAMPS THE EXHAUST FAN VFD TO THE EXHAUST FAN'S MINIMUM SPEED OVER 30 SECONDS (ADJ). THE VFD RAMPS THE SPEED OF THE FAN ARRAY SLOWLY AND LINEARLY OVER 120 SECONDS (ADJ) TO REACH ITS SET POINT.

4 THE UNIT CONTROLLER SHALL MONITOR BUILDING PRESSURE THROUGH THE REMOTE SPACE STATIC PRESSURE SENSOR LOCATED ABOVE THE CORRIDOR.

5 A NEGATIVE PRESSURE OF 0.05" SHOULD BE MAINTAINED IN THE PROJECT ROOMS. IF PRESSURE FALLS TO 0.1", RETURN VFD SHALL DECREASE SPEED OF RETURN FAN TO LEVEL REQUIRED TO MAINTAIN SLIGHT NEGATIVE PRESSURE IN SPACE.

FILTER MONITORING

1 DDC SHALL MONITOR AND DISPLAY THE AIR FILTER PRESSURE DROPS AND ISSUE A DIRTY FILTER ALARM UPON HIGH DIFFERENTIAL PRESSURE.

HEATING MODE

1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES OUTPUT OF THE GAS HEATING SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

COOLING MODE

1 THE UNIT'S PACKAGED CONTROLLER MODULATES / STAGES THE UNIT'S REFRIGERATION SYSTEM TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.

DEHUMIDIFICATION MODE

1 THE UNIT'S PACKAGED CONTROLLER SHALL MONITOR RETURN AIR HUMIDITY

2 IF HUMIDITY RISES ABOVE SETPOINT AND THE REFRIGERATION SYSTEM IS ACTIVE, THE UNIT SHALL ENABLE THE HOT GAS REHEAT COIL.

3 THE UNIT CONTROLLER SHALL COMMAND THE UNITS REFRIGERATION SYSTEM TO DEHUMIDIFY THE AIR BY MODULATING THE DX AND HOT GAS REHEAT SYSTEMS.

ENERGY RECOVERY DEVICE

1 DDC SHALL HAVE START/STOP CAPABILITY ON THE ENERGY WHEEL'S MOTOR STARTER/VFD.

2 THE WHEEL SHALL RUN CONTINUOUSLY WHENEVER THE RTU IS ENERGIZED.

3 WHENEVER THE ECONOMIZER IS NOT ACTIVE, THE FACE AND BYPASS DAMPERS WILL MODULATE TO ALLOW AIR TO FLOW THROUGH THE ENERGY WHEEL.

4 THE DIFFERENTIAL PRESSURE ACROSS THE DEVICE SHALL BE MONITORED. UPON REACHING 0.5" ABOVE THE SCHEDULED AIR PRESSURE DROP, AN ALARM SHALL BE ISSUED.

FROST CONTROL

1 WHENEVER ENERGY RECOVERY IS ACTIVE, DDC SHALL MODULATE THE WHEEL FACE AND BYPASS DAMPERS TO MAINTAIN A MINIMUM ADJUSTABLE EXHAUST LEAVING AIR TEMPERATURE SETPOINT TO PREVENT FROST FORMATION.

ECONOMIZER

1 WHENEVER OUTSIDE AIR TEMPERATURE IS BETWEEN 50 DEGREES (ADJ) AND 70 DEGREES (ADJ), THE FACE AND BYPASS DAMPERS SHALL MODULATE OVER 120 SECONDS (ADJ) TO BYPASS THE ENERGY RECOVERY DEVICE.

REMOTE START

1 THE UNIT SHALL HAVE CAPABILITY TO START VIA A REMOTE OVERRIDE PUSHBUTTON. SEE PLANS FOR LOCATION.

TEMPORARY OCCUPANCY

1 UPON ACTIVATION OF THE OVERRIDE PUSH BUTTON OVER RIDE, THE UNIT SHALL ENTER A TEMPORARY OCCUPIED MODE FOR 2 HOURS (ADJ).

2 THE UNIT SHALL ENTER ITS OCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED VENTILATION, HEATING, OR COOLING MODE.

NIGHT CYCLE

1 UPON ACHIEVING AN AIR TERMINAL ZONE TEMPERATURE BELOW UNOCCUPIED HEATING, THE UNIT SHALL ENTER A TEMPORARY OPERATION MODE.

2 THE UNIT WILL ENTER ITS UNOCCUPIED START UP MODE AND THEN SEQUENCE ITS ASSOCIATED HEATING OR COOLING MODE. IF ENTERING A COOLING MODE, THE COOLING SYSTEM WILL UNDERGO ITS OPTIMUM START FOR SYSTEM COOL DOWN.

SAFETY CONTROL

1 IF SMOKE IS DETECTED IN THE AIRSTREAM BY A DUCT SMOKE DETECTOR OR THE FIRE ALARM ZONE MODULE INDICATES A ZONE ALARM, THE UNIT SHALL BE SHUTDOWN. REFER TO SHUTDOWN MODE.

2 IF A DISCHARGE TEMPERATURE OF 45 DEGREES (ADJ) IS REACHED, THE CONTROLLER SHALL ISSUE AN ALARM.

3 IF A DISCHARGE TEMPERATURE OF 35 DEEGREES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE. SYSTEM TO BE ABLE TO BE RESET FROM BMS, MECHANICAL FREEZESTAT NOT PERMITTED.

4 IF A CONTROLLING SENSOR IS DETERMINED TO HAVE FAILED THAT WOULD DAMAGE THE EQUIPMENT OR CAUSE INAPPROPRIATE CONDITIONS IN THE SPACE, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.

5 IF A STATIC PRESSURE HIGH LIMIT OF 5.5 INCHES (ADJ) OR LOW PRESSURE LIMIT OF NEGATIVE 3.5 INCHES (ADJ) IS REACHED, THE UNIT SHALL BE SHUT DOWN. REFER TO SHUTDOWN MODE.

SHUTDOWN MODE CONTROL

1. UPON A SHUTDOWN COMMAND FROM THE DDC SYSTEM OR A SAFETY CONTROL DEVICE COMMAND, THE UNIT SHALL COMMENCE A SHUT DOWN MODE.
2. THE HEATING SYSTEM SHALL CYCLE OFF.
3. THE SUPPLY AND EXHAUST FANS ARE COMMANDED OFF.
4. AFTER 5 MINUTE DELAY (ADJ) THE OUTSIDE AIR DAMPER AND EXHAUST AIR DAMPERS SHALL CLOSE.

SET POINTS

1	OCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	60°F
2	OCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
3	UNOCCUPIED HEATING DISCHARGE TEMPERATURE SET POINT	65°F
4	UNOCCUPIED COOLING DISCHARGE TEMPERATURE SET POINT	55°F
5	DEHUMIDIFICATION SPACE RH SETPOINT	55%
5	INITIAL DUCT STATIC SET POINT	1.0 IN WC
6	SPACE PRESSURE SET POINT	0.1 IN WC

FAN POWER MONITORING

1 DDC MONITORS SUPPLY AND RETURN FAN VFD'S. DDC REPORTS KWH CONSUMPTION. CONSUMPTION SHALL BE DISPLAYED AS:
 1 INSTANTANEOUS ENERGY USAGE (KW)
 2 WEEKLY ENERGY USAGE (KWH)
 3 YEARLY ENERGY USAGE (KWH)
 4 WEEKLY COMPARATIVE USAGE AFTER FIRST YEAR OF OPERATION (KWH)

2 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

TREND DATA

1 TRENDING FUNCTIONS TO BE AVAILABLE FOR ALL CONTROL AND MONITORING POINTS.

2 SPECIFIC TRENDS TO BE SET UP AS DEFINED BY USER DURING SYSTEM TRAINING
 1 TRENDS ARE TO BE MAINTAINED FOR ONE WEEK INTERVALS AND THEN ARE TO BE ARCHIVED FOR USE FOR SYSTEM DIAGNOSTICS AND MEASUREMENT AND VERIFICATION OF SYSTEMS.

3 PROVIDE TRENDS TO SUPPORT COMMISSIONING ACTIVITIES AS DEFINED BY COMMISSIONING PLAN. REFER TO COMMISSIONING SPECIFICATIONS AND COMMISSIONING PLAN FOR REQUIREMENTS.

1 M-707 **VAV ENERGY RECOVERY 100% OA CONTROL DIAGRAM (PROJECT ROOMS RTU-8)**

NOT TO SCALE

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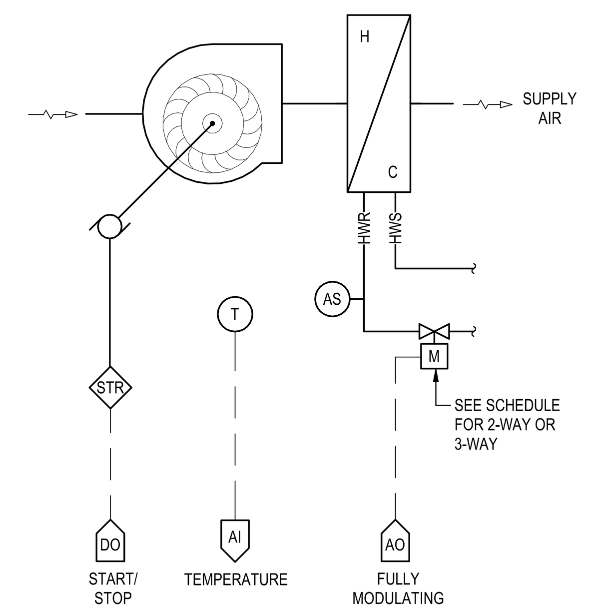
TEMPERATURE CONTROL DIAGRAMS
REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-707
100% CONSTRUCTION DOCUMENTS



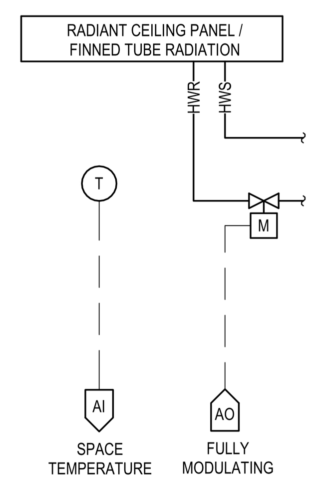
SEE SCHEDULES FOR QUANTITIES AND PLANS FOR LOCATIONS

SEQUENCE OF OPERATION
GENERAL
1. ALL SET POINTS AND TIME INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTIBLE.
2. UPON SENSING THE SPACE TEMPERATURE DROP BELOW SPACE SETPOINT (ADJUSTABLE), DDC SHALL OPEN THE ON/OFF HEATING CONTROL VALVE AND PROVIDE HOT WATER TO THE CABINET/UNIT HEATING COIL. THE AQUASTAT, UPON SENSING HOT WATER, SHALL COMMAND THE FAN TO RUN.
3. UPON SENSING THE SPACE TEMPERATURE RISE ABOVE SPACE SETPOINT, THE ROOM THERMOSTAT SHALL CLOSE THE ON/OFF HEATING CONTROL VALVE OF THE CABINET/UNIT HOT WATER HEATER. THE AQUASTAT, UPON SENSING LOSS OF HOT WATER, SHALL COMMAND THE FAN OFF.

SCHEDULING
1. THE UNIT HEATER SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM.

HEATING MODE
1. FAN SHALL CYCLE WITH THE HEATING COIL TO MEET SPACE TEMPERATURE SET POINT.
2. DDC SHALL MODULATE HEATING COIL CONTROL VALVE TO MEET SPACE TEMPERATURE SET POINT.
3. SPACE TEMPERATURE SET POINT SHALL BE:
   A. 70 °F OCCUPIED
   B. 60 °F UNOCCUPIED

2 M-708 TYPICAL HOT WATER CABINET UNIT HEATER / UNIT HEATER CONTROL DIAGRAM
NOT TO SCALE



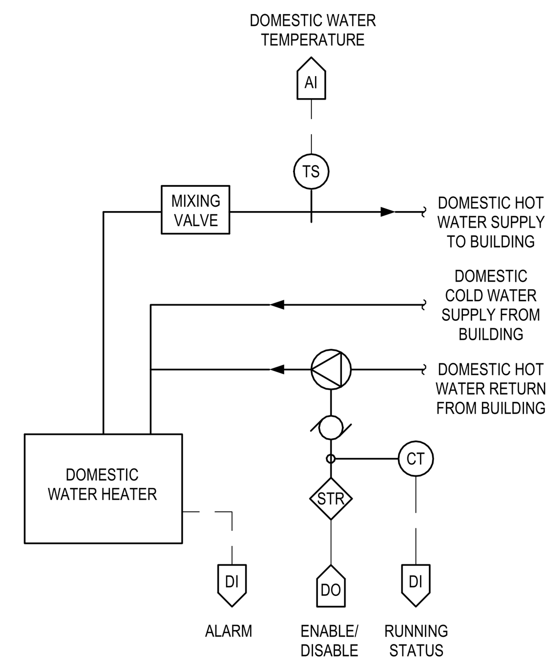
SEE SCHEDULES FOR QUANTITIES AND PLANS FOR LOCATIONS

SEQUENCE OF OPERATION
GENERAL
1. ALL SET POINTS AND TIME INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTIBLE.
2. UPON SENSING THE SPACE TEMPERATURE DROP BELOW SPACE SETPOINT (ADJUSTABLE), DDC SHALL OPEN THE MODULATING HEATING CONTROL VALVE AND PROVIDE HOT WATER TO THE RADIANT CEILING PANEL / FINNED TUBE RADIATOR. DDC SHALL MODULATE THE HEATING CONTROL VALVE TO MEET SPACE TEMPERATURE SET POINT.
3. UPON SENSING THE SPACE TEMPERATURE RISE ABOVE SPACE SETPOINT, THE ROOM THERMOSTAT SHALL MODULATE DOWN THE HEATING CONTROL VALVE OF THE RADIANT CEILING PANEL / FINNED TUBE RADIATOR. IF TEMPERATURE CONTINUES TO RISE IN THE SPACE, THE DDC SHALL CLOSE THE CONTROL VALVE.

SCHEDULING
1. THE PERIMTER HEATING DEVICE SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM.

SET POINTS
1. SPACE TEMPERATURE SET POINT SHALL BE:
   A. 70 °F OCCUPIED
   B. 60 °F UNOCCUPIED

3 M-708 TYPICAL PERIMETER HEATING DEVICE CONTROL DIAGRAM
NOT TO SCALE

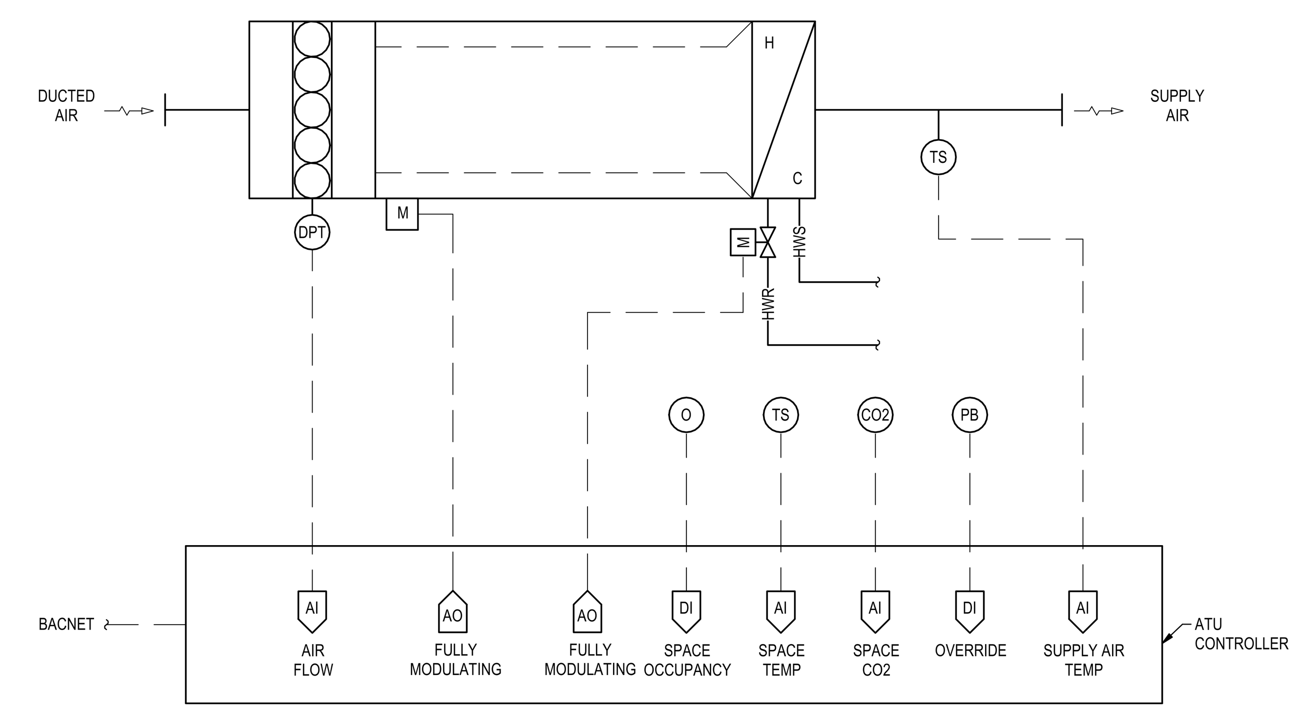


REFER TO PLUMBING DRAWINGS, SCHEDULES AND SPECIFICATIONS.

SEQUENCE OF OPERATION:

1. DDC MONITORS THE BUILDING DOMESTIC WATER HEATER SUPPLY TEMPERATURE AND ALARMS IF THE WATER TEMPERATURE EXCEEDS THE HIGH TEMPERATURE ALARM SETPOINT. SETPOINT IS INITIALLY SET AT 130°F (ADJUSTABLE).
2. DHW TEMPERATURE IS CONTROLLED BY ITS OWN SELF-CONTAINED CONTROL SYSTEM TO MAINTAIN THE DESIRED DOMESTIC HOT WATER TEMPERATURE.
3. DDC GENERATES HIGH DHW TEMPERATURE ALARM AT 130° F (ADJUSTABLE) AND LOW DHW TEMPERATURE ALARM AT 105° F (ADJUSTABLE) ALARMS TO BAS.
4. THE DOMESTIC HOT WATER PUMP AND HEAT EXCHANGER SYSTEM RUNS WHENEVER THE BUILDING IS IN ITS NORMAL OCCUPIED MODE. PUMP OR HEAT EXCHANGER MAY BE MANUALLY COMMANDED OFF AT THE FRONT END.
5. ALL PUMP MOTORS ARE MONITORED WITH CURRENT SENSORS. WHEN THE PUMP IS COMMANDED TO RUN, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL PUMP FAILURE ALARM. WHEN THE PUMP IS COMMANDED TO STOP, AND AFTER A DELAY OF 120 SECONDS (ADJUSTABLE), STATUS IS NOT APPROPRIATE, DDC PROVIDES THE BAS WITH A CRITICAL PUMP FAILURE ALARM.
6. WHENEVER A PUMP IS COMMANDED TO RUN AND THE STATUS IS SENSED PROPERLY BY THE CURRENT SENSOR, DDC TOTALIZES THE RUN TIME HOURS FOR BAS USE. IF A PUMP IS COMMANDED OFF OR COMMANDED OFF AND IN ALARM, DDC DOES NOT TOTALIZE RUN TIME HOURS. DDC PROVIDES TWO TOTALS - GRAND MASTER AND SERVICE TOTAL. BOTH ARE RESETTABLE ON THE BAS.

4 M-708 DOMESTIC WATER HEATER CONTROL DIAGRAM
NOT TO SCALE



SEE SCHEDULES FOR QUANTITIES PLANS FOR TEMPERATURE/CO2/PUSHBUTTON SENSOR LOCATIONS. REFER TO ELECTRICAL PLANS FOR OCCUPANCY SENSOR LOCATIONS.

NOTE
TC CONTRACTOR SHALL PROVIDE ALL DEVICES AND CIRCUITS FOR SOURCE OF POWER AND COMMUNICATION WIRING TO EACH ATU CONTROLLER.

SEQUENCE OF OPERATIONS
GENERAL
1. ALL SETPOINTS, DEADBANDS, AND TIME DELAYS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS (CREATE REQUIRED VIRTUAL POINTS).
2. APPROPRIATE DEADBANDS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.
3. ATU BOX MINIMUM AND MAXIMUM DESIGN VOLUME AIRFLOW SETTINGS SHALL BE AS INDICATED ON THE ATU BOX SCHEDULE (ADJUSTABLE BY BAS OPERATOR ONLY). ATU BOXES SHALL OPERATE AS CONSTANT VOLUME WHEN THE SCHEDULED MINIMUM AND MAXIMUM DESIGN AIRFLOW SETTINGS ARE EQUAL.
4. ACTUAL ATU AIRFLOW SHALL BE TOTALED IN REAL-TIME FOR BAS DISPLAY. PROVIDE TOTAL AIRFLOWS FOR EACH AHU AND TOTAL FOR THE BUILDING OF ALL AHU'S.

VARIABLE AIR VOLUME AIR TERMINAL UNIT CONTROL (ATU)
A. **UNOCCUPIED MODE (BUILDING OCCUPANCY SCHEDULE OFF)**
   1. IN THIS MODE THE BUILDING TIME-OF-DAY SCHEDULER DETERMINES THE FACILITY IS IN UNOCCUPIED MODE. THEN CONTROLLER SHALL USE THE UNOCCUPIED COOLING/HEATING SETPOINTS FOR SPACE TEMPERATURE CONTROL.
   2. WHEN BETWEEN UNOCCUPIED HEATING AND COOLING SETPOINTS (ADJUSTABLE), THE ATU DAMPER WILL BE CLOSED AND HOT WATER REHEAT COIL CONTROL VALVE CLOSED. ATU AIRFLOW SETPOINT SHALL BE ZERO CFM.
   3. IF THE SPACE TEMPERATURE INCREASES TO THE UNOCCUPIED COOLING SETPOINT (ADJUSTABLE), THE ATU CONTROLLER SHALL CALL FOR AIRFLOW AND MODULATE THE ATU DAMPER UP TO MAXIMUM DESIGN CFM AIRFLOW SETPOINT (ADJUSTABLE), IN ORDER TO MAINTAIN SPACE TEMPERATURE AT SETPOINT. REHEAT COIL AND SUPPLEMENTAL HEAT CONTROL VALVES SHALL REMAIN CLOSED. WHEN SPACE TEMPERATURE FALLS SUFFICIENTLY BELOW THE UNOCCUPIED COOLING SETPOINT, THE ATU CONTROLLER SHALL CALL FOR ZERO CFM AIRFLOW.
   4. IF THE SPACE TEMPERATURE DECREASES TO THE UNOCCUPIED HEATING SETPOINT (ADJUSTABLE), THE ATU CONTROLLER SHALL MODULATE THE REHEAT COIL CONTROL VALVE OPEN, AND MODULATE THE ATU DAMPER TO MAINTAIN THE SPACE TEMPERATURE SETPOINT (ADJUSTABLE). WHEN SPACE TEMPERATURE INCREASES SUFFICIENTLY ABOVE THE UNOCCUPIED HEATING SETPOINT, THE ATU CONTROLLER SHALL CALL FOR ZERO CFM AIRFLOW AND TURN OFF REHEAT COIL AND SUPPLEMENTAL HEAT (IF APPLICABLE).

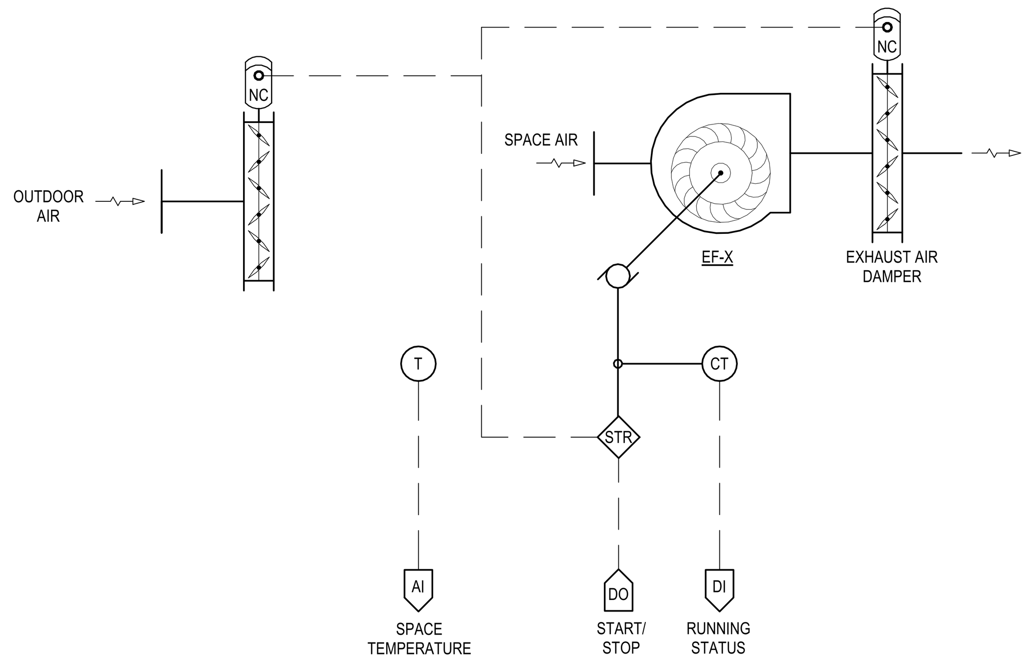
B. **OCCUPIED MODE (BUILDING OCCUPANCY SCHEDULE ON)**
   1. IN THIS MODE THE ATU IS IN OCCUPIED MODE. OCCUPIED MODE AND THE OCCUPANCY SENSOR INDICATES PEOPLE ARE PRESENT IN THE SPACE. THE CONTROLLER USES THE OCCUPIED COOLING/HEATING SETPOINTS FOR SPACE TEMPERATURE CONTROL.
   2. IN BETWEEN OCCUPIED HEATING AND COOLING SETPOINTS (ADJUSTABLE), THE ATU DAMPER WILL BE AT MINIMUM DESIGN CFM SETPOINT, HOT WATER REHEAT COIL CONTROL VALVE AND SUPPLEMENTAL HEATING CONTROL VALVE ARE CONTROLLING FOR OCCUPIED TEMPERATURE SETPOINTS.
   3. IF THE SPACE TEMPERATURE INCREASES TO THE OCCUPIED COOLING SETPOINT (ADJUSTABLE), THE ATU CONTROLLER CALLS FOR AIRFLOW AND MODULATE THE ATU DAMPER UP TO MAXIMUM DESIGN CFM AIRFLOW SETPOINT (ADJUSTABLE), IN ORDER TO MAINTAIN SPACE TEMPERATURE AT SETPOINT. REHEAT COIL AND SUPPLEMENTAL HEAT CONTROL VALVES MODULATES CLOSED. WHEN SPACE TEMPERATURE FALLS SUFFICIENTLY BELOW THE OCCUPIED COOLING SETPOINT, THE ATU CONTROLLER CALLS FOR MINIMUM DESIGN CFM SETPOINT.
   4. IF THE SPACE TEMPERATURE DECREASES TO THE OCCUPIED HEATING SETPOINT (ADJUSTABLE), THE ATU CONTROLLER MODULATES THE SUPPLEMENTAL HEAT CONTROL VALVE OPEN FIRST, THEN ON A CONTINUED DEMAND FOR HEAT MODULATES THE REHEAT COIL CONTROL VALVE OPEN, AND THEN MODULATE THE ATU DAMPER TO MAINTAIN THE REHEAT MINIMUM DESIGN CFM SETPOINT (ADJUSTABLE). WHEN SPACE TEMPERATURE INCREASES SUFFICIENTLY ABOVE THE OCCUPIED HEATING SETPOINT, THE ATU CONTROLLER CALLS FOR MINIMUM DESIGN CFM SETPOINT AND MODULATE SUPPLEMENTAL AND REHEAT COIL CONTROLS VALVES TO MAINTAIN STANDBY HEATING SETPOINT.
   5. ATU CONTROLLER REMAINS IN OCCUPIED MODE UNTIL THE TIME-OF-DAY SCHEDULER INDICATES UNOCCUPIED MODE (SEE HEREIN) OR THE OCCUPANCY SENSOR INDICATES, AFTER A TIME DELAY, NO PEOPLE ARE PRESENT AND THE CONTROLLER SWITCHES TO STANDBY CONTROL MODE (SEE HEREIN).

C. **STANDBY MODE (BUILDING OCCUPANCY SCHEDULE ON, OCCUPANCY SENSOR OFF FOR APPLICABLE ROOMS)**
   1. IN THIS MODE THE ATU IS IN OCCUPIED MODE. HOWEVER THE OCCUPANCY SENSOR INDICATES, AFTER A TIME DELAY, NO PEOPLE ARE PRESENT IN THE SPACE. THE CONTROLLER USES THE STANDBY COOLING/HEATING SETPOINTS FOR SPACE TEMPERATURE CONTROL.
   2. WHEN BETWEEN STANDBY HEATING AND COOLING SETPOINTS (ADJUSTABLE), THE ATU DAMPER WILL BE AT STANDBY DESIGN CFM SETPOINT, HOT WATER REHEAT COIL CONTROL VALVE AND SUPPLEMENTAL HEATING CONTROL VALVE ARE CONTROLLING FOR STANDBY TEMPERATURE SETPOINTS.
   3. WHEN A PERSON ENTERS THE SPACE, THE OCCUPANCY SENSOR RETURNS THE ATU CONTROL TO OCCUPIED MODE.

SEQUENCE OF OPERATION (CONT)
ALL ATU'S
1. THE DDC ATU CONTROLLER SHALL PERIODICALLY CALIBRATE ITS AIRFLOW SENSOR.
2. ATU'S SHALL BE PROGRAMMED SUCH THAT ALL ATU BOXES SUPPLIED BY A PARTICULAR AHU CAN BE DRIVEN TO MAXIMUM AIRFLOW WITH A SINGLE COMMAND FROM THE BAS OPERATOR INTERFACE.
3. ZONE SPACE TEMPERATURE SETPOINTS SHALL BE AS FOLLOWS:
   A. UNOCCUPIED HEATING SPACE TEMPERATURE SETPOINT: 62° F (ADJUSTABLE)
   B. STANDBY HEATING SPACE TEMPERATURE SETPOINT: 67° F (ADJUSTABLE)
   C. OCCUPIED HEATING SPACE TEMPERATURE SETPOINT: 70° F (ADJUSTABLE)
   D. OCCUPIED COOLING SPACE TEMPERATURE SETPOINT: 75° F (ADJUSTABLE)
   E. OCCUPANT ADJUSTMENT RANGE DURING OCCUPIED MODE: SETPOINT +/- 2°F (ADJUSTABLE)
   F. STANDBY COOLING SPACE TEMPERATURE SETPOINT: 76° F (ADJUSTABLE)
   G. UNOCCUPIED COOLING SPACE TEMPERATURE SETPOINT: 78° F (ADJUSTABLE)

DEMAND CONTROLLED VENTILATION
1. EACH ATU CONTROLLER SHALL INCLUDE THE INHERENT ABILITY TO OVERRIDE THE TEMPERATURE CONTROL LOOP AND MODULATE THE TERMINAL UNIT'S DAMPER WITH THE CO2 SENSOR AND ITS ASSOCIATED LOW CO2 AND HIGH CO2 SETPOINTS (ADJUSTABLE), IN CONJUNCTION WITH THE NORMAL TEMPERATURE CONTROL LOOP. ALL TEMPERATURE CONTROL FUNCTIONS, EXCEPT AIR VOLUME CONTROL, SHALL REMAIN ACTIVE DURING THIS MODE.
2. DURING THE OCCUPIED MODE, THE ATU CONTROLLER SHALL MONITOR THE SPACE CO2 SENSOR. WHEN THE SPACE CO2 LEVEL EXCEEDS 1000PPM (ADJUSTABLE), THE CONTROLLER SHALL INCREASE THE AIRFLOW AS REQUIRED TO REDUCE SPACE CO2. THE CONTROLLER (OR CONTROLLERS) MAY MODULATE THE ATU DISCHARGE AIRFLOW UP TO ITS MAXIMUM DESIGN CFM. THE ATU CONTROLLER SHALL MAINTAIN SPACE DRY BULB CONTROL BASED ON SETPOINT. MODULATION BETWEEN THE DAMPER'S CURRENT POSITION AND MAXIMUM DESIGN AIRFLOW SHALL OCCUR OVER A PERIOD OF 120 SECONDS (ADJUSTABLE).
3. WHEN THE SPACE CO2 FALLS BELOW LOW CO2 SETPOINT OF 750PPM AT THIS ZONE, THE ATU AIRFLOW CONTROL SHALL REVERT BACK TO ITS NORMAL DAMPER CONTROL ALGORITHM.
4. WHEN ANY ATU IS IN DEMAND CONTROLLED VENTILATION MODE, A GRAPHICAL ICON SHALL BE ACTIVATED AT THE BAS.WHEN ANY ATU IS IN DEMAND CONTROLLED VENTILATION MODE, A GRAPHICAL ICON SHALL BE ACTIVATED AT THE BAS.
5. DURING UNOCCUPIED MODE, THIS CONTROL IS DE-ACTIVATED.

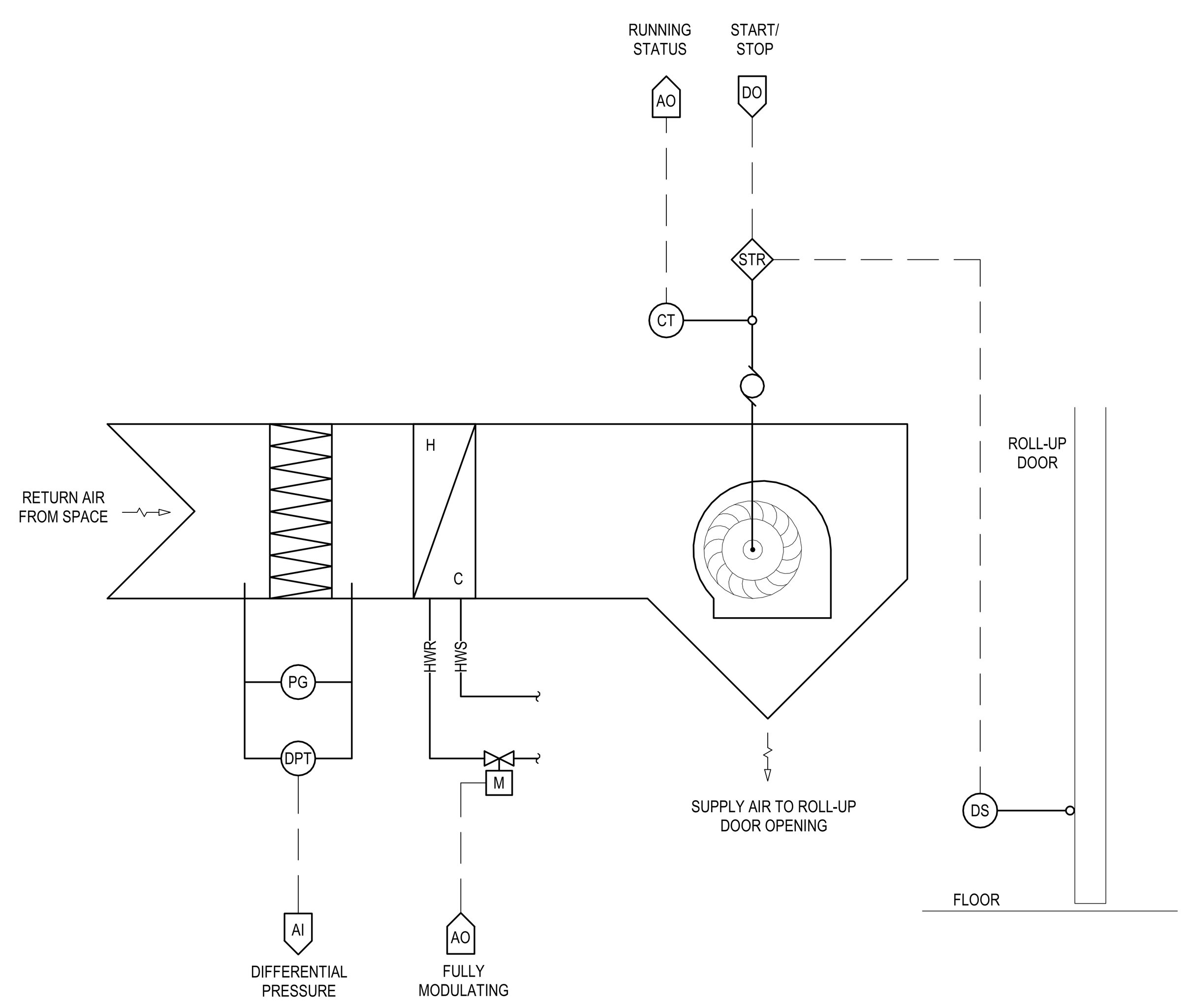
1 M-708 TYPICAL VAV/CAV AIR TERMINAL UNIT WITH HOT WATER REHEAT CONTROL DIAGRAM
NOT TO SCALE



SEE SCHEDULES FOR QUANTITIES AND PLANS FOR LOCATIONS

SEQUENCE OF OPERATION
GENERAL
1. ALL SETPOINTS, DEADBANDS, AND TIME INTERVALS DESCRIBED IN THE SEQUENCE SHALL BE ADJUSTABLE BY DDC/BAS SYSTEM OPERATORS (CREATE REQUIRED VIRTUAL POINTS).
2. DDC MONITORS THE ASSOCIATED ROOM TEMPERATURE SENSORS. ROOMS ALARM AT A LOW ALARM OF 50° F (ADJUSTABLE) AND HIGH ALARM OF 95° F (ADJUSTABLE).
3. WHEN SPACE TEMPERATURE INCREASES TO THE SETPOINT OF 85° F (ADJUSTABLE), DDC COMMANDS THE EXAHUST FAN TO RUN FOR VENTILATION AIR. THE EXHAUST FAN STARTER CIRCUIT OPENS BOTH DAMPERS.
4. WHEN SPACE TEMPERATURE DECREASES BELOW THE SETPOINT OF 83° F (ADJUSTABLE), DDC COMMANDS THE EXHAUST FAN TO STOP. DAMPER ACTUATORS DE-ENERGIZE AND THE DAMPERS CLOSE.
5. FANS HAVE START/STOP CAPABILITY FROM THE DDC/BAS SYSTEM. DDC MONITORS THE OPERATING STATUS OF THE FAN MOTOR VIA CURRENT SENSOR. WHEN A FAN IS COMMANDED TO RUN AND AFTER A 120 SECOND DELAY (ADJUSTABLE) THE MOTOR CURRENT IS NOT APPROPRIATE, DDC ACTIVATES A FAN MOTOR FAILURE ALARM. SIMILARLY, WHEN A FAN IS COMMANDED TO STOP AND AFTER A 120 SECOND DELAY (ADJUSTABLE) THE MOTOR CURRENT IS NOT APPROPRIATE, DDC ACTIVATES A FAN MOTOR FAILURE ALARM.

5 M-708 ELECTRICAL ROOM VENTILATION CONTROL DIAGRAM
NOT TO SCALE



SEE SCHEDULES FOR QUANTITIES AND PLANS FOR LOCATIONS

SEQUENCE OF OPERATION
GENERAL
1. ALL HAND-OFF-AUTO (HOA) SWITCHES NORMALLY REMAIN IN THE AUTO POSITION AND THE HAND AND OFF POSITIONS ARE USED FOR MAINTENANCE SITUATIONS. ALL SETPOINTS, DEADBANDS, AND TIME DELAY INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEADBANDS AND TIME DELAYS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS.
2. PROVIDE AND INSTALL ALL NECESSARY COMPONENTS AND ACCESSORIES FOR A COMPLETE AND OPERATIONAL SYSTEM INCLUDING, BUT NOT LIMITED TO SENSORS, RELAYS, COMMUNICATION WIRING AND CONDUIT, AND ALL NECESSARY ELECTRICAL DEVICES, WIRING, AND CONDUIT.

SCHEDULING
1. THE DOOR AIR CURTAIN SHALL HAVE SCHEDULING FUNCTIONALITY THROUGH THE DDC SYSTEM.

SUPPLY FAN CONTROL
1. WHEN ENABLED THROUGH DDC, WHENEVER THE DOOR SWITCH IS ACTIVATED, THE SUPPLY FAN SHALL BE ENERGIZED.
2. THE SUPPLY FAN RUNS CONTINUOUSLY.
3. DDC MONITORS THE SUPPLY FAN THROUGH ITS CURRENT SENSOR. UPON A FAILURE, AN ALARM IS ISSUED.
4. WHEN THE DOOR SWITCH IS DEACTIVATED, THE SUPPLY FAN IS DE-ENERGIZED.

FILTER MONITORING
1. DDC SHALL MONITOR THE AIR FILTER PRESSURE DROP AND ISSUE A DIRTY FILTER ALARM UPON HIGH DIFFERENTIAL PRESSURE.

HEATING MODE
1. DDC SHALL MONITOR ROOM TEMPERATURE AND DISPLAY IT ON THE GRAPHICAL INTERFACE.
2. DDC SHALL MODULATE THE HEATING COIL CONTROL VALVE TO MAINTAIN SPACE TEMPERATURE SET POINT.
3. SPACE TEMPERATURE SET POINT SHALL BE:
   A. 72 °F

6 M-708 TYPICAL DOOR AIR CURTAIN CONTROL DIAGRAM
NOT TO SCALE

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WHITE

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TEMPERATURE CONTROL DIAGRAMS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUN-2023

SHEET
M-708

100% CONSTRUCTION DOCUMENTS

WE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
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WHITE

ABBREVIATIONS

1/C	SINGLE CONDUCTOR
Φ	PHASE
A	AMPS
A/C	AIR CONDITIONING UNIT
AC	ALTERNATING CURRENT
ACH	ABOVE COUNTER HEIGHT
ACT	ABOVE CEILING TILE
ADA	AMERICANS WITH DISABILITIES ACT
ADJ	ADJUSTABLE
AF	AMP FRAME
AFC	ABOVE FINISHED CEILING
AFCI	ARC FAULT CIRCUIT INTERRUPTER
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLING UNIT
AIC	AMPS INTERRUPTING CAPACITY
AL	ALUMINUM
ALD	ASSISTED LISTENING DEVICE
ALT	ALTERNATE
ARCH	ARCHITECTURAL
AS	AMP SWITCH
AT	AMP TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AV	AUDIO VISUAL
AVG	AVERAGE
AWG	AMERICAN WIRE GAUGE
BC	BONDING CONDUCTOR
BCU	BARE COPPER
BFC	BELOW FINISHED CEILING
BFG	BELOW FINISHED GRADE
BKR	BREAKER
BLDG	BUILDING
BOF	BOTTOM OF FIXTURE
BTM	BOTTOM
C	CONDUIT
C/W	COMPLETE WITH
CAP	CAPACITY
CATV	CABLE ANTENNA TELEVISION
CB	CIRCUIT BREAKER
CCTV	CLOSED CIRCUIT TELEVISION
CEC	CANADIAN ELECTRIC CODE
CFOI	CONTRACTOR FURNISHED, OWNER INSTALLED
CIRC	CIRCULATING
CKT	CIRCUIT
CL	CENTERLINE
CLG	CEILING
CM	CEILING MOUNTED
CMU	CONCRETE MASONRY UNIT
CO	CONDUIT ONLY
COMM	COMMUNICATIONS
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
CPT	CONTROL POWER TRANSFORMER
CPU	CENTRAL PROCESSING UNIT
CR	CRITICAL BRANCH
CT	CURRENT TRANSFORMERS
CTR	CENTER
CU	COPPER
CUH	CABINET UNIT HEATER
D	DEDICATED
DC	DIRECT CURRENT
DET	DETAIL
DIAM	DIAMETER
DIM	DIMENSION
DISC	DISCONNECT
DIV	DIVISION
DL	DAMP LOCATION
DN	DOWN
DP	DISTRIBUTION PANEL
DPDT	DOUBLE POLE, DOUBLE THROW
DPR	DAMPER
DPST	DOUBLE POLE, SINGLE THROW
DWG	DRAWING
DWH	DOMESTIC WATER HEATER

ABBREVIATIONS

EA	EACH
EC	ELECTRICAL CONTRACTOR
EF	EXHAUST FAN
ELEC	ELECTRICAL
ELEV	ELEVATOR
EM	EMERGENCY
EM GEN	EMERGENCY GENERATOR
EMT	ELECTRICAL METALLIC TUBING
ENCL	ENCLOSURE
EP	ELECTRIC-PNEUMATIC
EPO	EMERGENCY POWER OFF
EQ	EQUIPMENT BRANCH
EQUIP	EQUIPMENT
ERL	EXISTING TO BE RELOCATED
ETD	EMERGENCY TRANSFER DEVICE
EWC	ELECTRIC WATER COOLER
EXH	EXHAUST
EXIST, E, EX	EXISTING
EXP	EXPLOSION PROOF
EXTER	EXTERIOR
F&I	FURNISHED AND INSTALLED
FA	FIRE ALARM
FAA	FIRE ALARM ANNUNCIATOR
FACP	FIRE ALARM CONTROL PANEL
FB	FLOOR BOX
FCU	FAN COIL UNIT
FLR	FLOOR
FLUOR	FLUORESCENT
FO	FIBER (FIBRE) OPTIC
FP	FIRE PROTECTION
FS	FUSIBLE SWITCH
FSCS	FIRE FIGHTER SMOKE CONTROL STATION
FU	FUSE
FVNR	FULL VOLTAGE NON REVERSING
FVR	FULL VOLTAGE REVERSING
G, GND	GROUND
G/Y	GREEN YELLOW
GA	GAUGE
GAL	GALLONS
GC	GENERAL CONTRACTOR
GEN	GENERATOR
GFI, GFCI	GROUND FAULT (CIRCUIT) INTERRUPTER
H	HOT CONDUCTOR
HC	HORIZONTAL CROSS CONNECT
HD	HAND DRYER
HFF	HAND FREE FIXTURE
HGT	HEIGHT
HH	HANDHOLE
HID	HIGH INTENSITY DISCHARGE
HK	HOUSE KEEPING PAD
HM	HORIZONTALLY MOUNTED
HOA	HAND-OFF-AUTO
HOR	HORIZONTAL
HP	HORSEPOWER
HTG	HEATING
HV	HIGH VOLTAGE
HVCB	HIGH VOLTAGE CIRCUIT BREAKER
HW	HOT WATER
HZ	HERTZ
IC	INTERMEDIATE CROSS CONNECT
ID	INSIDE DIAMETER
IDF	INTERMEDIATE DISTRIBUTION FRAME
IG	ISOLATED GROUND
IMC	INTERMEDIATE METAL CONDUIT
INST	INSTANTANEOUS
IP	INTERNET PROTOCOL
JB	JUNCTION BOX
K	KIRK KEY INTERLOCK
KAIC	KILO-AMPS INTERRUPTING CAPACITY
KV	KILOVOLT
KVA	KILOVOLT-AMPERES
KW	KILOWATT
LED	LIGHT EMITTING DIODE
LR	LEGALLY REQUIRED
LS	LIFE SAFETY BRANCH
LSIG	LONG TIME, SHORT TIME, INSTANTANEOUS, GROUND FAULT
LTG	LIGHTING
LV	LOW VOLTAGE

ABBREVIATIONS

MAU	MAKE UP AIR UNIT
MAX	MAXIMUM
MC	METAL CLAD CABLE
MCA	MINIMUM CIRCUIT AMPS
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCCB	MOLDED CASE CIRCUIT BREAKER
MCP	MOTOR CIRCUIT PROTECTOR
MCT	MAIN CROSS CONNECT
MDF	MAIN DISTRIBUTION FRAME
MDP	MAIN DISTRIBUTION PANEL
MECH	MECHANICAL
MET	MAIN EARTHING TERMINAL
MFR	MANUFACTURER
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MLO	MAIN LUG ONLY
MM	MULTIMODE FIBER (FIBRE) OPTIC STRAND
MSB	MAIN SWITCHBOARD
MTD	MOUNTED
MTG	MOUNTING
MTS	MAIN TERMINAL SPACE
MV	MEDIUM VOLTAGE
MVCB	MEDIUM VOLTAGE CIRCUIT BREAKER
MW	MICROWAVE OVEN
N	NEUTRAL
NAC	NOTIFICATION APPLIANCE CIRCUIT
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRIC CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NIC	NOT IN CONTRACT
NL	NIGHT LIGHT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFE	OWNER FURNISHED EQUIPMENT
OH	OVERHEAD
OL	OVERLOAD
OS	OCCUPANCY SENSOR, OPTIONAL STANDBY
OSP	OUTSIDE PLANT
P	POLE
PA	PUBLIC ADDRESS
PB	PULL BOX
PD	PUNCHDOWN
PF	POWER FACTOR
PH	PHASE
PNL	PANEL
POE	POINT OF ENTRANCE
POS	POINT OF SERVICE
PR	PAIR
PT	POTENTIAL TRANSFORMERS
PTS	PNEUMATIC TUBE STATION
PTZ	PAN/TILT/ZOOM
PV	PHOTOVOLTAIC
PVC	POLYVINYL CHLORIDE CONDUIT
PWR	POWER
R	RELOCATED
RA	RETURN AIR
REC	RECESSED
RECP	RECEPTACLE
REQD	REQUIRED
REX	REQUEST TO EXIT
RM	ROOM
RNC	RIGID NON-METALLIC CONDUIT
RO	RACEWAY ONLY
RSC, RGS	RIGID STEEL CONDUIT
SCCR	SHORT CIRCUIT CURRENT RATING
SEC	SECURITY
SECT	SECTION
SIM	SIMILAR
SM	SINGLE MODE FIBER OPTIC STRAND
SMR	SURFACE MOUNTED RACEWAY
SPD	SURGE PROTECTED DEVICE
SPDT	SINGLE POLE DOUBLE THROW
SPECS	SPECIFICATIONS
SPST	SINGLE POLE SINGLE THROW
SS	STAINLESS STEEL
ST	SHUNT TRIP
STD	STANDARD
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYS	SYSTEM

ABBREVIATIONS

TBB	TELECOMMUNICATIONS BACKBONE
TC	TEMPERATURE CONTROL OR TERMINAL CABINET
TE	TELECOMMUNICATIONS ENCLOSURE
TELE	TELEPHONE
TELECOM	TELECOMMUNICATIONS
TEMP	TEMPERATURE
TERM	TERMINAL
TGB	TELECOMMUNICATIONS GROUND BAR
TMGB	TELECOMMUNICATIONS MAIN GROUND BAR
TOF	TOP OF FIXTURE
TP	TAMPER RESISTANT
TR	TELECOMMUNICATIONS ROOM
TSP	TWISTED SHIELDED PAIR
TSTAT	THERMOSTAT
TTB	TELECOM TERMINAL BOARD
TV	TELEVISION
TYP	TYPICAL
UG	UNDERGROUND
UH	UNIT HEATER
UNO	UNLESS NOTED OTHERWISE
UPS	UNINTERRUPTIBLE POWER SUPPLY
USB	UNIVERSAL SERIAL BUS
UTP	UNSHIELDED TWISTED PAIR
UV	UNIT VENTILATOR
V	VOLTS
VA	VOLT-AMPS
VAV	VARIABLE AIR VOLUME
VC	VOLUME CONTROL
VDT	VISUAL DISPLAY TERMINAL
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VIF	VERIFY IN FIELD
VOL	VOLUME
VT	VAPOR TIGHT
W	WIRE, WATT
WAP	WIRELESS ACCESS POINT
WG	WIREGUARD
WL	WET LOCATION
WP	WEATHERPROOF
WT	WATERTIGHT
XFMR	TRANSFORMER

WORK DEFINITION

Symbol	Description
	NEW WORK
	EXISTING
	REMOVE EXISTING
×××	REMOVE EXISTING ELECTRICAL EQUIPMENT
	FUTURE
	TEMPORARY, AS NOTED
?##	KEY NOTE
???	EQUIPMENT IDENTIFICATION

TELECOM OUTLETS

Symbol	Description
	OUTLET
	OUTLET, CEILING MOUNTED
	OUTLET, MOUNTED IN FLOOR BOX
	OUTLET, MOUNTED IN POKE THRU
	OUTLET, MOUNTED IN POWER POLE

TELECOM OUTLET TYPES

Symbol	Description
#	# INDICATES QUANTITY OF DATA JACKS, PULLSTRING ALWAYS PROVIDED. WHERE NO QUANTITY IS NOTED, 2 DATA JACKS AND PULLSTRING.
AC	MOUNTED 3" ABOVE COUNTER BACKSPLASH
B	BLANK FACEPLATE, ROUGH-IN ONLY
D	DIRECT CONNECTION TO PANEL
M	PATIENT MONITORING
P	PAY TELEPHONE
R	RACEWAY MOUNTED
W	WALL MOUNTED TELEPHONE HANDSET OUTLET
WAP	WIRELESS ACCESS POINT CONNECTION

TELECOM MISCELLANEOUS

Symbol	Description
	CABLE TRAY WITH FLANGE SIDE RAILS AND LADDER RUNGS
	CABLE TRAY
	BUNDLED CABLE SUPPORT, J-HOOK SYSTEM
	BUNDLED CABLE SUPPORT, J-HOOK SYSTEM, CEILING MOUNTED
	BUNDLED CABLE SUPPORT, J-HOOK SYSTEM, PENDANT MOUNTED
	GROUND BAR, LENGTH TO SCALE
	RAISED FLOOR GROMMET
WAP	WIRELESS ACCESS POINT
WAP	WIRELESS ACCESS POINT, CEILING MOUNTED

AUDIO VISUAL

Symbol	Description
	CONTROL PANEL
LV	LOW VOLTAGE SWITCH
	MICROPHONE, CEILING MOUNTED
	MICROPHONE, WALL MOUNTED
	SYSTEMS TERMINAL CABINET, DRAWN TO SCALE
	TV CONTROL
AL	ASSISTIVE LISTENING, CEILING MOUNTED
AL	ASSISTIVE LISTENING, WALL MOUNTED
AV	AUDIO VISUAL PANEL
C	VIDEO CAMERA, CEILING MOUNTED
C	VIDEO CAMERA, WALL MOUNTED
IR	INFRARED RECEIVER, CEILING MOUNTED
IR	INFRARED RECEIVER, WALL MOUNTED
RF	RADIO FREQUENCY RECEIVER, CEILING MOUNTED
RF	RADIO FREQUENCY RECEIVER, WALL MOUNTED
S	SPEAKER, RECESSED AND CEILING MOUNTED
S	SPEAKER, SURFACE AND CEILING MOUNTED
S	SPEAKER, PENDANT MOUNTED
S	SPEAKER, RECESSED AND WALL MOUNTED
S	SPEAKER, SURFACE AND WALL MOUNTED
S	SPEAKER/MICROPHONE, RECESSED AND CEILING MOUNTED
S	SPEAKER/MICROPHONE, RECESSED AND WALL MOUNTED
TV	CATV OUTLET, CEILING MOUNTED
TV	CATV OUTLET, WALL MOUNTED
VC	VOLUME CONTROLLER
VD	VIDEO DISPLAY, CEILING MOUNTED
VD	VIDEO DISPLAY, RECESSED AND WALL MOUNTED
VD	VIDEO DISPLAY, SURFACE AND WALL MOUNTED
VP	VIDEO PROJECTOR, CEILING MOUNTED
VP	VIDEO PROJECTOR, RECESSED AND WALL MOUNTED
VP	VIDEO PROJECTOR, SURFACE AND WALL MOUNTED

FIRE ALARM

Symbol	Description
	FIRE SERVICE PHONE STATION OUTLET
	FLAME DETECTOR
CO	GAS DETECTOR, CARBON MONOXIDE
	HORN AND STROBE LIGHT, CEILING MOUNTED
	HORN AND STROBE LIGHT, WALL MOUNTED
	REMOTE INDICATOR, CEILING MOUNTED
	REMOTE INDICATOR, WALL MOUNTED
	SPEAKER AND STROBE LIGHT, CEILING MOUNTED
	SPEAKER AND STROBE LIGHT, WALL MOUNTED
	STROBE LIGHT, CEILING MOUNTED
	STROBE LIGHT, WALL MOUNTED
AIM	ADDRESSABLE INPUT MODULE
ARCM	AREA OF REFUGE COMMUNICATION MASTER UNIT
ARCR	AREA OF REFUGE COMMUNICATION REMOTE UNIT
AOM	ADDRESSABLE OUTPUT MODULE
D	ELECTRICALLY OPERATED SMOKE OR FIRE/SMOKE DAMPER CONNECTION
DCL	DOOR CLOSER
DH	DOOR HOLDER
F	CHIME, WALL MOUNTED
F	HORN, CEILING MOUNTED
F	HORN, WALL MOUNTED
F	PULL STATION
FAA	FIRE ALARM ANNUNCIATOR
FACP	FIRE ALARM CONTROL PANEL
FAT	FIRE ALARM TRANSMITTER
FATC	FIRE ALARM TERMINAL CABINET
GAP	GRAPHIC ANNUNCIATOR PANEL
H F#	HEAT DETECTOR, FIXED TEMPERATURE, # INDICATES °F OR °C
H RF	HEAT DETECTOR, COMBINED RATE OF RISE/FIXED TEMPERATURE
H R	HEAT DETECTOR, RATE OF RISE
NAC	FIRE ALARM NOTIFICATION APPLIANCE CIRCUIT PANEL
PS	PRESSURE DETECTOR/SWITCH
S AS	SMOKE DETECTOR, AIR SAMPLING
S BR	SMOKE DETECTOR, BEAM DETECTOR RECEIVER
S BT	SMOKE DETECTOR, BEAM DETECTOR TRANSMITTER
S E	SMOKE DETECTOR, ELEVATOR RECALL
S I	SMOKE DETECTOR, IONIZATION
S ID	SMOKE DETECTOR, IN DUCT
S P	SMOKE DETECTOR, PHOTOELECTRIC
SS	SMOKE DETECTOR, SINGLE STATION
S H	SMOKE/HEAT DETECTOR
S H CO	SMOKE/HEAT/CARBON MONOXIDE DETECTOR
S	SPEAKER, CEILING MOUNTED
S	SPEAKER, WALL MOUNTED
VS	VALVE SUPERVISORY TAMPER SWITCH
WF	FLOW DETECTOR/SWITCH
	FIRE/SMOKE DAMPER

GENERAL NOTES

1. THE ELECTRICAL CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FROM AUTHORITIES HAVING JURISDICTION AND PAY ALL ASSOCIATED FEES.
2. LOCATE JUNCTION AND PULL BOXES AS REQUIRED TO ALLOW ACCESS AFTER EQUIPMENT AND APPURTENANCES ARE INSTALLED. COORDINATE EXACT LOCATIONS WITH THE OTHER TRADES. COORDINATE LOCATIONS AND ELEVATIONS OF ELECTRICAL DEVICES WITH DRAWINGS AND OTHER TRADES PRIOR TO INSTALLATION.
3. PROTECT PERMANENT BUILDING FINISHES FROM DAMAGE DURING CONSTRUCTION PERIOD. PROVIDE PLYWOOD OR SIMILAR MATERIAL UNDER EQUIPMENT OR MATERIALS STORED ON FLOORS, AND IN AREAS WHERE CONSTRUCTION MAY DAMAGE FINISHES. SURFACES OR FINISHES DAMAGED DURING CONSTRUCTION SHALL BE REPLACED AT THE COST OF THE CONTRACTOR AT FAULT.
4. CONTRACTORS SHALL COORDINATE LOCATIONS OF FIXTURES AND ELECTRICAL DEVICES INSTALLED IN OR ON THE CEILING WITH ARCHITECTURAL REFLECTED CEILING PLAN. CEILING MOUNTED ELECTRICAL DEVICES SHALL BE MOUNTED IN THE CENTER OF THE CEILING TILES, UNLESS OTHERWISE NOTED.
5. PROPERLY SUPPORT PER CODE LOW VOLTAGE CABLING NOT IN CONDUIT. PROVIDE PROPER PERMANENT SUPPORT AS NEEDED TO COMPLY WITH CODE AND TAKE WEIGHT OFF CEILING SUPPORTS. REMOVE AND REINSTALL ELECTRICAL DEVICES AND EQUIPMENT AS NEEDED FOR PAINTING, WALL COVERINGS, CEILINGS, AND FINISH WORK. REFER TO ARCHITECTURAL DRAWINGS. LOW VOLTAGE CABLING LOCATED IN EXPOSED STRUCTURE (CEILING) AREAS SHALL BE INSTALLED IN CONDUIT (OR CABLE TRAY, IF APPLICABLE) AND ROUTED TIGHT TO DECK. INSTALLATIONS NOT IN COMPLIANCE WITH THIS REQUIREMENT SHALL BE REMOVED AND REINSTALLED AT CONTRACTOR'S EXPENSE.
6. WHERE PROJECT PHASING IS INDICATED IN ANY PART OF THE WORKING DOCUMENT PACKAGE, ELECTRICAL CONTRACTOR IS TO PLAN WORK SO AS TO FACILITATE SUCH PHASING.
7. FOR BRANCH CIRCUITS OVER 75' (25 METERS) IN LENGTH (TOTAL ONE WAY) FROM THE PANEL, THE ELECTRICAL CONTRACTOR SHALL CALCULATE THE VOLTAGE DROP AND PROVIDE AN APPROPRIATE CONDUCTOR SIZE TO ACHIEVE NO MORE THAN 3% MAXIMUM ALLOWABLE VOLTAGE DROP.
8. DO NOT SCALE THE DRAWINGS. BECAUSE OF THE SCALE OF THE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE ALL OFFSETS, FITTINGS OR OTHER SIMILAR ITEMS WHICH MAY BE REQUIRED TO MAKE A COMPLETE OPERATING SYSTEM. CAREFULLY INVESTIGATE CONDITIONS AFFECTING WORK AND INSTALL WORK IN SUCH MANNER THAT INTERFERENCES BETWEEN PIPES, CONDUITS, DUCTS, EQUIPMENT, ARCHITECTURAL AND STRUCTURAL FEATURES SHALL BE AVOIDED.

TELECOM, SECURITY, AND AV REQUIREMENTS:
CONTRACTOR SHALL REFER TO TECHNOLOGY, SECURITY, AND AV DRAWINGS FOR ADDITIONAL SYMBOLS AND REQUIREMENTS BY DIVISION 26 CONTRACTOR.

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ELECTRICAL SYMBOLS AND ABBREVIATIONS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E001

100% CONSTRUCTION DOCUMENTS

WE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID

BLACK

WHITE

ELECTRICAL SCHEMATICS

C#
3 1 G

CABLE IDENTIFICATION, TABLE
- CIRCUIT RATING, SEE FEEDER TABLE
  - A = ALUMINUM
  - C = COPPER
  - M = METAL CLAD
- GROUND REQUIRED, SIZE PER FEEDER TABLE
  - G = YES
  - - = NO
- NEUTRAL CONDUCTOR REQUIREMENT, SIZE PER FEEDER TABLE
  - - = NOT REQUIRED
  - 1 = 1 NEUTRAL CONDUCTOR
  - 2 = 200% NEUTRAL (2 NEUTRAL CONDUCTORS)
- QUANTITY OF PHASE CONDUCTORS, SIZE PER FEEDER TABLE

CABLE IDENTIFICATION, LEADER

4 #12+ #12G, [SIZE]C
- CONDUIT SIZE
- GROUND SIZE, IF BLANK NO GROUND REQUIRED
- QUANTITY AND SIZE OF CONDUCTORS

CABLE IDENTIFICATION, LEADER

4 SETS (3x1/C 600 kcmil, Cu, TR-XLPE, 15kV, 133%+#3/0G, [SIZE]C)
- CONDUIT SIZE
- GROUND SIZE, IF BLANK NO GROUND REQUIRED
- CONDUCTOR FEATURES
- QUANTITY AND SIZE OF CONDUCTORS
- QUANTITY OF SETS

0 — SHORT CIRCUIT CURRENT RATING

BUS DUCT

BUS

FEEDER

NAME
.
225 A
480 V
3 Ø, 4 W
42 CCT
— PANEL, SINGLE TUB

NAME
LOCATION
— PANEL, DOUBLE TUB, MAIN LUGS

NAME
LOCATION
NAME
.
— PANEL, DOUBLE TUB, FEED THRU LUGS

AC/DC INVERTER

AUTOTRANSFORMER

AUTOMATIC TRANSFER SWITCH, DUAL BYPASS

AUTOMATIC TRANSFER SWITCH, SINGLE BYPASS

BATTERY

BIMETALLIC THERMAL OVERLOAD

CAPACITOR

ELECTRICAL SCHEMATICS

- CIRCUIT BREAKER, LOW VOLTAGE, DRAW OUT
- CIRCUIT BREAKER, LOW VOLTAGE, FIXED
- CIRCUIT BREAKER, LOW VOLTAGE, WITH LIMITER
- CIRCUIT BREAKER, MEDIUM VOLTAGE, DRAW OUT
- CIRCUIT BREAKER, MEDIUM VOLTAGE, FIXED
- CIRCUIT BREAKER, MEDIUM VOLTAGE, VACUUM INTERRUPTER
- CONNECTION, CONNECTED
- CONNECTION, DRAW OUT, DISCONNECTED
- CONNECTION, FEED FROM/TO
- CONNECTION, NOT CONNECTED
- CONNECTION, SPLICE
- CONTACT
- CURRENT TRANSFORMER
- DEAD BREAK ELBOW
- DRAW OUT FUSE AND POTENTIAL TRANSFORMER
- FUSE
- FUSED CUTOUT
- GROUND
- GROUND STUD
- INDUCTOR
- LIGHTNING ARRESTOR, GAP TYPE
- LIGHTNING ARRESTOR, MOV TYPE
- LOAD BREAK ELBOW
- POTENTIAL TRANSFORMER
- POTHEAD
- STRESS CONE
- SWITCH, FUSED LOAD BREAK
- SWITCH, NON-FUSED LOAD BREAK
- SWITCH, NON-FUSED DOUBLE LOAD BREAK
- SWITCH, NON-FUSED LOAD BREAK WITH GROUNDING POSITION
- RESISTOR
- TRANSFER SWITCH
- TRANSFORMER
- TRANSFORMER CONFIGURATION, DELTA
- TRANSFORMER CONFIGURATION, DELTA, OPEN

ELECTRICAL SCHEMATICS

- TRANSFORMER CONFIGURATION, DELTA, CORNER GROUND
- TRANSFORMER CONFIGURATION, WYE
- TRANSFORMER CONFIGURATION, WYE, SOLID GROUND
- TRANSFORMER CONFIGURATION, WYE, RESISTOR, GROUND
- TRANSFORMER CONFIGURATION, WYE, RESISTOR, CURRENT TRANSFORMER, GROUND
- TRANSFORMER CONFIGURATION, WYE, INDUCTOR, CURRENT TRANSFORMER, GROUND
- TRANSFORMER CONFIGURATION, ZIGZAG
- ZERO SEQUENCE CURRENT TRANSFORMER
- 50 — RELAY, SINGLE FUNCTION
- 50/51 — RELAY, DUAL FUNCTION
- 50 50 50 / 50 50 50 — RELAY, MULTIFUNCTION
- A — AMMETER
- AS — AMPERAGE METER SWITCH
- DMS — DIGITAL METERING SYSTEM
- G — GENERATOR
- K — KIRK KEY
- LSIG — RELAY, TRIP UNIT
- LSIG — DRAW OUT BREAKER C/W INTEGRAL SOLID STATE TRIP UNIT
- LSIG — DRAW OUT BREAKER C/W SERIES ELECTROMECHANICAL TRIP UNIT
- M — INLINE SOCKET METER
- METER — METER
- O/L — ELECTRONIC THERMAL OVERLOAD
- SB — SHORTING BLOCK
- SPACE — SPACE, DRAW OUT BREAKER
- SPACE — SPACE, FIXED BREAKER
- SPD — SURGE PROTECTION DEVICE
- TS — TEST SWITCH
- V — VOLTMETER
- VS — VOLTAGE METER SWITCH
- X — INDICATOR, VOLTAGE PRESENT

LUMINAIRES

CIRCUITS EMERGENCY	NORMAL	
N/A	L01	LUMINAIRE IDENTIFICATION, SEE LUMINAIRES SCHEDULE
N/A	a	LOWER-CASE LETTER(S) NEAR LUMINAIRE DENOTE SWITCH LEG(S)
		RECESSED RECTANGULAR LUMINAIRE, DRAWN TO SCALE
		SURFACE MOUNTED RECTANGULAR LUMINAIRE, DRAWN TO SCALE
		RECESSED BASKET LUMINAIRE, DRAWN TO SCALE
		STRIP LUMINAIRE, LENGTH TO SCALE
		WALL MOUNTED RECTANGULAR LUMINAIRE, LENGTH TO SCALE(NUMBER OF MOUNTING POINTS WILL VARY WITH THE LUMINAIRE LENGTH AND ARE NOT INDICATED.)
		RECESSED DOWNLIGHT LUMINAIRE
		SURFACE MOUNTED DOWNLIGHT LUMINAIRE
		PENDANT MOUNTED LUMINAIRE
		LINEAR PENDANT MOUNTED LUMINAIRE, LENGTH TO SCALE (NUMBER OF MOUNTING POINTS WILL VARY WITH THE LUMINAIRE LENGTH AND ARE NOT INDICATED.)
		WALL MOUNTED LUMINAIRE
		WALL MOUNTED VERTICALLY ORIENTED LUMINAIRE
		WALL MOUNTED RECESSED LINEAR LUMINAIRE, LENGTH TO SCALE
	N/A	EXIT SIGN, FILLED SIDES INDICATE ILLUMINATED ANNOTATION, ARROWS INDICATE DIRECTIONAL GRAPHICS
	N/A	WALL MOUNTED EXIT SIGN, FILLED SIDES INDICATE ILLUMINATED ANNOTATION, ARROWS INDICATE DIRECTIONAL GRAPHICS
	N/A	EXIT SIGN WITH EMERGENCY BATTERY PACK
	N/A	WALL MOUNTED EXIT SIGN WITH EMERGENCY BATTERY PACK
	N/A	EMERGENCY BATTERY PACK, NUMBER OF LAMPS NOT INDICATED
	N/A	WALL MOUNTED EMERGENCY BATTERY PACK, NUMBER OF LAMPS NOT INDICATED
	N/A	EMERGENCY WITH REMOTE BATTERY PACK, NUMBER OF LAMPS NOT INDICATED
	N/A	WALL MOUNTED EMERGENCY WITH REMOTE BATTERY PACK, NUMBER OF LAMPS NOT INDICATED
		RECESSED LINEAR WALL WASH LUMINAIRE, LENGTH TO SCALE
		RECESSED WALL WASH LUMINAIRE
		SURFACE MOUNTED WALL WASH LUMINAIRE
		RECESSED ACCENT LUMINAIRE
		SURFACE MOUNTED ACCENT LUMINAIRE
		PENDANT MOUNTED ACCENT LUMINAIRE
		MONOPOINT LUMINAIRE
N/A		TRACK LIGHTING
N/A		CONTINUOUS SOURCE LUMINAIRE, PATH AS INDICATED
		MULTI-LAMP ACCENT LUMINAIRE, NUMBER OF LAMPS NOT INDICATED
		WALL MOUNTED MULTI-LAMP ACCENT LUMINAIRE, NUMBER OF LAMPS NOT INDICATED
		OVERCOUNTER TASK LUMINAIRE
		UNDERCOUNTER TASK LUMINAIRE
		FIBER OPTIC REMOTE SOURCE
		STEP LUMINAIRE
		ILLUMINATED SIGN
		WALL MOUNTED ILLUMINATED SIGN
		NIGHT LIGHT

LIGHTING CONTROLS

- $ — SINGLE POLE SWITCH
- INDICATES WIRELESS CONTROL
- $ a — LOWER-CASE LETTER(S) NEAR SWITCH DENOTE SWITCH LEG(S)
- $ 2 — DOUBLE POLE SWITCH
- $ 3 — THREE-WAY SWITCH
- $ 4 — FOUR-WAY SWITCH
- $ D — DIMMER SWITCH
- $ K — KEY OPERATED SWITCH
- $ LV — MOMENTARY CONTACT LOW VOLTAGE SWITCH
- $ O — OCCUPANCY SENSOR SWITCH
- $ OD — OCCUPANCY SENSOR/DIMMER SWITCH
- $ P — SWITCH WITH PILOT LIGHT
- $ PC — PHOTOCELL SWITCH
- $ T — TIMER SWITCH
- CS# — LOW VOLTAGE CONTROL STATION, # INDICATES STATION IDENTIFICATION
- DSC — DIMMING SYSTEM CONTROL PANEL
- J ELCU — EMERGENCY LIGHTING CONTROL UNIT
- LCP — LIGHTING CONTROL PANEL
- OS — OCCUPANCY SENSOR SWITCH, CEILING MOUNTED
- PS — PHOTO SENSOR CONTROL
- PS — PHOTO SENSOR CONTROL, CEILING MOUNTED
- DH — DAYLIGHT HARVESTING SENSOR
- DH — DAYLIGHT HARVESTING SENSOR, CEILING MOUNTED
- R — RELAY
- T — LOW VOLTAGE TRANSFORMER

SITE/LANDSCAPE/GARAGE LUMINAIRES

CIRCUITS EMERGENCY NORMAL

- LIGHTING STANDARD: LUMINAIRE, POLE, AND BASE
- LAMP POST
- ILLUMINATED BOLLARD
- IN-GROUND LUMINAIRE
- ADJUSTABLE IN-GROUND LUMINAIRE
- SURFACE MOUNTED GARAGE LUMINAIRE
- SURFACE MOUNTED SHIELDED GARAGE LUMINAIRE, LINES INDICATE NUMBER AND POSITION OF SHIELD(S)

CLOCK SYSTEMS

- CLOCK, 12 HOUR DIAL
- 24 — CLOCK, 24 HOUR DIAL
- D — CLOCK, DIGITAL
- ELAPSED TIME CLOCK
- ETC — ELAPSED TIME CONTROLLER

DOOR BUZZERS

- PUSH BUTTON
- B — BUZZER HORN
- B — BUZZER HORN AND VISUAL INDICATOR

SITE UTILITIES

- GROUND ROD
- HH — HANDHOLE
- M — SITE METER
- MH — MANHOLE
- PB — PULL BOX
- PMH — PRIMARY MANHOLE
- SMH — SECONDARY MANHOLE
- TMH — TELECOMMUNICATIONS MANHOLE

SITE UTILITY POLES

- CATV ONLY
- COMBINED SERVICES
- POWER ONLY
- RISER
- TELECOM ONLY
- STEPDOWN TRANSFORMER, POLE MOUNTED

ELECTRICAL EQUIPMENT

- 208V OR 240V POWER PANELBOARD
- 480V OR 600V POWER PANELBOARD
- EQUIPMENT CABINET OR PANEL
- EQUIPMENT CONNECTION, FILL INDICATES EMERGENCY CIRCUIT
- GROUND BAR
- MOTOR CONNECTION, 1Ø
- MOTOR CONNECTION, 3Ø
- BUS DUCT
- ATS — AUTOMATIC TRANSFER SWITCH
- B — BUS DUCT PLUG
- SPD — SURGE PROTECTIVE DEVICE
- T — TRANSFORMER, LESS THAN 30KVA, NOT TO SCALE
- TRANSFORMER, 30KVA OR GREATER, DRAWN TO SCALE

POWER DEVICES

- IFP — INTERACTIVE FLAT PANEL. REFER TO DETAIL ON DRAWING E502.
- TWS — TEACHER WORK STATION OUTLET DETAIL. REFER TO DETAIL ON DRAWING E502.
- FBX — FLOOR BOX. REFER TO SCHEDULE ON DRAWING E502 FOR REQUIREMENTS.
- WS1 — WORK STATION WITH ADJACENT POWER AND DATA. REFER TO DETAIL ON DRAWING E502.

CIRCUITS

- RACEWAY CONCEALED IN CEILING OR WALL. EXPOSED RACEWAY IS ALLOWED ONLY WHERE NOTED.
- RACEWAY BELOW SLAB OR UNDERGROUND
- RACEWAY UP
- RACEWAY DOWN
- RACEWAY CONTINUATION
- RACEWAY STUB-OUT WITH BUSHING
- J — JUNCTION BOX, CEILING OR ABOVE CEILING MOUNTED
- J — JUNCTION BOX, WALL MOUNTED
- PB — PULL BOX

RECEPTACLES

CIRCUITS EMERGENCY	NORMAL	
		SINGLE RECEPTACLE, 120V
		SINGLE RECEPTACLE, CEILING MOUNTED
		DUPLEX RECEPTACLE, 120V
		DUPLEX RECEPTACLE, CEILING MOUNTED
		DOUBLE DUPLEX RECEPTACLE, 120V
		DOUBLE DUPLEX RECEPTACLE, CEILING MOUNTED
		SPLIT WIRED RECEPTACLE, 120V, TOP SWITCHED
#	#	RECEPTACLE, NEMA #
#	#	COMBINATION RECEPTACLE, 120V AND NEMA #
		FURNITURE SYSTEMS RECEPTACLE, 120V
N/A		INDICATES CONTROLLED
N/A		INDICATES 15A
N/A		INDICATES TWIST LOCK
N/A	FB#	MULTI-SERVICE FLOOR BOX (REFER TO SCHEDULE ON E502)
N/A	PT#	MULTI-SERVICE POKE THRU (REFER TO SCHEDULE ON E502)
N/A		MULTI-SERVICE POWER POLE (RECEPTACLES/OUTLETS AS INDICATED)
N/A		MULTI-SERVICE ASSEMBLY (RECEPTACLES/OUTLETS AS INDICATED)
N/A		CLOCK RECEPTACLE, 120V
		CEILING CORD DROP, 120V

RECEPTACLE TYPES

- MOUNTED 3" ABOVE COUNTER BACKSPLASH
- D — DEDICATED CIRCUIT
- G — GROUND FAULT CIRCUIT INTERRUPTER
- GT — GROUND FAULT CIRCUIT INTERRUPTER AND TAMPER RESISTANT
- IG — ISOLATED GROUND
- S — SURGE PROTECTOR
- T — TAMPER RESISTANT
- U — INTEGRAL USB PORT(S)
- WP — GROUND FAULT CIRCUIT INTERRUPTER WITH WEATHER RESISTANT COVER

ELECTRICAL CONTROLS

- NON-FUSED SAFETY SWITCH
- FUSED SAFETY SWITCH, FUSE RATING INDICATED
- COMBINATION MOTOR STARTER AND FUSED SAFETY SWITCH, FUSE RATING INDICATED
- MOTOR STARTER
- MANUAL MOTOR STARTER
- AUTOMATIC DOOR PUSHPLATE
- EMERGENCY SHUTDOWN
- ENCLOSED CIRCUIT BREAKER
- C — CONTACTOR
- PUSH BUTTON CONTROL STATION
- $ — POWER SWITCH, MOTOR RATED
- $ K — POWER SWITCH, MOTOR RATED (KEYED)
- DDC — DIRECT DIGITAL CONTROL PANEL
- R — RELAY
- T — THERMOSTAT
- TC — TIME CLOCK
- VFD — VARIABLE FREQUENCY DRIVE

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ELECTRICAL SYMBOLS AND ABBREVIATIONS

REVISIONS

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E002

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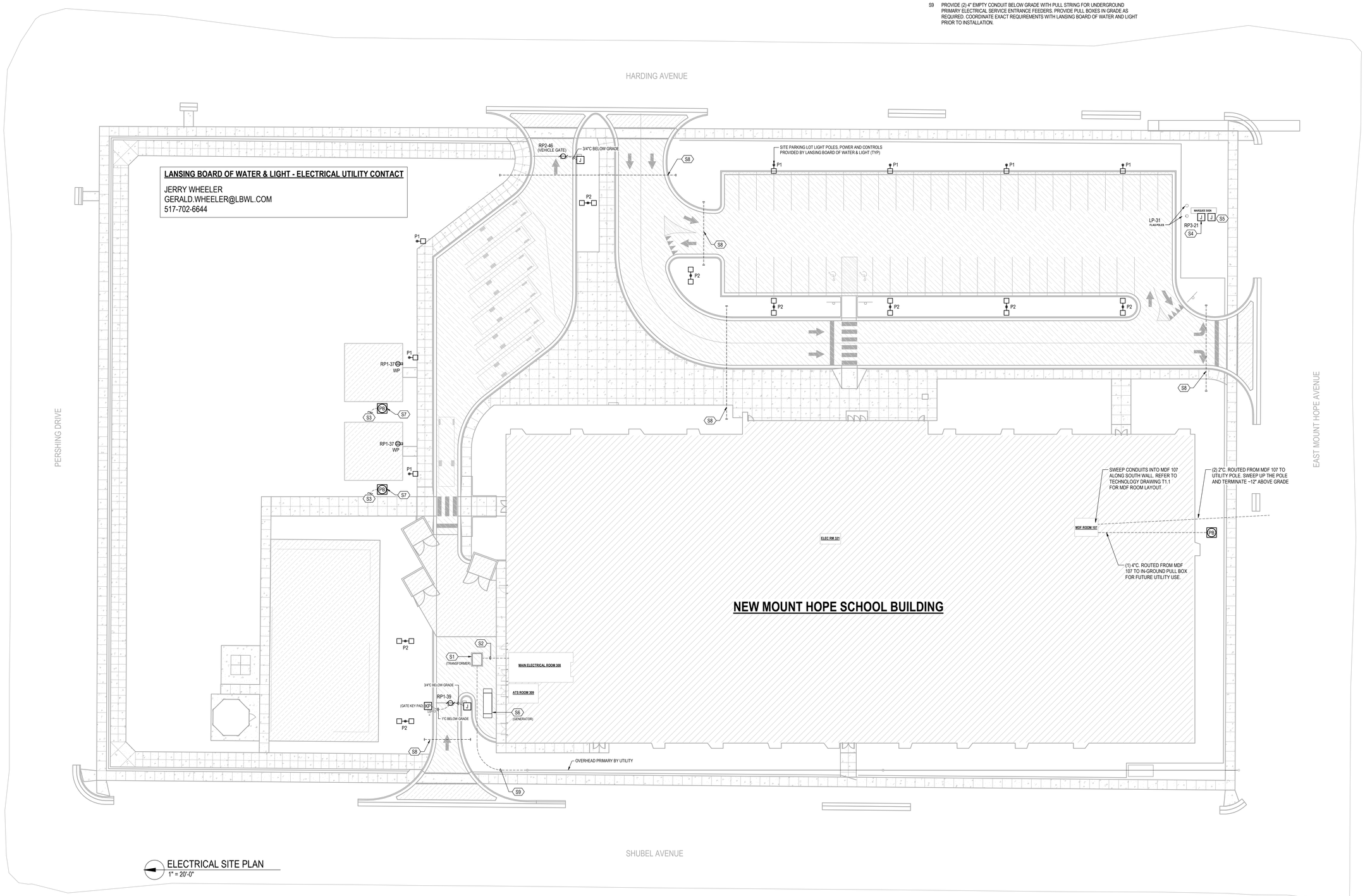
APPROVED BY: BC

SITE PLAN KEYNOTES

#	KEY NOTES
S1	NEW UTILITY TRANSFORMER FOR ELEMENTARY SCHOOL PROVIDED BY LANSING BOARD OF WATER & LIGHT (LBWL). CONCRETE PAD BY LBWL.
S2	UNDERGROUND SECONDARY ELECTRICAL SERVICE ENTRANCE FEEDERS FROM UTILITY TRANSFORMER TO MAIN SWITCHBOARD. PROVIDE LOCATOR WIRE AND WARNING TAPE. COORDINATE ROUTING WITH OTHER TRADES TO AVOID CONFLICT WITH UNDERGROUND PIPING IN AREA. REFERENCE ONE-LINE DIAGRAM ON E401 FOR ADDITIONAL INFORMATION.
S3	PROVIDE (2) 3" CONDUITS WITH PULL STRING FOR POWER TO OUTDOOR LEARNING PAVILIONS. ROUTE CONDUIT FROM PULL BOX AND STUB UP AND CAP IN MAIN ELECTRICAL ROOM. REFERENCE DETAIL ON DRAWING E502.
S4	PROVIDE (2) 2" CONDUITS FROM MDF ROOM 107 TO MARQUEE SIGN FOR POWER AND LIGHTING. CAP AND MARK ONE CONDUIT AS SPARE. IN SECOND CONDUIT, CONNECT CIRCUITS IN PANEL RP-B WITH 2#4, &1#4G. COORDINATE FINAL REQUIREMENTS WITH SIGNAGE COMPANY/SHOP DRAWINGS AND OWNER PRIOR TO ROUGH-IN.
S5	PROVIDE (1) 2" EMPTY CONDUIT WITH PULL STRING FOR COMMUNICATION CABLING FOR MARQUEE SIGN FROM MDF ROOM 107 TO MARQUEE SIGN.
S6	OUTDOOR NATURAL GAS GENERATOR. PROVIDE THE FOLLOWING 1" CONDUITS AND ASSOCIATED CABLES/CONDUCTORS FROM THE GENERATOR: (1) TO THE FIRE ALARM CONTROL PANEL (1) TO THE ATS ROOM FOR COMMUNICATION AND EPO FUNCTION (1) POWER CIRCUIT FOR BATTERY CHARGER (1) POWER CIRCUIT FOR BLOCK HEATER (1) TO ATS-LS FOR DEDICATED START SIGNAL (1) TO ATS-SB FOR DEDICATED START SIGNAL (1) SPARE
S7	POWER AND COMMUNICATION PRECAST CONCRETE VAULT FOR OUTDOOR LEARNING PAVILION. COORDINATE EXACT LOCATION WITH OWNER.
S8	PROVIDE (3) 4" EMPTY CONDUIT SLEEVES (SCHEDULE 40) WITH PULL-STRING ROUTED BELOW GRADE FOR FUTURE USE. CAP BOTH ENDS BELOW GRADE.
S9	PROVIDE (2) 4" EMPTY CONDUIT BELOW GRADE WITH PULL STRING FOR UNDERGROUND PRIMARY ELECTRICAL SERVICE ENTRANCE FEEDERS. PROVIDE PULL BOXES IN GRADE AS REQUIRED. COORDINATE EXACT REQUIREMENTS WITH LANSING BOARD OF WATER AND LIGHT PRIOR TO INSTALLATION.

SITE PLAN GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND AND ABBREVIATIONS.
2. ELECTRICAL CONTRACTOR SHALL VERIFY WITH CONSTRUCTION MANAGER, THAT A SURVEY HAS BEEN CONDUCTED AND ALL UNDERGROUND UTILITIES IDENTIFIED. CALL DIG TESS.
3. UTILITIES SHOWN ON THIS DRAWING ARE FOR REFERENCE ONLY. ELECTRICAL CONTRACTOR SHALL COORDINATE EXACT LOCATION OF ALL EXISTING UTILITIES AND ROUTING OF ALL NEW UNDERGROUND UTILITES WITH RESPECTIVE TRADES (GENERAL, PLUMBING, CIVIL, ETC.), PRIOR TO DIGGING. MINIMIZE DIGGING BY SHARING TRENCHES WHENEVER POSSIBLE.
4. COORDINATE ANY DEMOLITION, TEMPORARY, AND PERMANENT (ELECTRICAL AND TELEPHONE) SERVICES TO THE SITE, WITH THE RESPECTIVE LOCAL UTILITY COMPANY REPRESENTATIVES, IN FIELD, PRIOR TO COMMENCEMENT OF WORK. ALL ASSOCIATED COST/FEES BY THE UTILITY COMPANY SHALL BE INCLUDED IN THE BID PRICE.
5. AT COMPLETION OF THE PROJECT, ELECTRICAL CONTRACTOR SHALL REMOVE ALL DE-ENERGIZED CONDUCTORS FROM SITE.
6. OUTDOOR SPARE CONDUITS SHALL INCLUDE PULL STRING AND SHALL BE TERMINATED WITH A CAP.
7. ELECTRICAL CONTRACTOR SHALL DIG OUT ENTIRE LENGTH OF TRENCH TO PROPERLY SET DUCT ELEVATIONS, BEFORE DIGGING, CALL DIG TESS.
8. PROVIDE LOCATOR WIRE AND WARNING TAPE FOR ALL UNDERGROUND CONDUITS AND FEEDERS.
9. ALL ELECTRICAL UTILITY WORK SHALL BE IN COMPLIANCE WITH LANSING BOARD OF WATER & LIGHT (LBWL) GUIDELINES AND DETAILS. COORDINATE WITH LBWL AS REQUIRED.
10. ALL CONDUIT DEPTHS SHALL BE COORDINATED WITH FINAL GRADES TO ALLOW FOR MINIMUM REQUIRED CONDUIT DEPTH. REFER TO CIVIL DRAWINGS FOR GRADING PLANS.



ELECTRICAL SITE PLAN
1" = 20'-0"

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WHITE

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ELECTRICAL SITE PLAN

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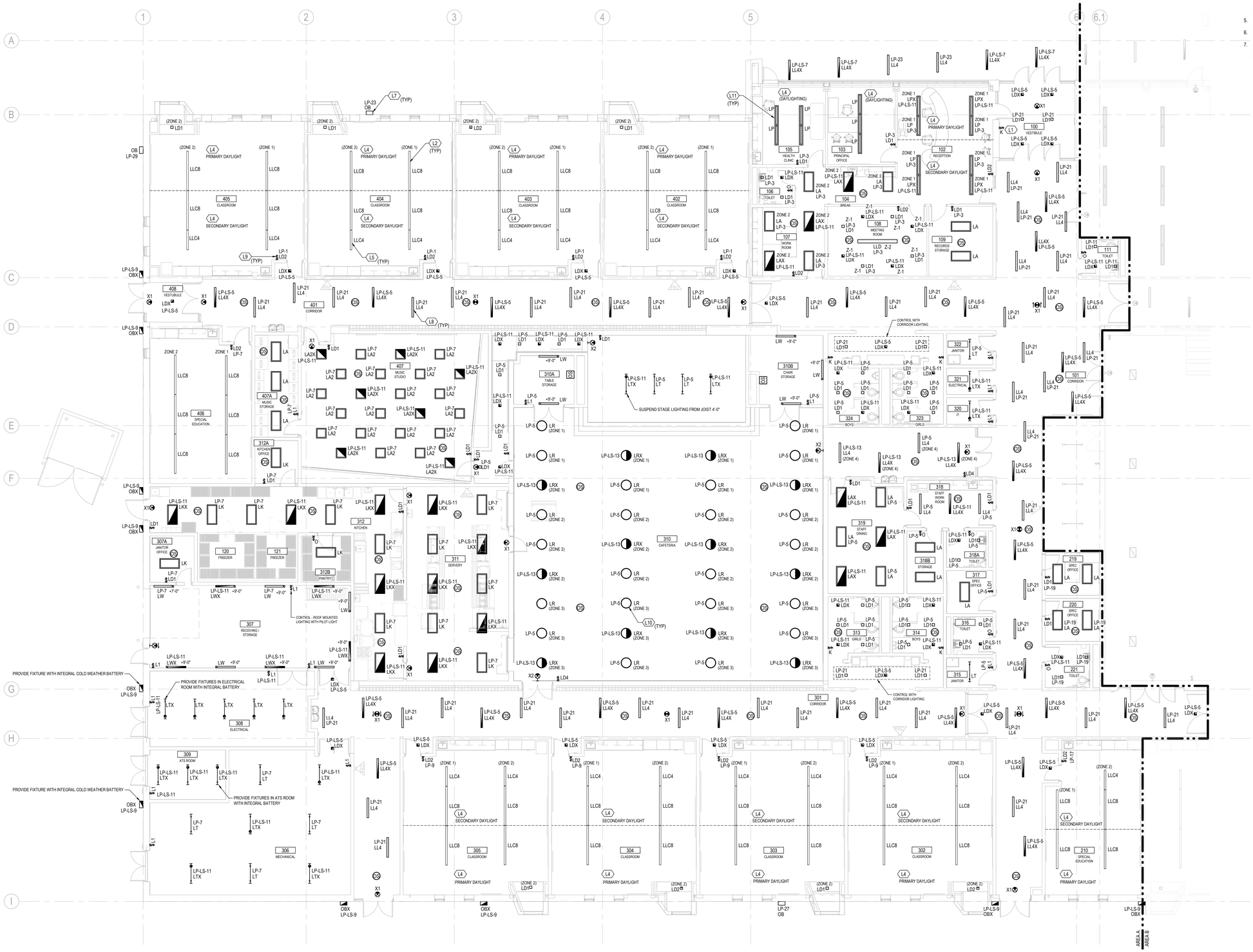


FIRST LEVEL LIGHTING PLAN - AREA A

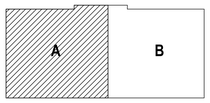
1/8" = 1'-0"

LIGHTING GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E601 & E602 FOR LIGHTING FIXTURE SCHEDULE AND CONTROLS INFORMATION.
3. THE CONTRACTOR SHALL PROVIDE A 'HOT' WIRE TIED AHEAD OF LOCAL SWITCHING AND THE LIGHTING CONTROL PANEL RELAYS FOR THE LEADS TO ALL NIGHT LIGHTS, EXIT LIGHTS, EMERGENCY BATTERY PACKS AND EMERGENCY UL924 RELAYS AND EXIT LIGHTS.
4. THE CONTRACTOR SHALL SUBMIT A FULL SET OF OCCUPANCY CONTROL LOCATION DRAWING SUBMITTALS TO THE AE PRIOR TO PURCHASE OR INSTALLATION. OCCUPANCY CONTROL LOCATIONS AND QUANTITIES SHALL BE BASED ON THE MANUFACTURER'S RECOMMENDATIONS. THE LIGHTING PLANS SHOW DESIGN INTENT ONLY AND DO NOT REFLECT EVERY MANUFACTURER PERMUTATIONS.
5. OCCUPANCY CONTROLS SHALL BE WIRED SUCH THAT ALL GENERAL ROOM LIGHTING IS CONTROLLED.
6. PROVIDE A DEDICATED NEUTRAL CONDUCTOR FOR EACH BRANCH CIRCUIT.
7. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY

LIGHTING KEYNOTES

#	KEY NOTES
L1	LOW VOLTAGE MASTER OVERRIDE ON SWITCH FOR OVERRIDE OF INTERIOR LIGHTING ON LIGHTING CONTROL RELAY PANEL. SWITCH COVER SHALL BE ENGRAVED/EMBOSSED WITH DESCRIPTION. COORDINATE FINAL LOCATION WITH BUILDING OWNER.
L2	CLASSROOM LINEAR LIGHT FIXTURES SHALL BE EQUIPPED WITH INTEGRAL OCCUPANCY AND PHOTOCELL SENSORS.
L4	PROVIDE DAYLIGHT HARVESTING CONTROL IN THIS SPACE.
L5	SUSPEND CLASSROOM LINEAR FIXTURES FROM BOTTOM OF STRUCTURAL JOIST SUCH THAT BOTTOM OF FIXTURE IS 10'-6" AFF.
L7	EXTERIOR LIGHTING SHALL BE CONTROLLED VIA BUILDING MANAGEMENT SYSTEM THROUGH CONTACTOR. REFER TO DETAILS ON DRAWING E602 FOR CONTACTOR DIAGRAM.
L8	CORRIDOR LIGHTING SHALL BE CONTROLLED VIA BUILDING MANAGEMENT SYSTEM THROUGH CONTACTOR. REFER TO DETAILS ON DRAWING E602 FOR CONTACTOR DIAGRAM.
L9	PROVIDE LOW VOLTAGE CONTROL STATION AS INDICATED IN SWITCH DESIGNATION DETAIL ON DRAWING E602.
L10	SUSPEND CAFETERIA PENDANT FIXTURE SUCH THAT BOTTOM OF FIXTURE IS 12'-0" AFF.
L11	SUSPEND TYPE LP LIGHT FIXTURE SUCH THAT BOTTOM OF FIXTURE IS 10'-0" AFF.



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LIGHTING PLAN - AREA A

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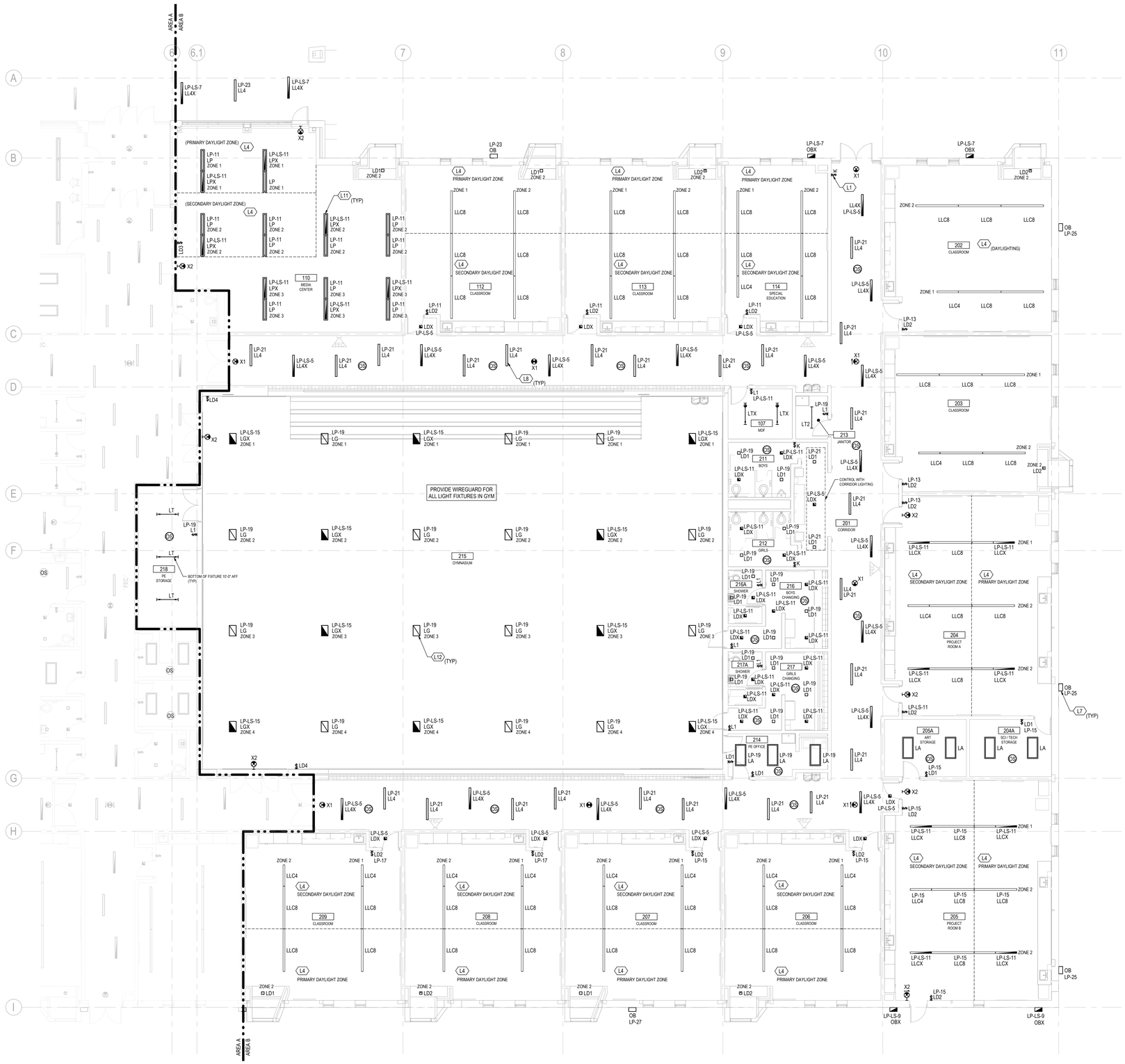


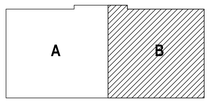
FIRST LEVEL LIGHTING PLAN - AREA B
1/8" = 1'-0"

LIGHTING GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E601 & E602 FOR LIGHTING FIXTURE SCHEDULE AND CONTROLS INFORMATION.
3. THE CONTRACTOR SHALL PROVIDE A 'HOT' WIRE TIED AHEAD OF LOCAL SWITCHING AND THE LIGHTING CONTROL PANEL RELAYS FOR THE LEADS TO ALL NIGHT LIGHTS, EXIT LIGHTS, EMERGENCY BATTERY PACKS AND EMERGENCY UL924 RELAYS AND EXIT LIGHTS.
4. THE CONTRACTOR SHALL SUBMIT A FULL SET OF OCCUPANCY CONTROL LOCATION DRAWING SUBMITTALS TO THE A/E PRIOR TO PURCHASE OR INSTALLATION. OCCUPANCY CONTROL LOCATIONS AND QUANTITIES SHALL BE BASED ON THE MANUFACTURER'S RECOMMENDATIONS. THE LIGHTING PLANS SHOW DESIGN INTENT ONLY AND DO NOT REFLECT EVERY MANUFACTURER PERMUTATIONS.
5. OCCUPANCY CONTROLS SHALL BE WIRED SUCH THAT ALL GENERAL ROOM LIGHTING IS CONTROLLED.
6. PROVIDE A DEDICATED NEUTRAL CONDUCTOR FOR EACH BRANCH CIRCUIT.
7. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY

LIGHTING KEYNOTES

#	KEY NOTES
L1	LOW VOLTAGE MASTER OVERRIDE ON SWITCH FOR OVERRIDE OF INTERIOR LIGHTING ON LIGHTING CONTROL RELAY PANEL. SWITCH COVER SHALL BE ENGRAVED/EMBOSSED WITH DESCRIPTION. COORDINATE FINAL LOCATION WITH BUILDING OWNER.
L4	PROVIDE DAYLIGHT HARVESTING CONTROL IN THIS SPACE.
L7	EXTERIOR LIGHTING SHALL BE CONTROLLED VIA BUILDING MANAGEMENT SYSTEM THROUGH CONTACTOR. REFER TO DETAILS ON DRAWING E602 FOR CONTACTOR DIAGRAM.
L8	CORRIDOR LIGHTING SHALL BE CONTROLLED VIA BUILDING MANAGEMENT SYSTEM THROUGH CONTACTOR. REFER TO DETAILS ON DRAWING E602 FOR CONTACTOR DIAGRAM.
L11	SUSPEND TYPE LP LIGHT FIXTURE SUCH THAT BOTTOM OF FIXTURE IS 10'-0" AFF.
L12	GYM HIGH BAY FIXTURE SHALL BE MOUNTED UNIFORMLY AT 24'-0" AFF. PROVIDE WIRE GUARD AND INTEGRAL OCCUPANCY SENSOR.



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LIGHTING PLAN - AREA B

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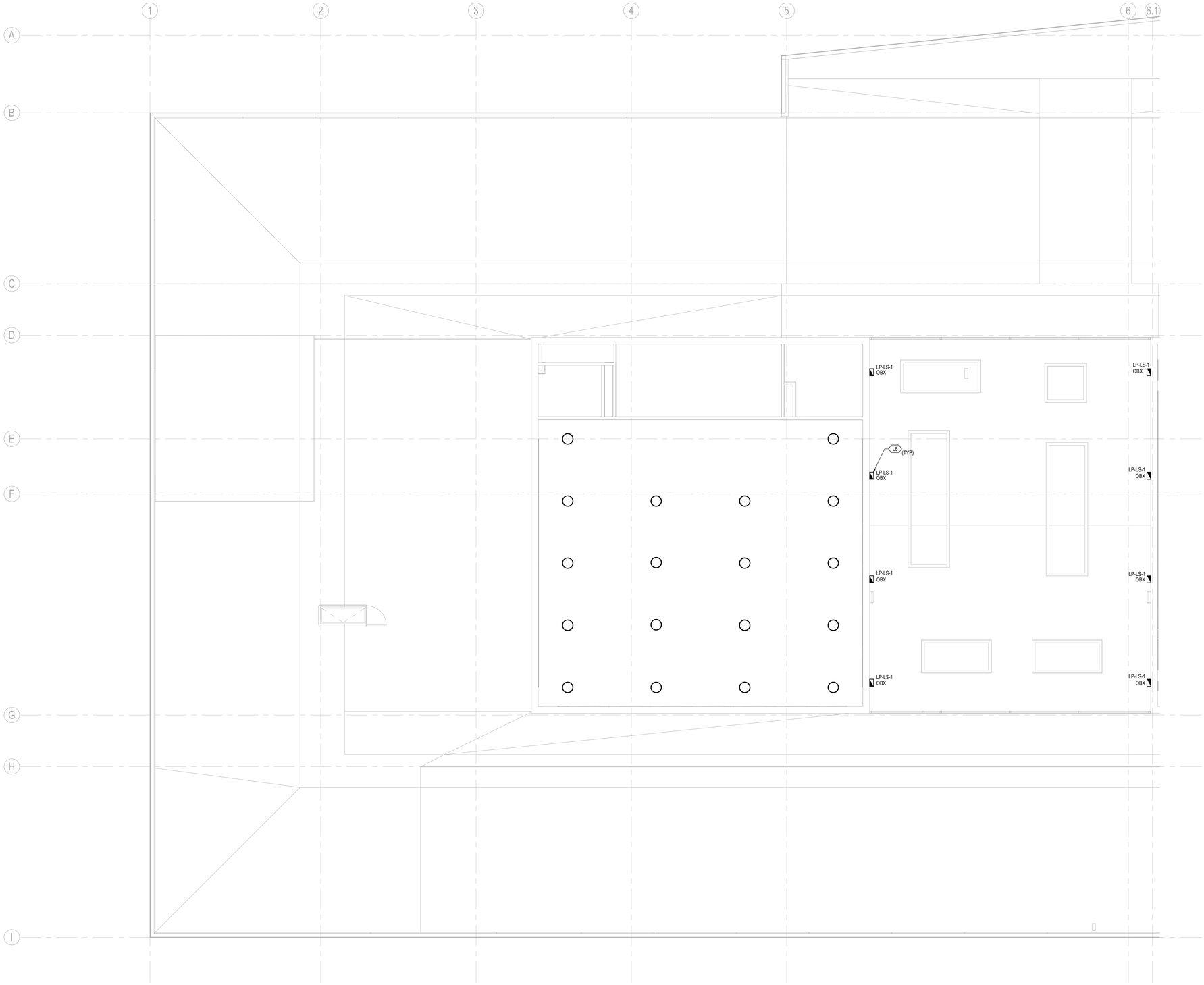


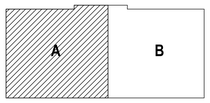
SECOND LEVEL LIGHTING PLAN - AREA A
1/8" = 1'-0"

LIGHTING GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E601 & E602 FOR LIGHTING FIXTURE SCHEDULE AND CONTROLS INFORMATION.
3. THE CONTRACTOR SHALL PROVIDE A 'HOT' WIRE TIED AHEAD OF LOCAL SWITCHING AND THE LIGHTING CONTROL PANEL RELAYS FOR THE LEADS TO ALL NIGHT LIGHTS, EXIT LIGHTS, EMERGENCY BATTERY PACKS AND EMERGENCY UL924 RELAYS AND EXIT LIGHTS.
4. THE CONTRACTOR SHALL SUBMIT A FULL SET OF OCCUPANCY CONTROL LOCATION DRAWING SUBMITTALS TO THE A/E PRIOR TO PURCHASE OR INSTALLATION. OCCUPANCY CONTROL LOCATIONS AND QUANTITIES SHALL BE BASED ON THE MANUFACTURER'S RECOMMENDATIONS. THE LIGHTING PLANS SHOW DESIGN INTENT ONLY AND DO NOT REFLECT EVERY MANUFACTURER PERMUTATIONS.
5. OCCUPANCY CONTROLS SHALL BE WIRED SUCH THAT ALL GENERAL ROOM LIGHTING IS CONTROLLED.
6. PROVIDE A DEDICATED NEUTRAL CONDUCTOR FOR EACH BRANCH CIRCUIT.
7. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY

LIGHTING KEYNOTES

#	KEY NOTES
L6	PROVIDE WALL MOUNTED LIGHTING FIXTURE TYPE OBX AT 9'-6" ABOVE ROOF DECK. ROOF LIGHTING SHALL BE CONTROLLED WITH PILOT SWITCH LOCATED ADJACENT TO ROOF ACCESS LADDER WITHIN RECEIVING/STORAGE ROOM 307.



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SECOND LEVEL LIGHTING PLAN - AREA A

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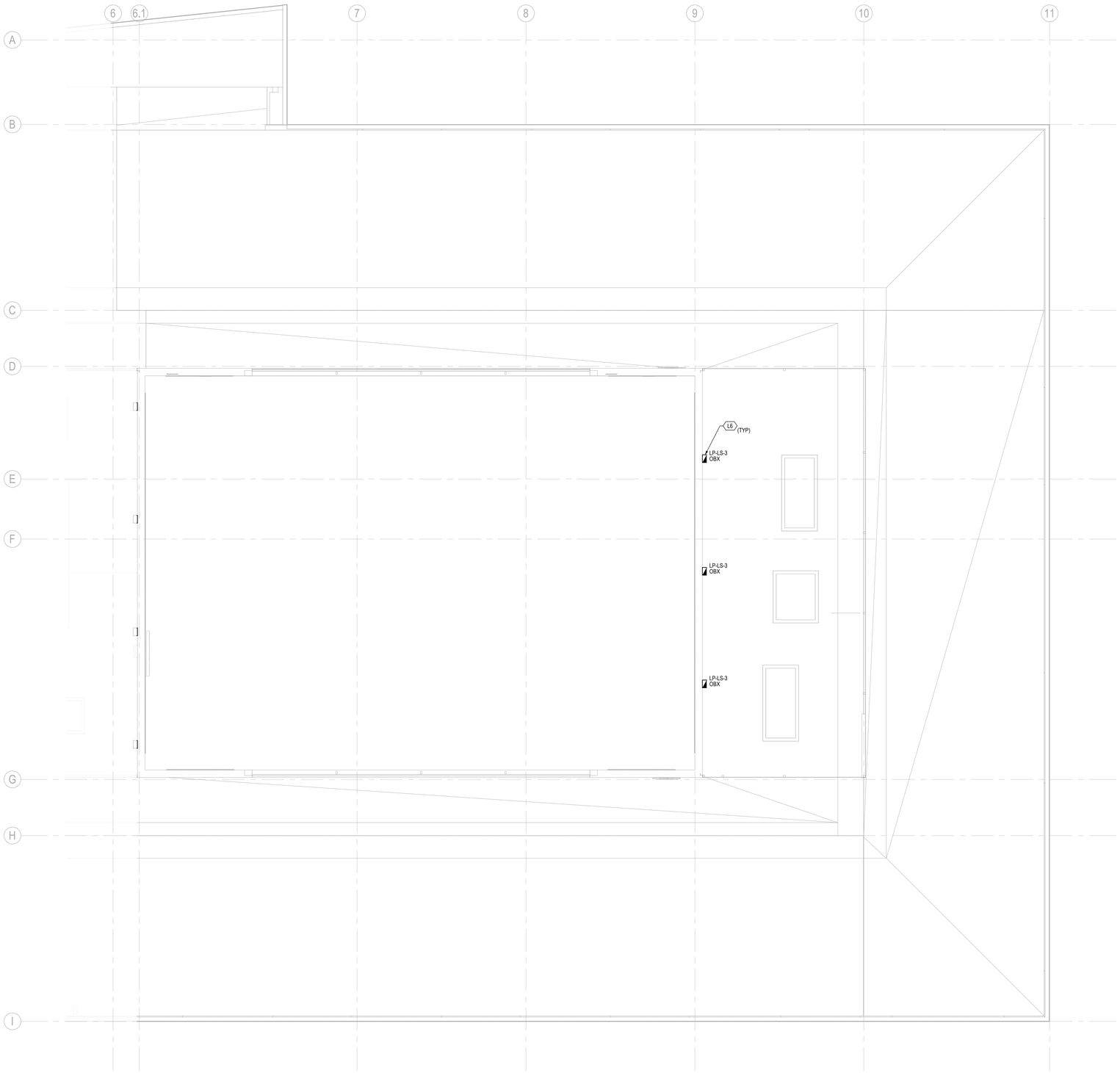

SECOND LEVEL LIGHTING PLAN - AREA B
1/8" = 1'-0"

LIGHTING GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E601 & E602 FOR LIGHTING FIXTURE SCHEDULE AND CONTROLS INFORMATION.
3. THE CONTRACTOR SHALL PROVIDE A 'HOT' WIRE TIED AHEAD OF LOCAL SWITCHING AND THE LIGHTING CONTROL PANEL RELAYS FOR THE LEADS TO ALL NIGHT LIGHTS, EXIT LIGHTS, EMERGENCY BATTERY PACKS AND EMERGENCY UL924 RELAYS AND EXIT LIGHTS.
4. THE CONTRACTOR SHALL SUBMIT A FULL SET OF OCCUPANCY CONTROL LOCATION DRAWING SUBMITTALS TO THE A/E PRIOR TO PURCHASE OR INSTALLATION. OCCUPANCY CONTROL LOCATIONS AND QUANTITIES SHALL BE BASED ON THE MANUFACTURER'S RECOMMENDATIONS. THE LIGHTING PLANS SHOW DESIGN INTENT ONLY AND DO NOT REFLECT EVERY MANUFACTURER PERMUTATIONS.
5. OCCUPANCY CONTROLS SHALL BE WIRED SUCH THAT ALL GENERAL ROOM LIGHTING IS CONTROLLED.
6. PROVIDE A DEDICATED NEUTRAL CONDUCTOR FOR EACH BRANCH CIRCUIT.
7. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY

LIGHTING KEYNOTES

#	KEY NOTES
L6	PROVIDE WALL MOUNTED LIGHTING FIXTURE TYPE OBX AT 9'-6" ABOVE ROOF DECK. ROOF LIGHTING SHALL BE CONTROLLED WITH PILOT SWITCH LOCATED ADJACENT TO ROOF ACCESS LADDER WITHIN RECEIVING/STORAGE ROOM 307.

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SECOND LEVEL LIGHTING PLAN - AREA B

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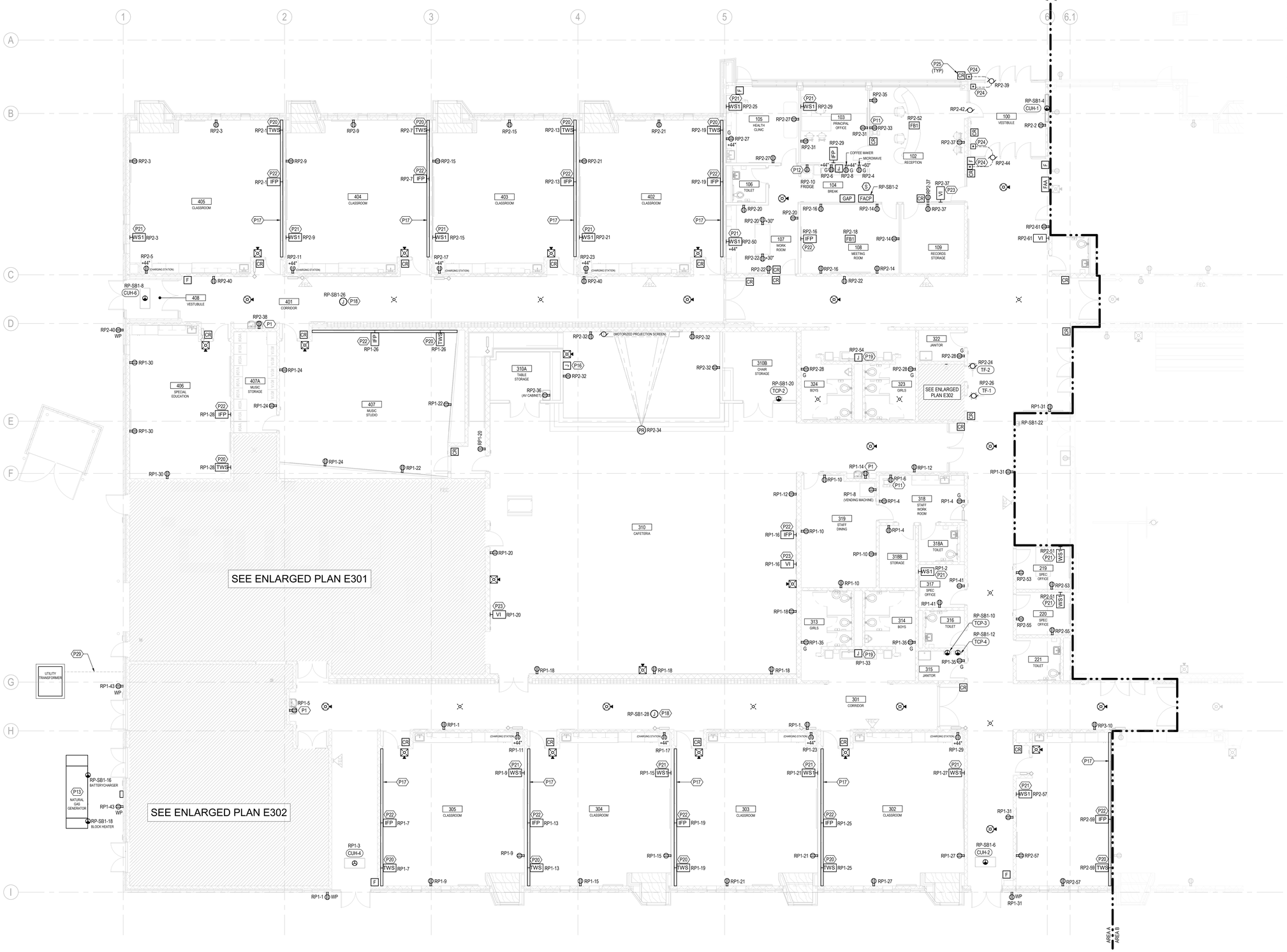

FIRST LEVEL POWER & AUXILIARY PLAN - AREA A
1/8" = 1'-0"

POWER & AUXILIARY GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E401 & E402 FOR ELECTRICAL SINGLE LINE DIAGRAMS.
3. EACH CIRCUIT SHALL HAVE A DEDICATED NEUTRAL CONNECTED BACK TO THE PANEL.
4. PROVIDE 120V CIRCUIT TO FIRE ALARM EXTENDER PANELS.
5. COORDINATE ALL DEVICE MOUNTING LOCATIONS, HEIGHTS, AND SPACINGS WITH ARCHITECTURAL FLOOR PLANS AND ELEVATIONS. BIDDERS SHALL EXAMINE ARCHITECTURAL DRAWINGS TO INCLUDE ANY NECESSARY COSTS WITH HIS BID.
6. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY.
7. COORDINATE MOUNTING HEIGHT OF DEVICES ABOVE MILLWORK WITH ARCHITECTURAL PLANS.
8. COORDINATE FINAL MOUNTING HEIGHT OF ELECTRICAL DEVICES FOR UNIT APPLIANCES WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS PRIOR TO ROUGH-IN.
9. SWITCHES AND RECEPTACLES INSTALLED ABOVE COUNTERTOPS SHALL BE THE SAME HEIGHT.
10. FURNISH AND INSTALL DUCT SMOKE DETECTORS ASSOCIATED WITH AIR HANDLING EQUIPMENT AND LIFE SAFETY DAMPERS. FIRE ALARM COMMUNICATION MODULES, POWER, AND ALL NECESSARY WIRING. REFER TO MECHANICAL FLOOR PLANS AND TEMPERATURE CONTROL DRAWINGS FOR LIFE SAFETY DAMPER LOCATIONS AND DUCT DETECTORS ASSOCIATED WITH AIR HANDLING UNITS. PROVIDE THE QUANTITY OF DUCT DETECTORS RECOMMENDED BY THE MANUFACTURER FOR THE INSTALLED DUCT CONFIGURATION.
11. REFER TO FIRE PROTECTION DRAWINGS AND DETAILS FOR LOCATIONS OF FLOW AND TAMPER SWITCHES. PROVIDE CONNECTION TO FIRE ALARM SYSTEM TO EACH.
12. ELECTRICAL CONTRACTOR SHALL REFER TO TECHNOLOGY DRAWINGS FOR DATA DEVICES, SECURITY DEVICES, DOOR ACCESS DEVICES, ETC. FOR LOCATIONS AND QUANTITIES. ELECTRICAL CONTRACTOR SHALL PROVIDE PATHWAYS AND ROUGH-INS AS INDICATED ON TECHNOLOGY DRAWINGS.
13. CIRCUIT ELECTRONIC TRAP PRIMERS TO NEARBY 120V RECEPTACLE CIRCUIT. REFER TO PLUMBING DRAWINGS FOR TRAP PRIMER LOCATIONS.
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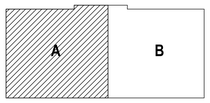
15. REFER TO STRUCTURAL DRAWINGS FOR PENETRATION REQUIREMENTS THROUGH EXISTING STRUCTURAL ELEMENTS.

POWER & AUXILIARY KEYNOTES

#	KEY NOTES
P1	PROVIDE GFCI BREAKER FOR EWC CIRCUIT. PROVIDE AN ADDITIONAL RECEPTACLE FOR BOTTLE FILLER COMPONENT. REFER TO EWC DATA SHEET FOR INSTALLATION INSTRUCTIONS AND LOCATE RECEPTACLES AS REQUIRED.
P11	POWER FOR COPY MACHINE: NEMA 5-20R RECEPTACLE AND 4#10, #10G, 3/4"C. CAP SPARE CONDUCTORS IN OUTLET BOX AND ELECTRICAL PANEL FOR FUTURE.
P12	ADD GFCI BREAKER FOR REFRIGERATOR.
P13	PROVIDE THE FOLLOWING 1" CONDUITS AND ASSOCIATED CABLES/CONDUCTORS FROM THE GENERATOR: (1) TO THE FIRE ALARM CONTROL PANEL (1) TO THE ATS ROOM FOR COMMUNICATION AND EPO FUNCTION (1) FOR POWER CIRCUITS FOR BATTERY CHARGER AND BLOCK HEATER POWER RESPECTIVELY (1) TO ATS-LS FOR DEDICATED START SIGNAL (1) TO ATS-SB FOR DEDICATED START SIGNAL (1) SPARE
P16	MOTORIZED PROJECTION SCREEN AND ASSOCIATED CONTROL SWITCH. PROVIDE 3/4" CONDUIT WITH PULL STRING FROM CONTROL STATION TO SCREEN LOCATION.
P17	PROVIDE 6-INCH CABLE TRAY FOR DATA / AV CABLING. MOUNT TO WALL WITH BOTTOM ELEVATION AT 14'-0" AFF. MODIFY RACEWAY IN FIELD TO FIT WALL LENGTH. PROVIDE ALL REQUIRED CONNECTORS, COVER PLATES ETC. FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
P18	J-BOX FOR POWER CONNECTION FOR SMOKE DAMPERS. PROVIDE TOGGLE TYPE DISCONNECT SWITCH FOR EACH UNIT, EXTEND WIRE AND CONDUIT FROM THE J-BOX TO EACH UNIT AND CONNECT APPROXIMATELY 6-11 ON ONE CIRCUIT. MINIMUM ONE CIRCUIT PER HVAC UNIT FOR DAMPERS.
P19	PROVIDE GFCI BREAKER FOR AUTOMATIC FAUCET CIRCUIT. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH SHOP DRAWINGS AND PLUMBING CONTRACTOR PRIOR TO ROUGH-IN.
P20	TEACHER WORKSTATION. REFER TO DETAIL ON DRAWING E502.
P21	WORKSTATION WITH ADJACENT POWER AND DATA. REFER TO DETAIL ON DRAWING E502.
P22	INTERACTIVE FLAT PANEL DISPLAY. REFER TO DETAIL ON DRAWING E502.
P23	DIGITAL VIDEO INTERFACE DISPLAY. REFER TO DETAIL ON DRAWING E502.
P24	ADA DOOR ACCESS CONTROL. PROVIDE 120V CIRCUIT AS SHOWN TO DOOR POWER SUPPLY. PROVIDE PATHWAYS AS SHOWN ON ACCESS CONTROL DETAIL ON DRAWING E502. REFER TO TECHNOLOGY DRAWINGS FOR ADDITIONAL INFORMATION.
P25	DOOR PROVIDED WITH CARD ACCESS CONTROL. PROVIDE CARD READER PATHWAYS AS SHOWN ON ACCESS CONTROL DETAIL ON DRAWING E502. REFER TO TECHNOLOGY DRAWINGS FOR COMMUNICATIONS REQUIREMENTS.
P29	UNDERGROUND SECONDARY ELECTRICAL SERVICE ENTRANCE FEEDERS FROM UTILITY TRANSFORMER TO MAIN SWITCHBOARD. PROVIDE LOCATOR WIRE AND WARNING TAPE. COORDINATE ROUTING WITH OTHER TRADES TO AVOID CONFLICT WITH UNDERGROUND PIPING IN AREA.



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POWER & AUXILIARY PLAN - AREA A

REVISIONS

REV	DESCRIPTION	DATE

PROJ.#: 220116
DATE: 23-JUNE-2023
SHEET
E211A

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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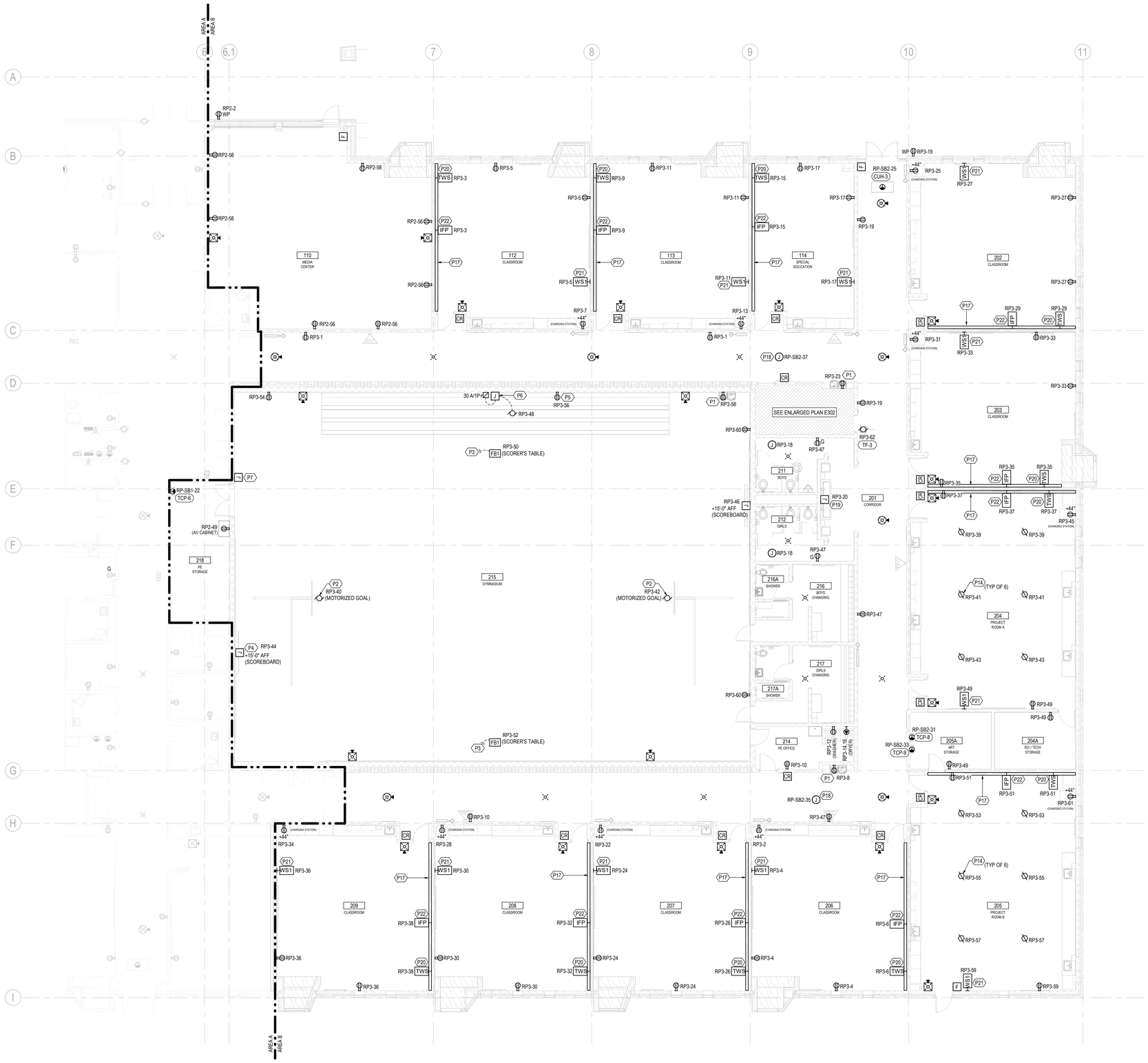
CHECKED BY: Checker APPROVED BY: Approver



FIRST LEVEL POWER & AUXILIARY PLAN - AREA B
1/8" = 1'-0"

POWER & AUXILIARY GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E401 & E402 FOR ELECTRICAL SINGLE LINE DIAGRAMS.
3. EACH CIRCUIT SHALL HAVE A DEDICATED NEUTRAL CONNECTED BACK TO THE PANEL.
4. PROVIDE 120V CIRCUIT TO FIRE ALARM EXTENDER PANELS.
5. COORDINATE ALL DEVICE MOUNTING LOCATIONS, HEIGHTS, AND SPACINGS WITH ARCHITECTURAL FLOOR PLANS AND ELEVATIONS. BIDDERS SHALL EXAMINE ARCHITECTURAL DRAWINGS TO INCLUDE ANY NECESSARY COSTS WITH HIS BID.
6. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY.
7. COORDINATE MOUNTING HEIGHT OF DEVICES ABOVE MILLWORK WITH ARCHITECTURAL PLANS.
8. COORDINATE FINAL MOUNTING HEIGHT OF ELECTRICAL DEVICES FOR UNIT APPLIANCES WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS PRIOR TO ROUGH-IN
9. SWITCHES AND RECEPTACLES INSTALLED ABOVE COUNTERTOPS SHALL BE THE SAME HEIGHT.
10. FURNISH AND INSTALL DUCT SMOKE DETECTORS ASSOCIATED WITH AIR HANDLING EQUIPMENT AND LIFE SAFETY DAMPERS, FIRE ALARM COMMUNICATION MODULES, POWER, AND ALL NECESSARY WIRING. REFER TO MECHANICAL FLOOR PLANS AND TEMPERATURE CONTROL DRAWINGS FOR LIFE SAFETY DAMPER LOCATIONS AND DUCT DETECTORS ASSOCIATED WITH AIR HANDLING UNITS. PROVIDE THE QUANTITY OF DUCT DETECTORS RECOMMENDED BY THE MANUFACTURER FOR THE INSTALLED DUCT CONFIGURATION.
11. REFER TO FIRE PROTECTION DRAWINGS AND DETAILS FOR LOCATIONS OF FLOW AND TAMPER SWITCHES. PROVIDE CONNECTION TO FIRE ALARM SYSTEM TO EACH.
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POWER & AUXILIARY KEYNOTES

#	KEY NOTES
P1	PROVIDE GFCI BREAKER FOR EWC CIRCUIT. PROVIDE AN ADDITIONAL RECEPTACLE FOR BOTTLE FILLER COMPONENT. REFER TO EWC DATA SHEET FOR INSTALLATION INSTRUCTIONS AND LOCATE RECEPTACLES AS REQUIRED.
P2	PROVIDE POWER FOR RETRACTABLE BACKBOARD GOAL AND HEIGHT ADJUSTER. EXTEND ONE 3/4" CONDUIT WITH PULL STRING FROM EACH JUNCTION BOX TO RESPECTIVE GOAL CONTROL SWITCH BANK. COORDINATE ADDITIONAL REQUIREMENTS WITH BACKBOARD INSTALLER AND PROVIDE ROUGH-IN AND ELECTRICAL CONNECTIONS.
P3	REFER TO DETAIL ON DRAWING E502 FOR EXACT POWER AND DATA REQUIREMENTS. COORDINATE LOCATION WITH ARCHITECTURAL ELEVATIONS AND EXACT POWER REQUIREMENTS WITH INSTALLER PRIOR TO ROUGH-IN.
P4	PROVIDE POWER AND JUNCTION BOX WITH 1" CONDUIT AND PULL STRING AT SCOREBOARD LOCATION. EXTEND 1" CONDUIT WITH PULL STRING TO SCORER'S TABLE LOCATION AT FLOOR BOX. COORDINATE LOCATION WITH ARCHITECTURAL DRAWINGS AND EXACT POWER REQUIREMENTS WITH INSTALLER PRIOR TO ROUGH-IN. REFERENCE DETAIL ON E50X FOR ADDITIONAL REQUIREMENTS.
P5	PROVIDE RECEPTACLE AT 18" ABOVE TOP OF BLEACHERS.
P6	COORDINATE REQUIREMENTS OF BLEACHER MOTORS WITH GENERAL CONTRACTOR AND BLEACHER INSTALLER PRIOR TO ROUGH-IN OF THE FOLLOWING: PROVIDE A 30A/30AF/1P DISCONNECT MOUNTED AT X'-0" FOR BLEACHER DRIVE MOTORS. PROVIDE A 12"X2"1"X6" RECESSED JUNCTION BOX (MOTOR CONTROL BOX) ADJACENT TO DISCONNECT WITH 1" CONDUIT CONNECTING THE TWO. PROVIDE A 4"X4"X4" RECESSED JUNCTION BOX (DRIVE BOX) FOR EACH BLEACHER MOTOR MOUNTED AT 25" A.F.F. ROUTE 3/4" CONDUIT FROM THE MOTOR CONTROL BOX TO EACH DRIVE BOX.
P7	SWITCH CABINET FOR CONTROL OF BLEACHERS, GOAL HOISTS, AND SCOREBOARD. PROVIDE ROUGH-IN (JUNCTION BOXES, CONDUIT, ETC.) AS REQUIRED FOR CONTROLS. COORDINATE REQUIREMENTS WITH INSTALLER PRIOR TO ROUGH-IN TO ENSURE ALL REQUIREMENTS ARE MET FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
P11	POWER FOR COPY MACHINE; NEMA 5-20R RECEPTACLE AND 4#10, #10G, 3/4"C. CAP SPARE CONDUCTORS IN OUTLET BOX AND ELECTRICAL PANEL FOR FUTURE.
P14	PROVIDE CORD AND REEL ASSEMBLY (HUBBELL HBL25123GF220M1) CONCEALED ALONG SIDE OF STRUCTURAL JOIST WITH A QUAD GFCI NEMA 5-20R RECEPTACLE. REEL SHALL BE WHITE. PROVIDE 25 FT DROP CORD. CONTRACTOR IS RESPONSIBLE FOR MOUNTING AND SUPPORT OF CORD REEL FOR A COMPLETE AND FULLY FUNCTIONAL SETUP.
P17	PROVIDE 6-INCH CABLE TRAY FOR DATA / AV CABLING. MOUNT TO WALL WITH BOTTOM ELEVATION AT 14'-0" AFF. MODIFY RACEWAY IN FIELD TO FIT WALL LENGTH. PROVIDE ALL REQUIRED CONNECTORS, COVER PLATES ETC. FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
P18	J-BOX FOR POWER CONNECTION FOR SMOKE DAMPERS. PROVIDE TOGGLE TYPE DISCONNECT SWITCH FOR EACH UNIT. EXTEND WIRE AND CONDUIT FROM THE J-BOX TO EACH UNIT AND CONNECT APPROXIMATELY 6-11 ON ONE CIRCUIT. MINIMUM ONE CIRCUIT PER HVAC UNIT FOR DAMPERS.
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POWER & AUXILIARY PLAN - AREA B

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E211B

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
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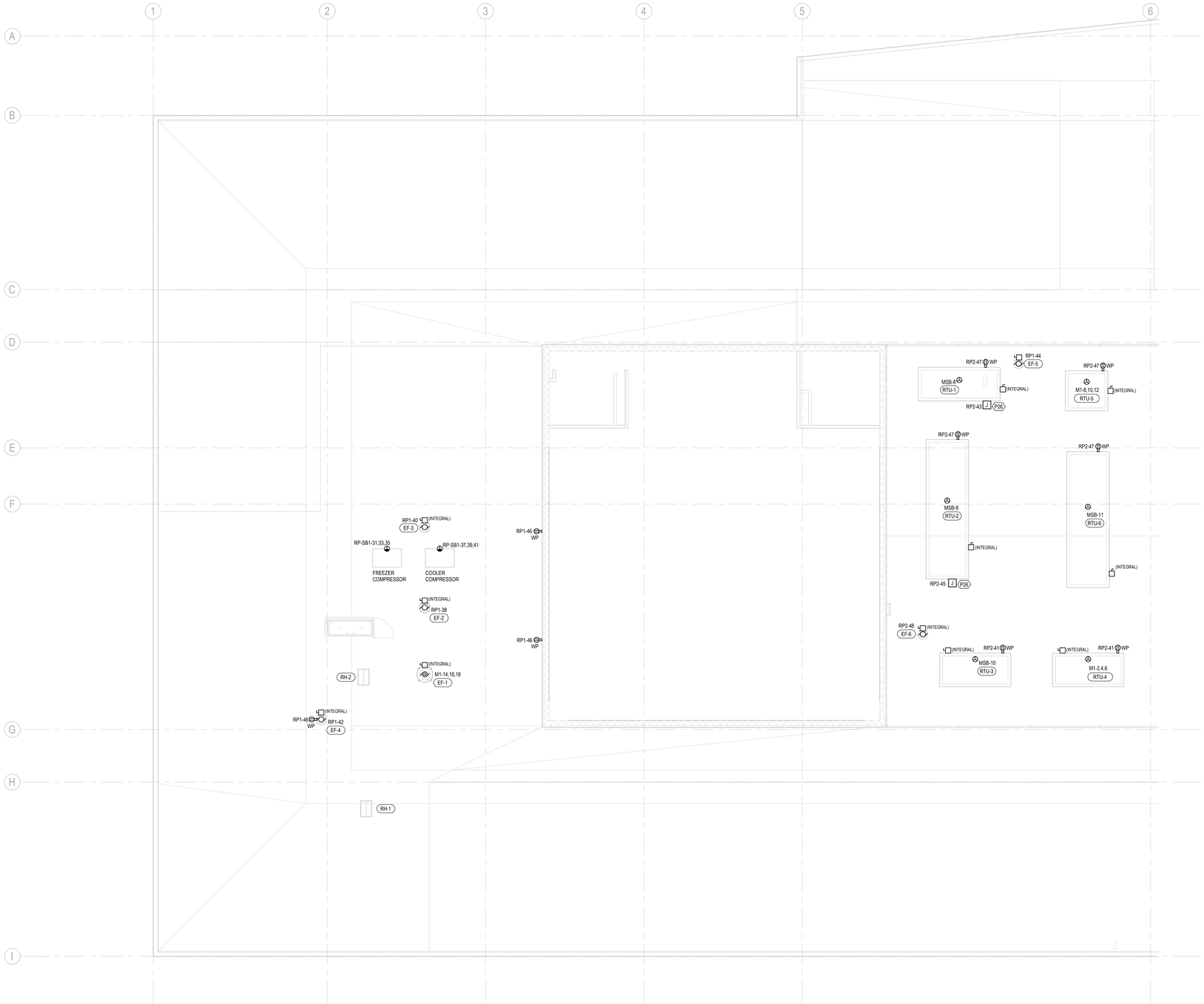
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



SECOND LEVEL POWER & AUXILIARY PLAN - AREA A
1/8" = 1'-0"

POWER & AUXILIARY GENERAL NOTES

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2. REFER TO DRAWING E401 & E402 FOR ELECTRICAL SINGLE LINE DIAGRAMS.
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4. PROVIDE 120V CIRCUIT TO FIRE ALARM EXTENDER PANELS.
5. COORDINATE ALL DEVICE MOUNTING LOCATIONS, HEIGHTS, AND SPACINGS WITH ARCHITECTURAL FLOOR PLANS AND ELEVATIONS. BIDDERS SHALL EXAMINE ARCHITECTURAL DRAWINGS TO INCLUDE ANY NECESSARY COSTS WITH HIS BID.
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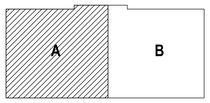
POWER & AUXILIARY KEYNOTES

#	KEY NOTES
P26	JUNCTION BOX INDICATED FOR HEAT TRACE CONNECTION POINT. COORDINATE EXACT LOCATION WITH EQUIPMENT FURNISHED PRIOR TO ROUGH-IN AND CONNECT TO CIRCUIT INDICATED. COORDINATE WITH MECHANICAL CONTRACTOR, PLUMBING CONTRACTOR AND HEAT TRACE SUBMITTAL FOR EXACT CONNECTION POINTS.



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ROOF POWER & AUXILIARY PLAN - AREA A

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E212A

100% CONSTRUCTION DOCUMENTS

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WHITE
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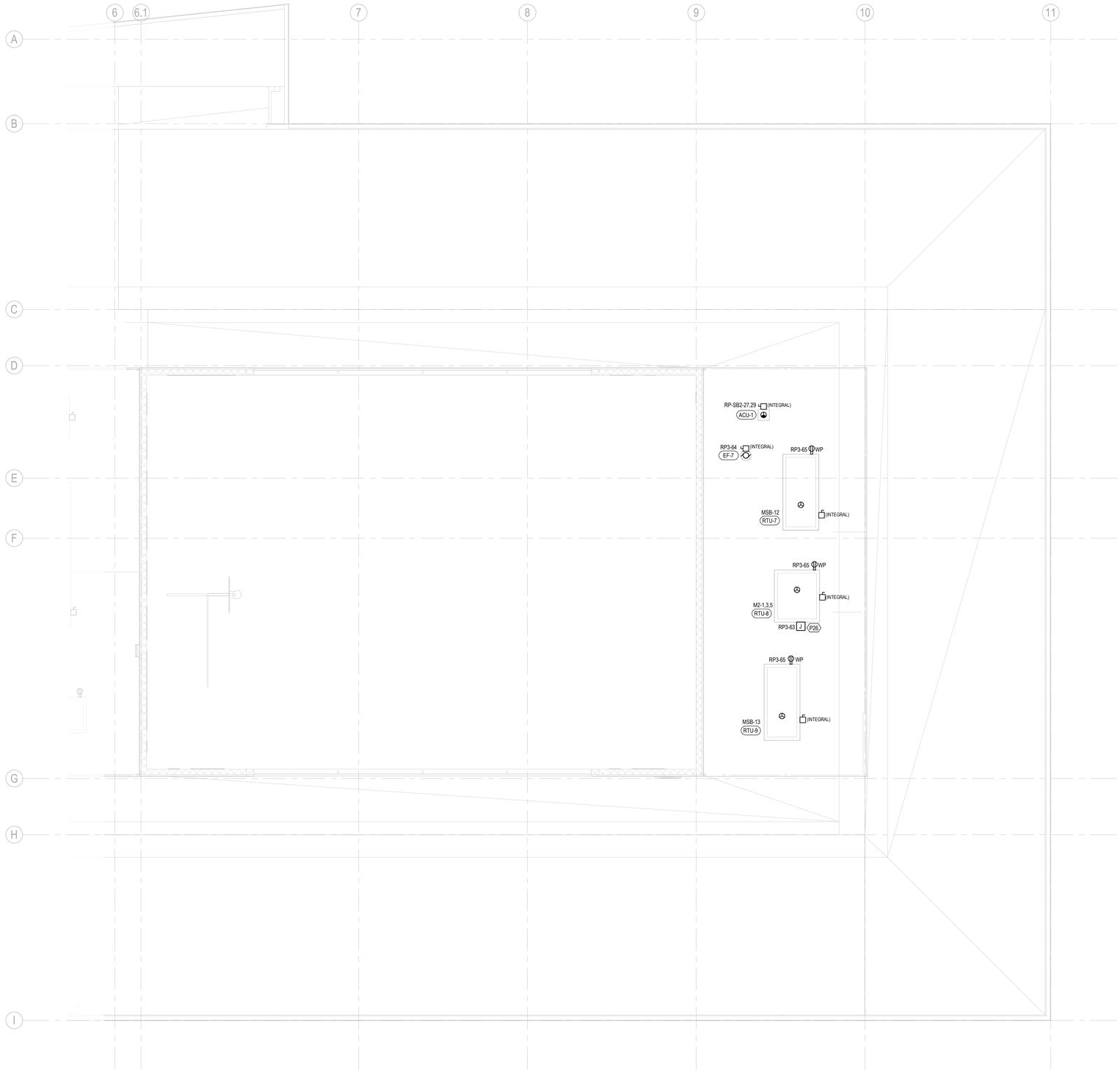

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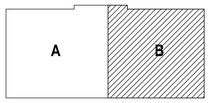

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CHECKED BY: Checker APPROVED BY: Approver

KITCHEN EQUIPMENT SCHEDULE

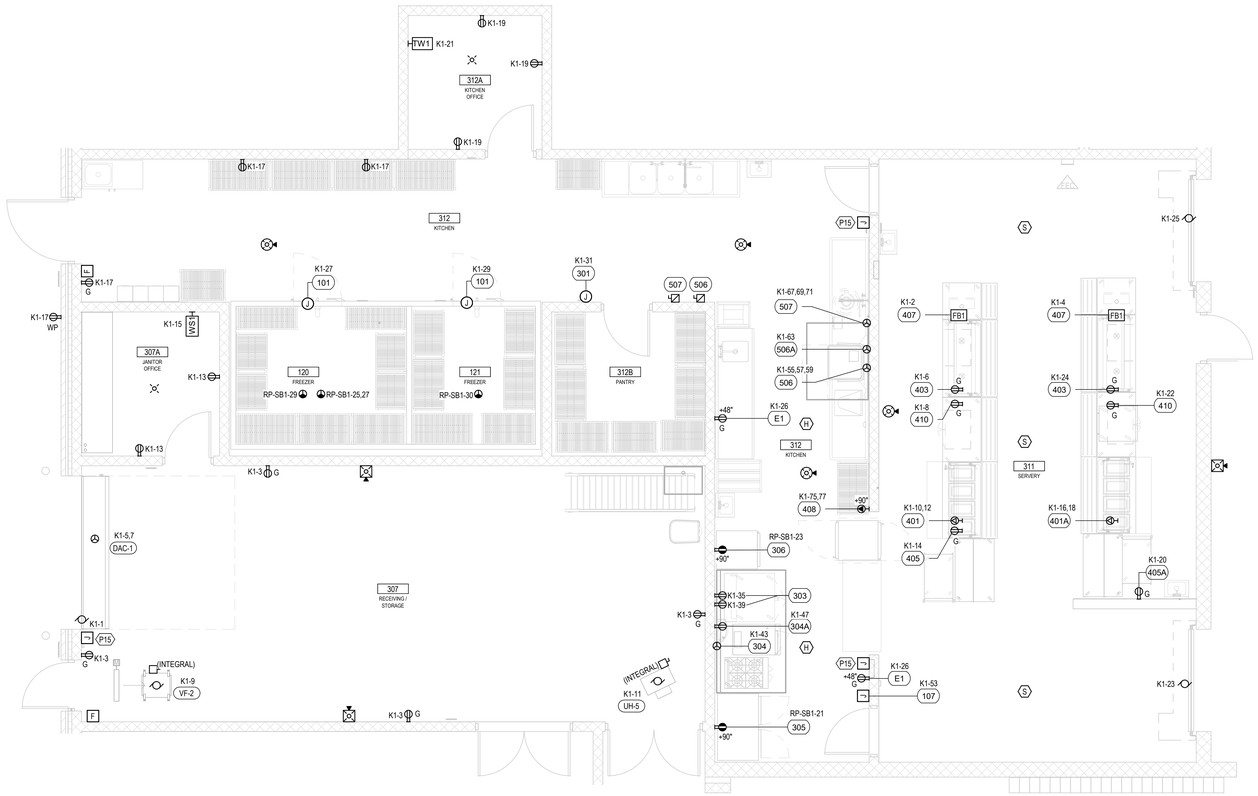
TAG	DESCRIPTION	AMPS	VOLTS	PHASE	CONNECTION: ELECTRICAL CONNECTION	CONNECTION: RECEPT CONFIG/SIZE	CONNECTION: DISCONNECT	CONNECTION: AFF (in)	COMMENTS
101	WALK-IN COOLER/FREEZER	8.0	120	1	HARD-WIRED BY E.C.			ABOVE CEILING	
107	FIRE PROTECTION SYSTEM	10	120	1	HARD-WIRED BY E.C.			ABOVE CEILING	
301	HOOD	10	120	1	HARD-WIRED BY E.C.			ABOVE CEILING	NOTE 7
303	CONVECTION OVEN - DOUBLE CHECK	8.9	120	1	CORD & PLUG	NEMA 5-20R		24	
304	STEAMER	2	120	1	HARD-WIRED BY E.C.			24	
304A	REVERSE OSMOSIS SYSTEM	2.0	120	1	CORD & PLUG	NEMA 5-20R		24	
305	FREEZER	11.2	120	1	CORD & PLUG	NEMA 5-20R		90	
306	REFRIGERATOR	4.9	120/208	1	CORD & PLUG	NEMA 5-20R		90	
401	HOT FOOD TABLE	20.4	208	1	CORD & PLUG			5	NOTE 3
401A	HOT FOOD TABLE W/HEATED BASE	20.4	208	1	CORD & PLUG			5	NOTE 3
403	COLD FOOD TABLE	9.5	120	1	CORD & PLUG	NEMA 6-20R		5	NOTE 3
405	MILK COOLER	3	120	1	CORD & PLUG		100/3P/NF/4X	5	NOTE 3
405A	MILK COOLER	3	120	1	CORD & PLUG	NEMA 5-20R		16	
407	CASH REGISTER/POINT OF SALE SYSTEM	10	120	1	CORD & PLUG	NEMA 5-20R		5	NOTE 4
408	PASS THRU REFRIGERATOR/HEATED CABINET	11	120	1	CORD & PLUG	NEMA 5-20R		90	
410	UNDER COUNTER REFRIGERATOR	2	120	1	CORD & PLUG			5	NOTE 3
506	DISHWASHER & BOOSTER HEATER	45.4	208	3	HARD-WIRED BY E.C.		60A/3P/NF/4X	16	NOTE 5
506A	DRAIN WATER TEMPERING KIT	12	120	1	HARD-WIRED BY E.C.			16	NOTE 1
507	DISPOSAL	6.6	208	3	HARD-WIRED BY E.C.		30A/3P/NF/4X	16	NOTE 1
E-1	GENERAL PURPOSE DUPLEX	10	120	1				48	NOTE 8
E-2	GENERAL PURPOSE DUPLEX	10	120	1				16	NOTE 8
	ADDITIONAL KITCHEN CIRCUITS								
	CONVENIENCE DUPLEX ELECTRICAL OUTLET	[20]	120	1				18" (U.N.O)	
	DEFROST HEATER/EVAPORATOR COIL	13.2	208	1				ABOVE CEILING	
	EVAPORATOR COIL FAN MOTOR	1.8	120	1				ABOVE CEILING	
	CONDENSATE DRAIN HEAT TAPE	[20]	120	1				VERIFY	NOTE 6
	TIME-CLOCK	[20]	120	1				VERIFY	
	DOOR BELL	[20]	120	1				VERIFY	NOTE 9
	OVERHEAD COILING DOOR	[20]	120	1	HARD-WIRED BY E.C.				NOTE 10

EQUIPMENT SCHEDULE NOTES

1. DOOR HEATERS, LIGHT SWITCHES AND PRESSURE RELIEF PORTS PRE-WIRED TO JUNCTION BOX AT TOP OF COLD STORAGE ASSEMBLY BY COOLER/FREEZER MANUFACTURER. ELECTRICAL CONTRACTOR SHALL MAKE ALL FINAL CONNECTIONS.
2. DISCONNECT PROVIDED BY EQUIPMENT PROVIDER. MAKE ALL CONNECTIONS AS REQUIRED TO DISCONNECT AND CONTROL PANEL.
3. REFER TO PEDESTAL MOUNTED RECEPTACLE DETAIL ON FOOD SERVICE DRAWING FSE-3 FOR INSTALLATION REQUIREMENTS.
4. PROVIDE (2) 3/4" CONDUIT (W/ PULLSTRING) TO POINT OF SALE SYSTEM TO IDF ROOM FOR DATA CABLING. CONDUIT SHALL BE ROUTED BELOW SLAB TO THE NEAREST WALL.
5. PROVIDE CONCEALED CONDUIT FOR DISHWASHER VENT FAN CONTROL AT 64" AFF.
6. RECEPTACLE SHALL BE WATERPROOF RATED AND PROVIDED WITH HINGED COVER.
7. HOOD LIGHTS PROVIDED BY MANUFACTURER.
8. PROVIDE CIRCUIT TO LOAD CENTER FOR SERVING COUNTER. MAKE ALL CONNECTIONS AS REQUIRED.
9. REFER TO DOOR BELL WIRING SCHEMATIC DETAIL ON DRAWING E502 FOR DOOR BELL SYSTEM REQUIREMENTS.
10. PROVIDE INTERCONNECTION AS REQUIRED TO COILING DOOR SWITCH. VERIFY LOCATION WITH ARCHITECT PRIOR TO ROUGH-IN.

GENERAL EQUIPMENT SCHEDULE NOTES

A. EQUIPMENT IDENTIFICATION VALUES BASED ON KITCHEN DRAWINGS. ALL NUMBERS ARE NOT USED.
B. VERIFY FINAL REQUIREMENTS WITH FINAL DIMENSIONED SHOP DRAWINGS AND EQUIPMENT PACKAGE.
C. AMPERAGES INDICATED IN BRACKETS [X] DESIGNATES CIRCUIT MINIMUM CIRCUIT AMPS AND NOT EQUIPMENT LOAD.



ENLARGED KITCHEN PLAN
1/4" = 1'-0"

GENERAL KITCHEN NOTES

1. PROVIDE GFCI PROTECTION FOR ALL 120 OR 208 VOLT, SINGLE PHASE RECEPTACLES RATED 50 AMPS OR LESS IN THE KITCHEN. PROVIDE GFCI PROTECTION FOR ALL 208 VOLT, THREE PHASE RECEPTACLES RATED 100 AMPS OR LESS IN THE KITCHEN, PER N.E.C. ARTICLE 210.8(B). UNLESS NOTED OTHERWISE, PROVIDE GFCI TYPE CIRCUIT BREAKERS.
2. LOCATIONS SHOWN ARE APPROXIMATE CONNECTION POINTS ON EQUIPMENT. KITCHEN EQUIPMENT CONTRACTOR (KEC) SHALL PROVIDE FULLY DIMENSIONED ROUGH-IN PLANS. THE ELECTRICAL CONTRACTOR SHALL FIELD COORDINATE WITH THE KEC FOR EXACT EQUIPMENT LOCATIONS PRIOR TO INSTALLATION.
3. CONTRACTOR SHALL PROVIDE APPROPRIATE RECEPTACLE FOR ALL EQUIPMENT NOTED AS CORD & PLUG CONNECTED. WHERE EQUIPMENT IS NOT FURNISHED WITH CORD/PLUG, THE CONTRACTOR SHALL PROVIDE APPROPRIATE CORD AND CORD CAP. CORD SHALL BE HARD USAGE SOW TYPE.
4. ALL EXPOSED CONDUIT SHALL BE RUN TIGHT TO THE WALL. ELECTRICAL CONTRACTOR SHALL NOT ATTACH CONDUIT TO ANY LEGS OR SHELVING BRACING. CONDUIT MAY BE SECURED TO THE BOTTOM OF THE TABLES OR OTHER STEEL SURFACES. ALL FLEXIBLE CONDUIT SHALL BE "SEALTITE" OR EQUAL. FLEXIBLE METALLIC CONDUIT IS NOT ACCEPTABLE. ALL COVER PLATES SHALL BE STAINLESS STEEL.
5. ALL KITCHEN DISCONNECTS SHALL BE MOUNTED IN A SAFE, EASILY ACCESIBLE LOCATION, AND SHALL BE STAINLESS STEEL.
6. REFER TO DIVISION 11400 GENERAL AND ITEM SPECIFICATIONS FOR ADDITIONAL INSTALLATION REQUIREMENTS.
7. UTILITY REQUIREMENTS, DIMENSIONS, INTERCONNECTIONS AND SO ON ARE BASED ON THE FIRST NAME MANUFACTURER IN THE SPECIFICATIONS. THE FSEC IS RESPONSIBLE FOR ADVISING ANY DEVIATIONS WHICH MAY RESULT FROM THE USE OF MANUFACTURERS OTHER THAN THE FIRST NAMES.
8. ALL COOKING EQUIPMENT MUST BE SHUT-OFF AUTOMATICALLY PER NFPA CODES, UTILIZING SHUNT TRIP BREAKERS OR CONTACTORS, AS PROVIDED BY THE ELECTRICAL CONTRACTOR, OR GAS SUPPLY SHUT-OFF VALVES AS FURNISHED BY THE FSEC AND INSTALLED IN GAS SUPPLY LINE BY THE PLUMBING CONTRACTOR. CONNECT TO HOOD FIRE SUPPRESSION SYSTEM FOR AUTOMATIC SHUNT-TRIP UPON ALARM.
9. REFER TO MECHANICAL PLANS FOR EXACT LOCATIONS OF HOOD EXHAUST FANS AND SUPPLY FANS. ELECTRICAL CONTRACTOR SHALL PROVIDE 4-HOUR TWIST TIMER TO CONTROL HOOD EXHAUST FANS. COORDINATE FAN CONTROLS WITH THE TEMPERATURE CONTROLS CONTRACTOR. FIELD COORDINATE LOCATIONS OF TWIST TIMERS.
10. PROVIDE ALL INTERCONNECTING WIRING FOR WALK-IN COOLER AND WALK-IN FREEZER LIGHTS, DOOR HEATERS, COMPRESSORS, EVAPORATORS, ALARM SYSTEMS, HEATED PRESSURE RELIEF VENTS, TIME CLOCKS, INTERLOCKS, ECT. ARE NOT PRE-WIRED. ELECTRICAL CONTRACTOR SHALL WIRE PER MANUFACTURERS REQUIRMENTS. CONDUITS FOR LIGHTING SHALL BE RUN OVER TOP OF BOXES. INTERIOR CONDUIT RUNS ARE NOT ACCEPTABLE. CONDUIT PENETRATIONS INTO WALK-IN UNITS SHALL BE PVC AND TRANSITIONED TO EMT OUTSIDE OF THE UNITS.
11. ALL WALK-IN CONDUIT PENETRATIONS SHALL BE SEALED BY THE ELECTRICAL CONTRACTOR WITH FOAM AND TO ENSURE THAT THERE ARE NO AIR LEAKS.
12. ELECTRICAL CONTRACTOR SHALL INTERWIRE TIME CLOCK SERVING FREEZER/COOLER CONDENSING UNITS.
13. VFD: VARIABLE FREQUENCE DRIVES (VFDs) SHALL BE FURNISHED BY MECHANICAL CONTRACTOR AND INSTALLED BY ELECTRICAL. CONTRACTOR SHALL MAKE ALL FINAL ELECTRICAL CONNECTIONS.
14. REFER TO TECHNOLOGY DRAWINGS FOR ADDITIONAL BACK BOX LOCATIONS. COORDINATE INSTALLATION SUCH THAT DATA AND POWER BOXES ARE ADJACENT WHERE REQUIRED.

POWER & AUXILIARY KEYNOTES

(#) KEY NOTES

P15 JUNCTION BOX INDICATED FOR MOTORIZED OVERHEAD DOOR. DOOR CONTROLS SHALL BE CONNECTED TO SECURITY AND FIRE ALARM SYSTEMS. OVERHEAD DOOR SHALL CLOSE UPON ACTIVATION OF SECURITY ALARM AND OPEN UPON ACTIVATION OF FIRE ALARM. VERIFY LOCATION AND REQUIREMENTS WITH DOOR SYSTEM INSTALLER PRIOR TO ROUGH-IN AND PROVIDE CONDUIT, JUNCTION BOX(ES), ETC. AS REQUIRED FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.

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ENLARGED ELECTRICAL PLANS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
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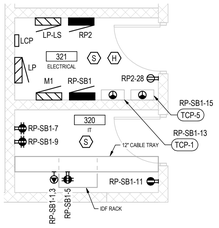
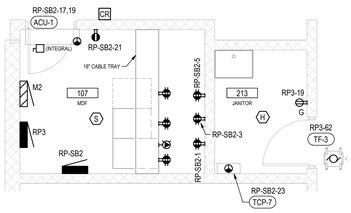
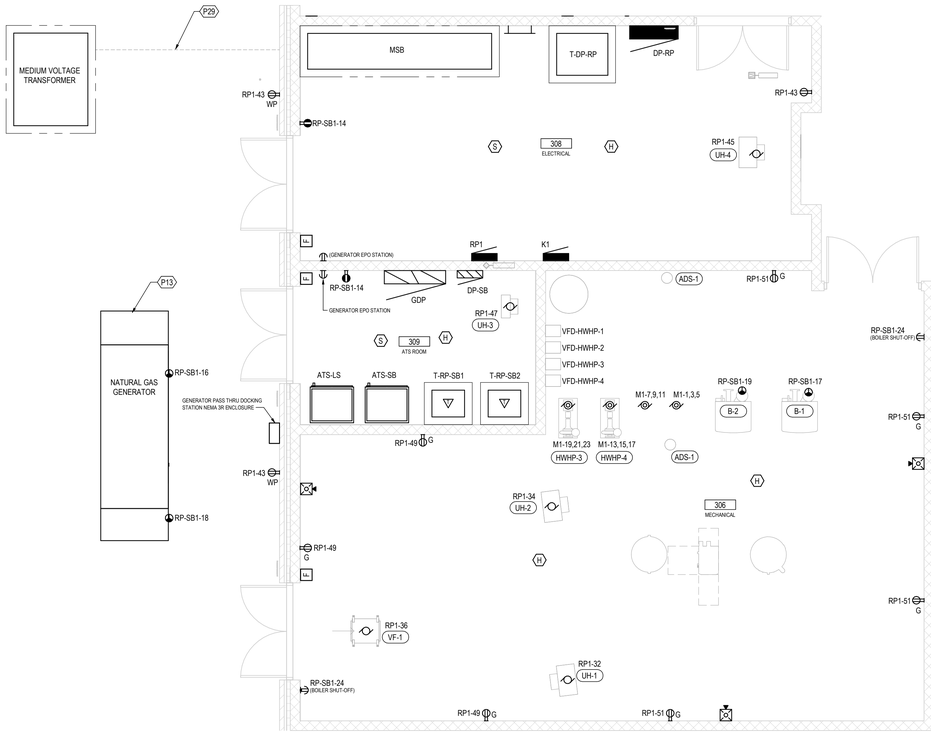
CHECKED BY: Checker APPROVED BY: Approver



ENLARGED ELECTRICAL/IDF ROOMS
1/4" = 1'-0"



ENLARGED MDF/JANITOR ROOM
1/4" = 1'-0"



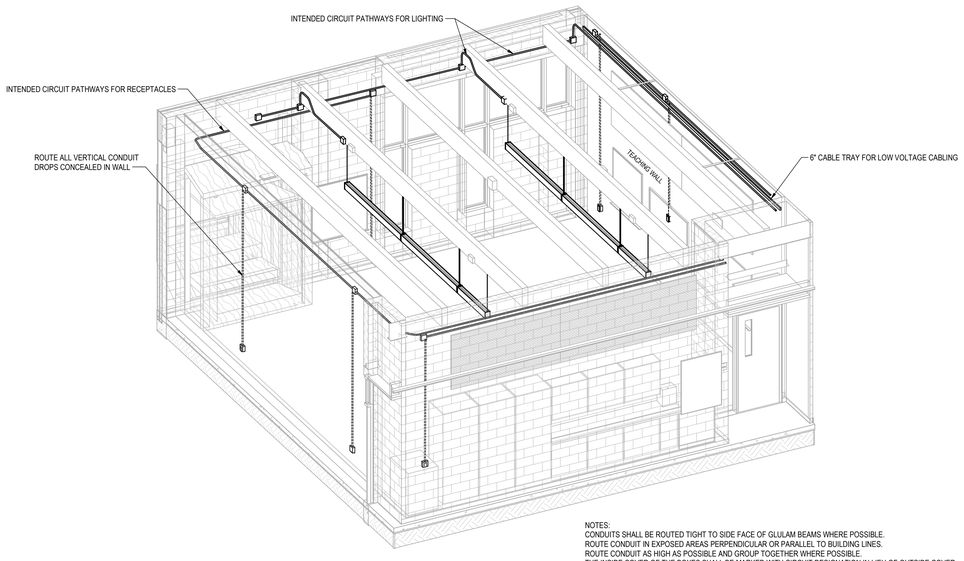
ENLARGED MAIN ELECTRICAL AND BOILER ROOM
1/4" = 1'-0"

POWER & AUXILIARY GENERAL NOTES

1. REFER TO DRAWING E001 AND E002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO DRAWING E401 & E402 FOR ELECTRICAL SINGLE LINE DIAGRAMS.
3. EACH CIRCUIT SHALL HAVE A DEDICATED NEUTRAL CONNECTED BACK TO THE PANEL.
4. PROVIDE 120V CIRCUIT TO FIRE ALARM EXTENDER PANELS.
5. COORDINATE ALL DEVICE MOUNTING LOCATIONS, HEIGHTS, AND SPACINGS WITH ARCHITECTURAL FLOOR PLANS AND ELEVATIONS. BIDDERS SHALL EXAMINE ARCHITECTURAL DRAWINGS TO INCLUDE ANY NECESSARY COSTS WITH HIS BID.
6. IN GENERAL, DEVICES AT LOWER HEIGHTS SHALL BE STACKED DIRECTLY BELOW DEVICES AT HIGHER ELEVATIONS. PROVIDE CONDUIT OFFSET AS NECESSARY.
7. COORDINATE MOUNTING HEIGHT OF DEVICES ABOVE MILLWORK WITH ARCHITECTURAL PLANS.
8. COORDINATE FINAL MOUNTING HEIGHT OF ELECTRICAL DEVICES FOR UNIT APPLIANCES WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS PRIOR TO ROUGH-IN.
9. SWITCHES AND RECEPTACLES INSTALLED ABOVE COUNTERTOPS SHALL BE THE SAME HEIGHT.
10. FURNISH AND INSTALL DUCT SMOKE DETECTORS ASSOCIATED WITH AIR HANDLING EQUIPMENT AND LIFE SAFETY DAMPERS, FIRE ALARM COMMUNICATION MODULES, POWER, AND ALL NECESSARY WIRING. REFER TO MECHANICAL FLOOR PLANS AND TEMPERATURE CONTROL DRAWINGS FOR LIFE SAFETY DAMPER LOCATIONS AND DUCT DETECTORS ASSOCIATED WITH AIR HANDLING UNITS. PROVIDE THE QUANTITY OF DUCT DETECTORS RECOMMENDED BY THE MANUFACTURER FOR THE INSTALLED DUCT CONFIGURATION.
11. REFER TO FIRE PROTECTION DRAWINGS AND DETAILS FOR LOCATIONS OF FLOW AND TAMPER SWITCHES. PROVIDE CONNECTION TO FIRE ALARM SYSTEM TO EACH.
12. ELECTRICAL CONTRACTOR SHALL REFER TO TECHNOLOGY DRAWINGS FOR DATA DEVICES, SECURITY DEVICES, DOOR ACCESS DEVICES, ETC. FOR LOCATIONS AND QUANTITIES. ELECTRICAL CONTRACTOR SHALL PROVIDE PATHWAYS AND ROUGH-INS AS INDICATED ON TECHNOLOGY DRAWINGS.
13. CIRCUIT ELECTRONIC TRAP PRIMERS TO NEARBY 120V RECEPTACLE CIRCUIT. REFER TO PLUMBING DRAWINGS FOR TRAP PRIMER LOCATIONS.
14. ELECTRICAL CONTRACTOR SHALL REFER TO TECHNOLOGY DRAWINGS FOR DATA DEVICES, SECURITY DEVICES, DOOR ACCESS DEVICES, ETC. FOR LOCATIONS AND QUANTITIES. ELECTRICAL CONTRACTOR SHALL PROVIDE PATHWAYS AND ROUGH-INS AS INDICATED ON TECHNOLOGY DRAWINGS.
15. REFER TO STRUCTURAL DRAWINGS FOR PENETRATION REQUIREMENTS THROUGH EXISTING STRUCTURAL ELEMENTS.

POWER & AUXILIARY KEYNOTES

#	KEY NOTES
P13	PROVIDE THE FOLLOWING 1" CONDUITS AND ASSOCIATED CABLES/CONDUCTORS FROM THE GENERATOR: (1) TO THE FIRE ALARM CONTROL PANEL (1) TO THE ATS ROOM FOR COMMUNICATION AND EPO FUNCTION (1) FOR POWER CIRCUITS FOR BATTERY CHARGER AND BLOCK HEATER POWER RESPECTIVELY (1) TO ATS-LS FOR DEDICATED START SIGNAL (1) TO ATS-SB FOR DEDICATED START SIGNAL (1) SPARE
P29	UNDERGROUND SECONDARY ELECTRICAL SERVICE ENTRANCE FEEDERS FROM UTILITY TRANSFORMER TO MAIN SWITCHBOARD. PROVIDE LOCATOR WIRE AND WARNING TAPE. COORDINATE ROUTING WITH OTHER TRADES TO AVOID CONFLICT WITH UNDERGROUND PIPING IN AREA.



NOTES:
CONDUITS SHALL BE ROUTED TIGHT TO SIDE FACE OF GLULAM BEAMS WHERE POSSIBLE.
ROUTE CONDUIT IN EXPOSED AREAS PERPENDICULAR OR PARALLEL TO BUILDING LINES.
ROUTE CONDUIT AS HIGH AS POSSIBLE AND GROUP TOGETHER WHERE POSSIBLE.
THE INSIDE COVER OF THE BOXES SHALL BE MARKED WITH CIRCUIT DESIGNATION IN LIEU OF OUTSIDE COVER

TYP CLASSROOM CONDUIT ROUTING

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ENLARGED ELECTRICAL PLANS

REVISIONS

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PROJ. #: 220116
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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

3 PHASE DRY TYPE TRANSFORMER CIRCUIT SIZING SCHEDULE

*** REFER TO NOTE 2.**

SIZE (KVA)	PRIMARY VOLTAGE (480V)				SECONDARY VOLTAGE (208Y/120V)			
	COPPER (CU)				COPPER (CU)			
	OVERCURRENT FUSE/CB (AMPS)	CONDUCTOR SIZE	GROUND SIZE	CONDUIT SIZE	OVERCURRENT FUSE/CB (AMPS)	CONDUCTOR SIZE	GROUND SIZE	CONDUIT SIZE
9 KVA	20 A	#12	#12	3/4"	30 A	#10	#8	3/4"
15 KVA	30 A	#10	#10	3/4"	60 A	#4	#8	1 1/4"
30 KVA	60 A	#8 (#6)	#10	1"	100 A	#1	#6	1 1/2"
45 KVA	90 A	#4	#8	1 1/4"	150 A	#1/0	#6	2"
75 KVA	150 A	#1 (#1/0)	#6	1 1/2"	250A (225A)	#250 (#4/0)	#2	3" (2 1/2")
112.5 KVA	225 A	#2/0	#4	2"	400 A	2 SETS #3/0	#1/0	2 - 2"
150 KVA	300 A	#4/0	#4	2 1/2"	500 A	2 SETS #250	2 SETS #1/0	2 - 3"
225 KVA	450 A	2 SETS #4/0	2 SETS #2	2"	800 A	3 SETS OF #350	3 SETS #2/0	3 - 3"
300 KVA	600 A	2 SETS #250	2 SETS #2	2 - 2 1/2"	1000 A	3 SETS #500	3 SETS #3/0	3 - 3 1/2"
500 KVA	800 A	2 SETS #600	2 SETS #1/0	2 - 3"	2000 A	6 SETS #500	6 SETS #3/0	6 - 3 1/2"

NOTES:

1. TRANSFORMERS AND FEEDERS ARE BASED ON PRIMARY, 480V, 3ø, 3W PRIMARY 208Y/120V, 3ø , 4W SECONDARY.
2. CONDUCTORS ARE BASED ON 90°C., 600V, INSULATED COPPER WIRE APPLIED AT 75° FOR TERMINATION RATED 60°/75° OR 75°C..
3. THIS TABLE REFERENCES STANDARD TRANSFORMERS, K RATING MAY REQUIRE INCREASED NEUTRALS.

SCHEMATICS

CABLE IDENTIFICATION, TABLE

C01 — CIRCUIT IDENTIFICATION, SEE FEEDER TABLE
A = ALUMINUM
C = COPPER
M = METAL CLAD

3|1|1

- QUANTITY OF GROUND CONDUCTORS, SIZE PER FEEDER TABLE
  - 0 = NOT REQUIRED
  - 1 = 1 GROUND CONDUCTOR
  - 2 = 1 GROUND CONDUCTOR AND 1 ISOLATED GROUND CONDUCTOR
- QUANTITY OF NEUTRAL CONDUCTORS, SIZE PER FEEDER TABLE
  - 0 = NOT REQUIRED
  - 1 = 1 NEUTRAL CONDUCTOR
  - 2 = 2 NEUTRAL CONDUCTORS
- QUANTITY OF PHASE CONDUCTORS, SIZE PER FEEDER TABLE

SCHEMATICS

- CIRCUIT BREAKER, LOW VOLTAGE, DRAW OUT
- CIRCUIT BREAKER, LOW VOLTAGE, FIXED
- CONNECTION, CONNECTED
- CONNECTION, DRAW OUT, DISCONNECTED
- CONNECTION, FEED FROM/TO
- CURRENT TRANSFORMER
- GROUND

SCHEMATICS

- TRANSFER SWITCH
- TRANSFORMER
- TRANSFORMER CONFIGURATION, DELTA
- TRANSFORMER CONFIGURATION, WYE, SOLID GROUND
- DMS — DIGITAL METERING SYSTEM
- G — GENERATOR
- K — KEY OPERATED SWITCH
- LSIG — RELAY, TRIP UNIT
- LSIG — DRAW OUT BREAKER C/W INTEGRAL SOLID STATE TRIP UNIT
- M — INLINE SOCKET METER

COPPER FEEDERS

ID	NOMINAL CIRCUIT RATING	SETS	CONDUCTORS	GROUND	CONDUIT W/ N (4W)	CONDUIT W/O N (3W)
C01	20	1	#12	#12	3/4"	3/4"
C02	30	1	#10	#10	3/4"	3/4"
C03	40	1	#8	#10	3/4"	3/4"
C04	50	1	#6	#10	1"	3/4"
C05	60	1	#4	#10	1 1/4"	1"
C06	70	1	#4	#8	1 1/4"	1 1/4"
C07	80	1	#3	#8	1 1/4"	1 1/4"
C08	90	1	#2	#8	1 1/2"	1 1/4"
C09	100	1	#1	#8	1 1/2"	1 1/2"
C10	125	1	#1	#6	1 1/2"	1 1/2"
C11	150	1	#1/0	#6	2"	1 1/2"
C12	175	1	#2/0	#6	2"	2"
C13	200	1	#3/0	#6	2"	2"
C14	225	1	#4/0	#4	2 1/2"	2"
C15	250	1	250 kcmil	#4	3"	2 1/2"
C16	300	1	350 kcmil	#4	3"	2 1/2"
C17	350	1	500 kcmil	#3	3 1/2"	3"
C18	400	1	500 kcmil	#3	3 1/2"	3"
C19	450	2	#4/0	#2	2 1/2"	2"
C20	500	2	250 kcmil	#2	3"	2 1/2"
C21	600	2	350 kcmil	#1	3"	2 1/2"
C22	800	2	500 kcmil	#1/0	3 1/2"	3"
C23	900	3	350 kcmil	#2/0	3"	3"
C24	1000	3	500 kcmil	#2/0	3 1/2"	3"
C25	1200	4	350 kcmil	#3/0	3"	3"
C26	1600	5	500 kcmil	#4/0	3 1/2"	3"
C27	2000	6	500 kcmil	250 kcmil	3 1/2"	3"
C28	2500	7	500 kcmil	350 kcmil	3 1/2"	3 1/2"
C29	3000	8	500 kcmil	500 kcmil	4"	3 1/2"
C30	4000	11	500 kcmil	500 kcmil	4"	3 1/2"

FEEDER GENERAL NOTES:

1. COPPER CONDUCTORS ARE BASED ON TYPE THHN/THWN COPPER CONDUCTORS ONLY. CONDUITS BASED ON THHN/THWN CONDUCTORS ONLY. OTHER CONDUCTORS MAY REQUIRE LARGER CONDUITS.
2. ALUMINUM CONDUCTORS ARE BASED ON TYPE XHHN COMPACT STRANDED ALUMINUM CONDUCTORS ONLY. CONDUITS BASED ON XHHN CONDUCTORS ONLY. OTHER CONDUCTORS MAY REQUIRE LARGER CONDUITS.

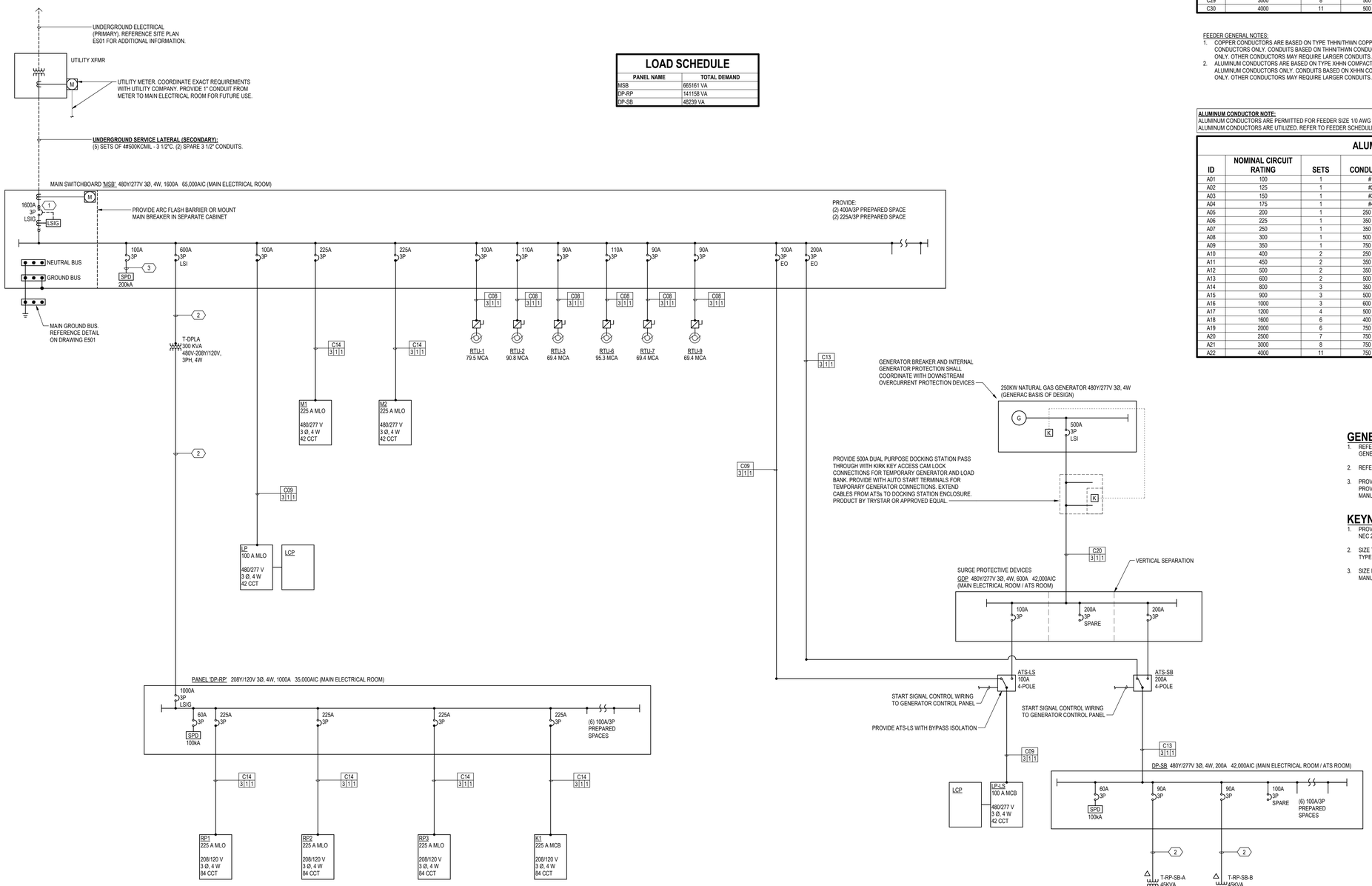
ALUMINUM CONDUCTOR NOTE:
ALUMINUM CONDUCTORS ARE PERMITTED FOR FEEDER SIZE 1/0 AWG AND LARGER. UPSIZE CONDUCTOR SIZE AND CONDUIT AS REQUIRED WHERE ALUMINUM CONDUCTORS ARE UTILIZED. REFER TO FEEDER SCHEDULE FOR ADDITIONAL REQUIREMENTS REGARDING ALUMINUM CONDUCTORS.

ALUMINUM FEEDERS

ID	NOMINAL CIRCUIT RATING	SETS	CONDUCTORS	GROUND	CONDUIT W/ N (4W)	CONDUIT W/O N (3W)
A01	100	1	#1/0	#6	2"	2"
A02	125	1	#2/0	#4	2"	2"
A03	150	1	#3/0	#4	2"	2"
A04	175	1	#4/0	#4	2 1/2"	2"
A05	200	1	250 kcmil	#4	2 1/2"	2 1/2"
A06	225	1	350 kcmil	#2	3"	2 1/2"
A07	250	1	350 kcmil	#2	3"	2 1/2"
A08	300	1	500 kcmil	#2	3 1/2"	3"
A09	350	1	750 kcmil	#1	4"	3 1/2"
A10	400	2	250 kcmil	#1	2 1/2"	2 1/2"
A11	450	2	350 kcmil	#1/0	3"	2 1/2"
A12	500	2	350 kcmil	#1/0	3"	2 1/2"
A13	600	2	500 kcmil	#2/0	3 1/2"	3"
A14	800	3	350 kcmil	#3/0	3"	3"
A15	900	3	500 kcmil	#4/0	3 1/2"	3"
A16	1000	3	600 kcmil	#4/0	4"	4"
A17	1200	4	500 kcmil	250 kcmil	3 1/2"	3"
A18	1600	6	400 kcmil	350 kcmil	3"	2 1/2"
A19	2000	6	750 kcmil	500 kcmil	4"	4"
A20	2500	7	750 kcmil	750 kcmil	5"	4"
A21	3000	8	750 kcmil	750 kcmil	5"	4"
A22	4000	11	750 kcmil	750 kcmil	5"	4"

LOAD SCHEDULE

PANEL NAME	TOTAL DEMAND
MSB	665161 VA
DP-RP	141158 VA
DP-SB	48239 VA



1 / E401 **ELECTRICAL ONE LINE DIAGRAM**
NTS

GENERAL NOTES - ONE LINE DIAGRAM

1. REFER TO DRAWING E001 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO E500 SERIES DRAWINGS FOR SUPPLEMENTAL DETAILS.
3. PROVIDE WIRING SIZE AND TYPE FOR SPD PER SPD MANUFACTURER. PROVIDE OVERCURRENT PROTECTION FOR SPD THAT IS SIZED PER SPD MANUFACTURER REQUIREMENTS.

KEYNOTES - ONE LINE DIAGRAM

1. PROVIDE ARC ENERGY REDUCTION SWITCH (ARMS) IN COMPLIANCE WITH NEC 240.87.
2. SIZE TRANSFORMER FEEDER (PRIMARY AND SECONDARY) PER 3-PHASE DRY TYPE TRANSFORMER CIRCUIT SIZING SCHEDULE ON E401.
3. SIZE FEEDER AND BREAKER FOR SURGE PROTECTIVE DEVICE PER MANUFACTURER'S RECOMMENDATION.

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ELECTRICAL SINGLE LINE DIAGRAM

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CHECKED BY: Checker APPROVED BY: Approver

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WHITE

Stantec Panel

Name:	**M1**	Volts:	480Y/277V	Mains Type:	MLO	Type:	
Location:	ELECTRICAL 321	Phases:	3	Mains Rating:	225 A	AIC Rating:	42000
Supply From:	MSB	Wires:	4	Max Rating:	225 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	HWHP-1 MECHANICAL 306	20 A	3		831	11030						3	50 A	RTU-4	2
3	--	--	--	--			831	11030			--	--	--	--	4
5	--	--	--	--					831	11030	--	--	--	--	6
7	HWHP-2 MECHANICAL 306	20 A	3		831	5986						3	30 A	RTU-5	8
9	--	--	--	--			831	5986			--	--	--	--	10
11	--	--	--	--					831	5986	--	--	--	--	12
13	HWHP-4 MECHANICAL 306	20 A	3		2106	582						3	20 A	EF-1	14
15	--	--	--	--			2106	582			--	--	--	--	16
17	--	--	--	--					2106	582	--	--	--	--	18
19	HWHP-3 MECHANICAL 306	20 A	3		2106	0					--	3	20 A	SPARE	20
21	--	--	--	--			2106	0			--	--	--	--	22
23	--	--	--	--					2106	0	--	--	--	--	24
25	SPARE	20 A	3	--	0	0					--	3	30 A	SPARE	26
27	--	--	--	--			0	0			--	--	--	--	28
29	--	--	--	--					0	0	--	--	--	--	30
31	SPARE	20 A	3	--	0	0					--	3	30 A	SPARE	32
33	--	--	--	--			0	0			--	--	--	--	34
35	--	--	--	--					0	0	--	--	--	--	36
37	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	38
39	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	40
41	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	42
				Total Load:	**22.52 kVA**		**22.52 kVA**		**22.52 kVA**						
				Total Amps:	**81 A**		**81 A**		**81 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	51047 VA	100.00%	51047 VA		
Motor	19371 VA	108.15%	20951 VA	**Total Conn. Load:**	**67551 VA**
				Total Est. Demand:	**68963 VA**
				Total Conn.:	**81 A**
				Total Est. Demand:	**83 A**

CB Legend (blank = circuit breaker):
G = GFCI S = Shunt Trip D = Switching Duty A = AFCI H = HID Rated C = HACR Rated † = Existing Circuit ‡ = Revised Circuit

Notes:

Stantec Panel

Name:	**M2**	Volts:	480Y/277V	Mains Type:	MLO	Type:	
Location:	MDF 107	Phases:	3	Mains Rating:	225 A	AIC Rating:	42000
Supply From:	MSB	Wires:	4	Max Rating:	225 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	RTU-8	50 A	3		11030	0					--	3	20 A	SPARE	2
3	--	--	--	--			11030	0			--	--	--	--	4
5	--	--	--	--					11030	0	--	--	--	--	6
7	SPARE	30 A	3	--	0	0					--	3	20 A	SPARE	8
9	--	--	--	--			0	0			--	--	--	--	10
11	--	--	--	--					0	0	--	--	--	--	12
13	SPARE	20 A	3	--	0	0					--	3	20 A	SPARE	14
15	--	--	--	--			0	0			--	--	--	--	16
17	--	--	--	--					0	0	--	--	--	--	18
19	SPARE	20 A	3	--	0	0					--	3	20 A	SPARE	20
21	--	--	--	--			0	0			--	--	--	--	22
23	--	--	--	--					0	0	--	--	--	--	24
25	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	26
27	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	28
29	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	30
31	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	32
33	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	34
35	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	36
37	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	38
39	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	40
41	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	42
				Total Load:	**11.03 kVA**		**11.03 kVA**		**11.03 kVA**						
				Total Amps:	**40 A**		**40 A**		**40 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	33089 VA	100.00%	33089 VA		
				Total Conn. Load:	**33089 VA**
				Total Est. Demand:	**33089 VA**
				Total Conn.:	**40 A**
				Total Est. Demand:	**40 A**

CB Legend (blank = circuit breaker):
G = GFCI S = Shunt Trip D = Switching Duty A = AFCI H = HID Rated C = HACR Rated † = Existing Circuit ‡ = Revised Circuit

Notes:

Stantec Panel

Name:	**LP**	Volts:	480Y/277V	Mains Type:	MLO	Type:	
Location:	ELECTRICAL 321	Phases:	3	Mains Rating:	100 A	AIC Rating:	35000
Supply From:	MSB	Wires:	4	Max Rating:	100 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	LIGHTING CLASSROOMS 402 - 405	20 A	1		2948	0					--	1	20 A	SPARE	2
3	LIGHTING ROOMS 108, 107, 104, 109,...	20 A	1				913	0			--	1	20 A	SPARE	4
5	LTG CAFETERIA, STAGE, GROUP REST	20 A	1						1533	0	--	1	20 A	SPARE	6
7	LTG KIT, MECH, ELEC, RECEIVING	20 A	1		2601	0					--	1	20 A	SPARE	8
9	LIGHTING CLASSROOMS 302 - 305	20 A	1				2925	0			--	1	20 A	SPARE	10
11	LIGHTING MEDIA CENTER, 112 - 114	20 A	1						3121	0	--	1	20 A	SPARE	12
13	LIGHTING CLASSROOMS 202 - 204	20 A	1		2416	0					--	1	20 A	SPARE	14
15	LIGHTING CLASSROOMS 205 - 207	20 A	1				2413	0			--	1	20 A	SPARE	16
17	LIGHTING CLASSROOMS 208 -210	20 A	1						2111	0	--	1	20 A	SPARE	18
19	LIGHITNG GYM, STO, GROUP REST	20 A	1		2333	0					--	1	20 A	SPARE	20
21	LIGHTING CORR 401, VEST 100	20 A	1				1506	0			--	1	20 A	SPARE	22
23	EAST EXTERIOR BUILDING LIGHTING	20 A	1						105	0	--	1	20 A	SPARE	24
25	SOUTH EXTERIOR BUILDING LIGHTING	20 A	1		75	0					--	1	20 A	SPARE	26
27	WEST EXTERIOR BUILDING LIGHTING	20 A	1				75	0			--	1	20 A	SPARE	28
29	NORTH EXTERIOR BUILDING LIGHTING	20 A	1						25	0	--	1	20 A	SPARE	30
31	FLAG POLE LIGHTING	20 A	1		100	0					--	1	20 A	SPARE	32
33	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	34
35	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	36
37	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	38
39	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	40
41	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	42
				Total Load:	**10.43 kVA**		**7.82 kVA**		**6.87 kVA**						
				Total Amps:	**38 A**		**29 A**		**25 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	25115 VA	125.00%	31394 VA		
Other	0 VA	0.00%	0 VA	**Total Conn. Load:**	**25115 VA**
				Total Est. Demand:	**31394 VA**
				Total Conn.:	**30 A**
				Total Est. Demand:	**38 A**

CB Legend (blank = circuit breaker):
G = GFCI S = Shunt Trip D = Switching Duty A = AFCI H = HID Rated C = HACR Rated † = Existing Circuit ‡ = Revised Circuit

Notes:

Stantec Panel

Name:	**K1**	Volts:	208Y/120V	Mains Type:	MLO	Type:	
Location:	ELECTRICAL 308	Phases:	3	Mains Rating:	400 A	AIC Rating:	
Supply From:	DP-RP	Wires:	4	Max Rating:	225 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	MOTORIZED OVERHEAD DOOR 307	20 A	1		1656	1200						1	20 A	407 - CASH REGISTER/POS	2
3	RECEPTACLES RECEIVING/STOR 307	20 A	1				720	1200				1	20 A	407 - CASH REGISTER/POS	4
5	DAC-1 RECEIVING / STORAGE 307	20 A	2						1248	1140		1	20 A	403 - COLD FOOD TABLE	6
7	--	--	--	--	1248	240						1	20 A	410 - UNDER COUNTER...	8
9	VF-2 RECEIVING / STORAGE 307	20 A	1				696	2122				2	30 A	401 - HOT FOOD TABLE	10
11	UH-5 RECEIVING / STORAGE 307	20 A	1						528	2122	--	--	--	--	12
13	RECEPTACLES JANITOR OFFICE 307A	20 A	1		360	360						1	20 A	405 - MILK COOLER	14
15	POWER JANITOR OFFICE 307A	20 A	1				380	2122				2	30 A	401A - HOT FOOD TABLE HEATED BASE	16
17	RECEPTACLES KITCHEN 312	20 A	1						720	2122	--	--	--	--	18
19	RECEPTACLES KITCHEN OFFICE 312A	20 A	1		540	360						1	20 A	405A -MILK COOLER	20
21	WORK STN KITCHEN OFFICE 312A	20 A	1				380	240				1	20 A	410 - UNDER COUNTER...	22
23	MOTORIZED OVERHEAD SERVERY 311	20 A	1						1656	1140		1	20 A	403 - COLD FOOD TABLE	24
25	MOTORIZED OVERHEAD SERVERY 311	20 A	1		1656	360						1	20 A	RECEPTACLE KITCHEN 312	26
27	101 - LIGHTS/DOOR HTR FREEZER 120	20 A	1				960								28
29	101 - LIGHTS/DOOR HTR FREEZER 120	20 A	1						960						30
31	301 - HOOD KITCHEN 312	20 A	1		1200										32
33															34
35	303 - CONVECTION OVEN	20 A	1						1068						36
37	303 - SHUNT TRIP	--	1	--	--										38
39	303 - CONVECTION OVEN	20 A	1				1068								40
41	303 - SHUNT TRIP	--	1	--					--						42
43	304 - STEAMER	20 A	1		240										44
45	304 - SHUNT TRIP	--	1	--			--								46
47	304A - REVERSE OSMOSIS SYSTEM	20 A	1						240						48
49	304A - SHUNT TRIP	--	1	--	--										50
51															52
53	107 - FIRE PROTECTION SYSTEM	20 A	1						1200						54
55	506 - DISHWASHER & BOOSTER HTR	60 A	3		5452										56
57	--	--	--	--			5452								58
59	--	--	--	--					5452						60
61	506 - SHUNT TRIP	--	1	--	--										62
63	506A - DRAIN WATER TEMPERING KIT	20 A	1				600								64
65	506A - SHUNT TRIP	--	1	--					--						66
67	507 - DISPOSAL	20 A	3		793										68
69	--	--	--	--			793								70
71	--	--	--	--					793						72
73	507 - SHUNT TRIP	--	1	--	--										74
75	408 - PASS THRU REF/HEATED CAB	20 A	2				1125								76
77	--	--	--	--					1125						78
79	SPARE	20 A	1	--	0										80
81	SPARE	20 A	1	--			0								82
83	SPARE	20 A	1	--					0						84
				Total Load:	**15.13 kVA**		**17.72 kVA**		**21.12 kVA**						
				Total Amps:	**126 A**		**151 A**		**179 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	2496 VA	100.00%	2496 VA		
Kitchen Equipment - Non-Dwelling Unit	19574 VA	80.00%	15659 VA	**Total Conn. Load:**	**53924 VA**
Motor	6192 VA	106.69%	6606 VA	**Total Est. Demand:**	**45738 VA**
Power	7480 VA	100.00%	7480 VA	**Total Conn.:**	**150 A**
Receptacle	19292 VA	75.92%	14646 VA	**Total Est. Demand:**	**127 A**

CB Legend (blank = circuit breaker):
G = GFCI S = Shunt Trip D = Switching Duty A = AFCI H = HID Rated C = HACR Rated † = Existing Circuit ‡ = Revised Circuit

Notes:

Stantec Panel

Name:	**RP1**	Volts:	208Y/120V	Mains Type:	MLO	Type:	
Location:	ELECTRICAL 308	Phases:	3	Mains Rating:	225 A	AIC Rating:	22000
Supply From:	DP-RP	Wires:	4	Max Rating:	225 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	RECEPTACLES CORRIDOR 301	20 A	1		540	380						1	20 A	WORK STATION SPEC OFFICE 317	2
3	CUH-4	20 A	1				200	540				1	20 A	RECEPTACLES ROOM 318B, 318	4
5	EWC CORRIDOR 301	20 A	1	G					300	800		1	20 A	COPIER STAFF WORK ROOM 318	6
7	WORK STN/FLAT PNL CLASSROOM 305	20 A	1		760	500					G	1	20 A	VENDING STAFF DINING 319	8
9	RECEPTACLES CLASSROOM 305	20 A	1				740	720				1	20 A	RECEPTACLES STAFF DINING 319	10
11	CHARGING STATION CLASSROOM 305	20 A	1						1440	360		1	20 A	RECEPTACLES CAFETERIA 310	12
13	WORK STN/FLAT PNL CLASSROOM 304	20 A	1		760	300						1	20 A	EWC CAFETERIA 310	14
15	RECEPTACLE CLASSROOM 304	20 A	1				740	760				1	20 A	FLAT PANEL/DISPLAY CAFETERIA 310	16
17	CHARGING STATION CLASSROOM 304	20 A	1						1440	720		1	20 A	RECEPTACLES CAFETERIA 310	18
19	WORK STN/FLAT PNL CLASSROOM 303	20 A	1		760	740						1	20 A	RECEPTS/DISPLAY CAFETERIA 310	20
21	RECEPTACLES CLASSROOM 303	20 A	1				740	360				1	20 A	RECEPTACLES MUSIC STUDIO 407	22
23	CHARGING STATION CLASSROOM 303	20 A	1						1440	540		1	20 A	RECEPTACLES ROOM 407A, 407	24
25	WORK STN/FLAT PNL CLASSROOM 302	20 A	1		760	760						1	20 A	WORK STN/FLAT PNL STUDIO 407	26
27	RECEPTACLES CLASSROOM 302	20 A	1				740	760				1	20 A	WORK STN/FLAT PNL SPEC EDU 406	28
29	CHARGING STATION CLASSROOM 302	20 A	1						1440	540		1	20 A	RECEPTACLES SPECIAL EDU 406	30
31	RECEPTACLES ROOM 101, 201	20 A	1		720	528						1	20 A	UH-1 MECHANICAL 306	32
33	AUTOMATIC SINKS CORRIDOR 301	20 A	1	G			500	528				1	20 A	UH-2 MECHANICAL 306	34
35	RECEPTACLES ROOM 315, 313, 314	20 A	1						540	1176		1	20 A	VF-1 MECHANICAL 306	36
37	OUTDOOR LEARNING CENTER RCPTS	20 A	1		360	696						1	20 A	EF-2 (1/4 HP)	38
39	MOTORIZED VEHICULAR GATE	20 A	1				696	696				1	20 A	EF-3 (1/4 HP)	40
41	RECEPTACLES SPEC OFFICE 317	20 A	1						360	696		1	20 A	EF-4 (1/4 HP)	42
43	RECEPTACLES ROOM 308, 309	20 A	1		540	528						1	20 A	EF-5 (1/6 HP)	44
45	UH-4 ELECTRICAL 308	20 A	1				528	540				1	20 A	ROOFTOP MAINTENANCE RECEPTS	46
47	UH-3 ATS ROOM 309	20 A	1						528	0	--	1	20 A	SPARE	48
49	RECEPTACLES MECHANICAL 306	20 A	1		540	0					--	1	20 A	SPARE	50
51	RECEPTACLES MECHANICAL 306	20 A	1				720	0			--	1	20 A	SPARE	52
53	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	54
55	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	56
57	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	58
59	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	60
61	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	62
63	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	64
65	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	66
67	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	68
69	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	70
71	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	72
73	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	74
75	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	76
77	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	78
79	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	80
81	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	82
83	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	84
				Total Load:	**9.88 kVA**		**10.13 kVA**		**11.93 kVA**						
				Total Amps:	**82 A**		**85 A**		**100 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	200 VA	100.00%	200 VA		
Motor	6600 VA	104.45%	6894 VA	**Total Conn. Load:**	**31927 VA**
Power	8100 VA	100.00%	8100 VA	**Total Est. Demand:**	**28171 VA**
Receptacle	18100 VA	77.62%	14050 VA	**Total Conn.:**	**89 A**
				Total Est. Demand:	**78 A**

CB Legend (blank = circuit breaker):
G = GFCI S = Shunt Trip D = Switching Duty A = AFCI H = HID Rated C = HACR Rated † = Existing Circuit ‡ = Revised Circuit

Notes:

Stantec Panel

Name:	**RP2**	Volts:	208Y/120V	Mains Type:	MLO	Type:	
Location:	ELECTRICAL 321	Phases:	3	Mains Rating:	225 A	AIC Rating:	22000
Supply From:	DP-RP	Wires:	4	Max Rating:	225 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	WORK STN / FLAT PNL CLASSROOM...	20 A	1		760	360						1	20 A	RECEPTACLE VESTIBULE 100	2
3	RECEPTACLES CLASSROOM 405	20 A	1				740	1000				1	20 A	MICROWAVE BREAK 104	4
5	CHARGING STATION CLASSROOM 405	20 A	1						1440	1800		1	20 A	DISHWASHER BREAK 104	6
7	WORK STN / FLAT PNL CLASSROOM...	20 A	1		760	1500						1	20 A	COFFEE MAKER BREAK 104	8
9	RECEPTACLES CLASSROOM 404	20 A	1				740	1200			G	1	20 A	REFRIGERATOR BREAK 104	10
11	CHARGING STATION CLASSROOM 404	20 A	1						1440	500		1	20 A	FIRE ALARM CONTROL PANEL	12
13	WORK STN / FLAT PNL CLASSROOM...	20 A	1		760	540						1	20 A	RECEPTACLES MEETING ROOM 108	14
15	RECEPTACLES CLASSROOM 403	20 A	1				740	740				1	20 A	FLAT PANEL/ RECEPTS MTG ROOM 108	16
17	CHARGING STATION CLASSROOM 403	20 A	1						1440	1000		1	20 A	FLOOR BOX MEETING ROOM 108	18
19	WORK STN / FLAT PNL CLASSROOM...	20 A	1		760	540						1	20 A	RECEPTACLES WORK ROOM 107	20
21	RECEPTACLES CLASSROOM 402	20 A	1				740	540				1	20 A	RECEPTACLES ROOM 101, 107	22
23	CHARGING STATION CLASSROOM 402	20 A	1						1440	528		1	20 A	TF-2 JANITOR 322	24
25	WORK STATION HEALTH CLINIC 105	20 A	1		380	528						1	20 A	TF-1 CORRIDOR 101	26
27	RECEPTACLES HEALTH CLINIC 105	20 A	1				540	720				1	20 A	RECEPTACLES ROOM 322, 324, 323	28
29	WORK STN / FLAT PANEL PRINC 103	20 A	1						760						30
31	RECEPTACLES PRINCIPAL OFFICE 103	20 A	1		360	720						1	20 A	STAGE RECEPTACLES	32
33	COPIER RECEPTION 102	20 A	1				800	789				1	20 A	STAGE PROJECTION SYSTEM	34
35	WORK STATION RECEPTION 102	20 A	1						800	1000		1	20 A	AV SOUND SYSTEM TABLE STOR 310A	36
37	RECEPTACLES ROOM 109, 102	20 A	1		920	300					G	1	20 A	EWC CORRIDOR 401	38
39	MOTORIZED DOOR VESTIBULE 100	20 A	1				696	540				1	20 A	RECEPTACLES CORRIDOR 401	40
41	RTU-3 & RTU-4 SERVICE RECEPTACLE	20 A	1						360	696		1	20 A	MOTORIZED DOOR RECEPTION 102	42
43	RTU-1 HEAT TRACE	20 A	1	G	1000	696						1	20 A	MOTORIZED DOOR CORRIDOR 101	44
45	RTU-2 HEAT TRACE	20 A	1	G			1000	696				1	20 A	MOTORIZED VEHICULAR GATE	46
47	RTU-1,2,5,6 SERVICE RECEPTACLES	20 A	1						720	528		1	20 A	EF-6 (1/6 HP)	48
49	AV CABINET PE STORAGE 218	20 A	1		1200	380						1	20 A	POWER/DATA WORK ROOM 107	50
51	WORK STATION ROOMS 219, 220	20 A	1				760	1000				1	20 A	RECEPTION 102 FLOOR BOX	52
53	RECEPTACLES SPEC OFFICE 219	20 A	1						360	500	G	1	20 A	AUTOMATIC SINKS BOYS/GIRLS 324	54
55	RECEPTACLES SPEC OFFICE 220	20 A	1		360	720						1	20 A	RECEPTACLES MEDIA CENTER 110	56
57	RECEPTACLES SPECIAL EDU 210	20 A	1				740	540				1	20 A	RECEPTACLES MEDIA CENTER 110	58
59	WORK STN/FLAT PNL SPECIAL EDU 210	20 A	1						760	0	--	1	20 A	SPARE	60
61	DIGITAL SIGNAGE CORRIDOR 101	20 A	1		560	0					--	1	20 A	SPARE	62
63	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	64
65	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	66
67	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	68
69	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	70
71	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	72
73	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	74
75	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	76
77	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	78
79	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	80
81	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	82
83	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	84
				Total Load:	**13.88 kVA**		**14.96 kVA**		**15.76 kVA**						
				Total Amps:	**116 A**		**126 A**		**133 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Motor	4896 VA	103.55%	5070 VA		
Other	300 VA	100.00%	300 VA	**Total Conn. Load:**	**44095 VA**
Power	13620 VA	100.00%	13620 VA	**Total Est. Demand:**	**36184 VA**
Receptacle	26160 VA	69.11%	18080 VA	**Total Conn.:**	**122 A**
				Total Est. Demand:	**100 A**

CB Legend (blank = circuit breaker):
G = GFCI S = Shunt Trip D = Switching Duty A = AFCI H = HID Rated C = HACR Rated † = Existing Circuit ‡ = Revised Circuit

Notes:

Stantec Panel

Name:	**RP3**	Volts:	208Y/120V	Mains Type:	MLO	Type:	
Location:	MDF 107	Phases:	3	Mains Rating:	225 A	AIC Rating:	22000
Supply From:	DP-RP	Wires:	4	Max Rating:	225 A	Mounting:	Surface
Serves:				Lugs:	Single Lugs	Enclosure:	Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	RECEPTACLES CORRIDOR 201	20 A	1		360	1440						1	20 A	CHARGING STATION CLASSROOM 206	2
3	WORK STN/FLAT PNL CLASSROOM 112	20 A	1				760	740				1	20 A	RECEPTACLES CLASSROOM 206	4
5	RECEPTACLES CLASSROOM 112	20 A	1						740	760		1	20 A	WORK STN/FLAT PNL CLASSROOM 206	6
7	CHARGING STATION CLASSROOM 112	20 A	1		1440	180						1	20 A	RECEPTACLES CORRIDOR 201	8
9	WORK STN/FLAT PNL CLASSROOM 113	20 A	1				760	540				1	20 A	RECEPTACLES ROOM 201, 101, 214	10
11	RECEPTACLES CLASSROOM 113	20 A	1						740	1000	G	1	20 A	WASHER PE OFFICE 214	12
13	CHARGING STATION CLASSROOM 113	20 A	1		1440	2200					G	2	30 A	ELECTRIC DRYER PE OFFICE 214	14
15	WORK STN/FLAT PNL SPECIAL EDU 114	20 A	1				760	2200			--	--	--	--	16
17	RECEPTACLE SPECIAL EDUCATION 114	20 A	1						740	1000		1	20 A	VAPE DETECTOR BOYS/GIRLS RR	18
19	RECEPTACLES CORRIDOR 201	20 A	1		720	500					G	1	20 A	AUTOMATIC FAUCET	20
21	MARGUEE SIGN SITE POWER/LTG	20 A	1				1000	1440				1	20 A	CHARGING STATION CLASSROOM 207	22
23	EWC CORRIDOR 201	20 A	1	G					180	740		1	20 A	RECEPTACLES CLASSROOM 207	24
25	CHARGING STATION CLASSROOM 202	20 A	1		1440	760						1	20 A	WORK STN/ FLAT PNL CLASSROOM 207	26
27	RECEPTACLES CLASSROOM 202	20 A	1				740	1440				1	20 A	CHARGING STATION CLASSROOM 208	28
29	WORK STN/FLAT PNL CLASSROOM 202	20 A	1						760	740		1	20 A	RECEPTACLES CLASSROOM 208	30
31	CHARGING STATION CLASSROOM 203	20 A	1		1440	760						1	20 A	WORK STN/FLAT PNL CLASSROOM 208	32
33	RECEPTACLE CLASSROOM 203	20 A	1				740	1440				1	20 A	CHARGING STATION CLASSROOM 209	34
35	FLAT PANEL CLASSROOM 203	20 A	1						940	740		1	20 A	RECEPTACLES CLASSROOM 209	36
37	FLAT PNL/RECPTS PROJECT RM A 204	20 A	1		940	760						1	20 A	WORK STN/FLAT PNL CLASSROOM 209	38
39	POWER CORD REELS RM A 204	20 A	1				1600	1176				1	20 A	BACKBOARD JOIST GYMNASIUM 215	40
41	POWER CORD REELS RM A 204	20 A	1						1600	1176		1	20 A	BACKBOARD JOIST GYMNASIUM 215	42
43	POWER CORD REELS RM A 204	20 A	1		1600	300						1	20 A	GYM SCOREBOARD	44
45	CHARGING STN PROJECT ROOM A 204	20 A	1				1440	300				1	20 A	GYM SCOREBOARD	46
47	RECEPTACLES ROOM 201, 212, 211	20 A	1						720	1176		1	20 A	TELESCOPING BLEACHERS GYM	48
49	RECEPTACLES ROOM 205A, 204A, 204	20 A	1		920	1000						1	20 A	FLOOR BOX GYMNASIUM 215	50
51	FLAT PNL/RECPTS PROJECT RM B 205	20 A	1				940	1000				1	20 A	FLOOR BOX GYMNASIUM 215	52
53	POWER CORD REELS RM B 205	20 A	1						1600	180		1	20 A	RECEPTACLES GYMNASIUM 215	54
55	POWER CORD REELS RM B 205	20 A	1		1600	180						1	20 A	RCPT ABOVE BLEACHER GYM 215	56
57	POWER CORD REELS RM B 205	20 A	1				1600	300			G	1	20 A	EWC GYMNASIUM 215	58
59	RECEPTACLES PROJECT ROOM B 205	20 A	1						560	360		1	20 A	RECEPTACLES GYMNASIUM 215	60
61	CHARGING STN PROJECT ROOM B 205	20 A	1		1440	528						1	20 A	TF-3 JANITOR 213	62
63	RTU-8 HEAT TRACE	20 A	1	G			1000	528				1	20 A	EF-7 (1/6 HP)	64
65	RTU-7,8,9 SERVICE RECEPTACLES	20 A	1						540	0	--	1	20 A	SPARE	66
67	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	68
69	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	70
71	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	72
73	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	74
75	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	76
77	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	78
79	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	80
81	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	82
83	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	84
				Total Load:	**21.84 kVA**		**22.13 kVA**		**16.58 kVA**						
				Total Amps:	**189 A**		**191 A**		**138 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Motor	4584 VA	106.41%	4878 VA		
Other	0 VA	0.00%	0 VA	**Total Conn. Load:**	**60530 VA**
Power	18640 VA	100.00%	18640 VA	**Total Est. Demand:**	**46714 VA**
Receptacle	38160 VA	63.10%	24080 VA	**Total Conn.:**	**168 A**
				Total Est. Demand:	**130 A**

CB Legend (blank = circuit breaker):
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Notes:

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

ELECTRICAL PANEL SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116

DATE: 23-JUNE-2023

SHEET

E411

100% CONSTRUCTION DOCUMENTS

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DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

Stantec — Panel

Name: **LP-LS** | Volts: 480Y/277V | Mains Type: MCB | Type:
Location: ELECTRICAL 321 | Phases: 3 | Mains Rating: 100 A | AIC Rating: 35000
Supply From: | Wires: 4 | MCB Rating: 100 A | Mounting: Surface
Serves: | Lugs: Single Lugs | Enclosure: Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	NORTH ROOF EMERGENCY LIGHTING	20 A	1		200	0					--	1	20 A	SPARE	2
3	SOUTH ROOF EMERGENCY LIGHTING	20 A	1				75	0			--	1	20 A	SPARE	4
5	CORRIDOR EGRESS LIGHTING	20 A	1						1505	0	--	1	20 A	SPARE	6
7	EAST EXTERIOR EGRESS LIGHTING	20 A	1		155	0					--	1	20 A	SPARE	8
9	NORTH & WEST EXTERIOR EM LTG	20 A	1				230	0			--	1	20 A	SPARE	10
11	INTERIOR EMERGENCY LIGHTING	20 A	1						3691	0	--	1	20 A	SPARE	12
13	CAFETERIA EMERGENCY LIGHTING	20 A	1		403	0					--	1	20 A	SPARE	14
15	GYMNASIUM EMERGENCY LIGHTING	20 A	1				1110	0			--	1	20 A	SPARE	16
17	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	18
19	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	20
21	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	22
23	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	24
25	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	26
27	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	28
29	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	30
31	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	32
33	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	34
35	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	36
37	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	38
39	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	40
41	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	42
				Total Load:	**0.75 kVA**		**1.41 kVA**		**5.18 kVA**						
				Total Amps:	**3 A**		**5 A**		**19 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	7316 VA	125.00%	9144 VA		
				Total Conn. Load:	**7316 VA**
				Total Est. Demand:	**9144 VA**
				Total Conn.:	**9 A**
				Total Est. Demand:	**11 A**

CB Legend (blank = circuit breaker):
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Notes:

Stantec — Panel

Name: **RP-SB1** | Volts: 208Y/120V | Mains Type: MCB | Type:
Location: ELECTRICAL 321 | Phases: 3 | Mains Rating: 150 A | AIC Rating: 22000
Supply From: T-RP-SB1 | Wires: 4 | MCB Rating: 150 A | Mounting: Surface
Serves: | Lugs: Single Lugs | Enclosure: Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	IT ROOM 320 RACK RECEPTACLE	30 A	2		1872	500						1	20 A	FACP BREAK 104	2
3	--	--	--	--			1872	200				1	20 A	CUH-1 / EXTERIOR RECEPTACLE	4
5	IT ROOM 320 RACK RECEPTACLE	20 A	1						1200	200		1	20 A	CUH-2	6
7	ACCESS CONTROL PANEL IT RM 320	20 A	1		1000	200						1	20 A	CUH-6	8
9	ACCESS CONTROL PANEL IT RM 320	20 A	1				1000	1000				1	20 A	TCP-3 JANITOR 315	10
11	RECEPTACLE IT ROOM 320	20 A	1						500	1000		1	20 A	TCP-4 JANITOR 315	12
13	TCP-1 ELECTRICAL 321	20 A	1		1000	360						1	20 A	RECEPTACLE ATS & MAIN ELEC RMS	14
15	TCP-5 ELECTRICAL 321	20 A	1				1000	500				1	20 A	GENERATOR BATTERY CHARGER	16
17	B-1 MECHANICAL 306	20 A	1						1560	500		1	20 A	GENERATOR BLOCK HEATER	18
19	B-2 MECHANICAL 306	20 A	1		1560	1000						1	20 A	TCP-2 CHAIR STORAGE 310B	20
21	305 - KITCHEN FREEZER	20 A	1	G			1344	1000				1	20 A	TCP-6 PE STORAGE 218	22
23	306 - KITCHEN COOLER	20 A	1	G					588	0	--	1	20 A	SPARE	24
25	E101C - KITCHEN FREEZER 120	20 A	2	G	1560	0					--	1	20 A	SPARE	26
27	--	--	--	--			1560	0			--	1	20 A	SPARE	28
29	E101E - FREEZER COIL HEAT TRACE	20 A	1	G					600	0	--	1	20 A	SPARE	30
31	E101D - FREEZER COMPRESSOR	20 A	3		1801	0					--	1	20 A	SPARE	32
33	--	--	--	--			1801	0			--	1	20 A	SPARE	34
35	--	--	--	--					1801	0	--	1	20 A	SPARE	36
37	E101B - COOLER COMPRESSOR	20 A	3		1201	0					--	1	20 A	SPARE	38
39	--	--	--	--			1201	0			--	1	20 A	SPARE	40
41	--	--	--	--					1201						42
				Total Load:	**12.05 kVA**		**12.48 kVA**		**9.15 kVA**						
				Total Amps:	**104 A**		**108 A**		**76 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	20447 VA	100.00%	20447 VA		
Power	3000 VA	100.00%	3000 VA	**Total Conn. Load:**	**33683 VA**
Receptacle	9736 VA	100.00%	9736 VA	**Total Est. Demand:**	**33683 VA**
Kitchen	500 VA	100.00%	500 VA	**Total Conn.:**	**93 A**
				Total Est. Demand:	**93 A**

CB Legend (blank = circuit breaker):
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Notes:

Stantec — Panel

Name: **RP-SB2** | Volts: 208Y/120V | Mains Type: MCB | Type:
Location: MDF 107 | Phases: 3 | Mains Rating: 150 A | AIC Rating: 22000
Supply From: T-RP-SB2 | Wires: 4 | MCB Rating: 150 A | Mounting: Surface
Serves: | Lugs: Single Lugs | Enclosure: Type 1

Notes:

CKT	Circuit Description	Trip	Poles	CB	A		B		C		CB	Poles	Trip	Circuit Description	CKT
1	MDF 107 ACCESS CONTROL PANEL	20 A	1		1000	0					--	1	20 A	SPARE	2
3	MDF 107 ACCESS CONTROL PANEL	20 A	1				1000	0			--	1	20 A	SPARE	4
5	MDF 107 ACCESS CONTROL PANEL	20 A	1						1000	0	--	1	20 A	SPARE	6
7	MDF 107 RACK RECEPTACLE	30 A	2		1872	0					--	1	20 A	SPARE	8
9	--	--	--	--			1872	0			--	1	20 A	SPARE	10
11	MDF 107 RACK RECEPTACLE	20 A	1						1200	0	--	1	20 A	SPARE	12
13	MDF 107 RACK RECEPTACLE	20 A	1		1200	0					--	1	20 A	SPARE	14
15	MDF 107 RACK RECEPTACLE	20 A	1				1200	0			--	1	20 A	SPARE	16
17	ACU-1 EVAPORATOR	20 A	2						125	0	--	1	20 A	SPARE	18
19	--	--	--	--	125	0					--	1	20 A	SPARE	20
21	RECEPTACLE MDF 107	20 A	1				500	0			--	1	20 A	SPARE	22
23	TCP-7 JANITOR 213	20 A	1						1000	0	--	1	20 A	SPARE	24
25	CUH-3	20 A	1		200	0					--	1	20 A	SPARE	26
27	ACU-1 CONDENSING UNIT	30 A	2				1976	0			--	1	20 A	SPARE	28
29	--	--	--	--					1976	0	--	1	20 A	SPARE	30
31	TCP-8 ART STORAGE 205A	20 A	1		0	0					--	1	20 A	SPARE	32
33	TCP-9 ART STORAGE 205A	20 A	1				0	0			--	1	20 A	SPARE	34
35	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	36
37	SPARE	20 A	1	--	0	0					--	1	20 A	SPARE	38
39	SPARE	20 A	1	--			0	0			--	1	20 A	SPARE	40
41	SPARE	20 A	1	--					0	0	--	1	20 A	SPARE	42
				Total Load:	**4.40 kVA**		**6.55 kVA**		**5.30 kVA**						
				Total Amps:	**37 A**		**56 A**		**45 A**						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	4402 VA	100.00%	4402 VA		
Power	1000 VA	100.00%	1000 VA	**Total Conn. Load:**	**16246 VA**
Receptacle	10844 VA	96.11%	10422 VA	**Total Est. Demand:**	**15824 VA**
				Total Conn.:	**45 A**
				Total Est. Demand:	**44 A**

CB Legend (blank = circuit breaker):
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Notes:

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
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Mt. Hope
1210 E Mt Hope Ave, Lansing, MI 48910

ELECTRICAL PANEL SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E412

100% CONSTRUCTION DOCUMENTS

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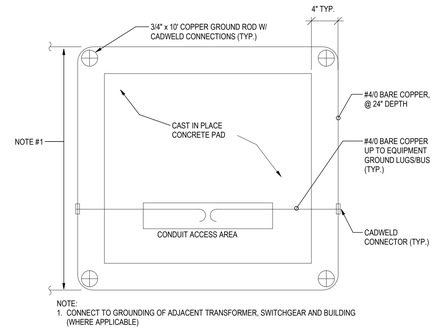
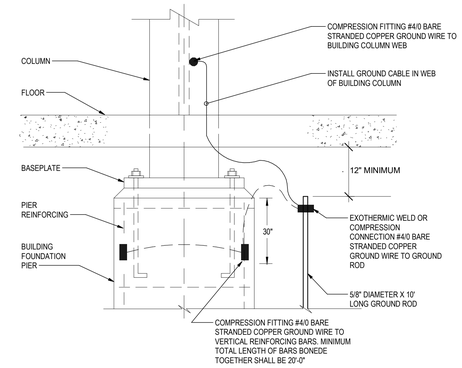
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



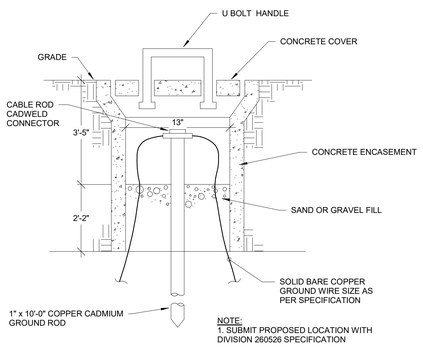
TRANSFORMER AND GENERATOR GROUNDING PLAN

SCALE: NONE



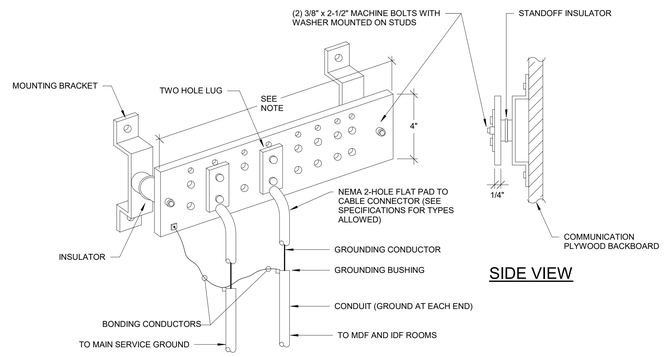
COLUMN GROUNDING DETAIL

SCALE: NONE



GROUNDING ROD INSPECTION BOX (LOCK BOX)

SCALE: NONE

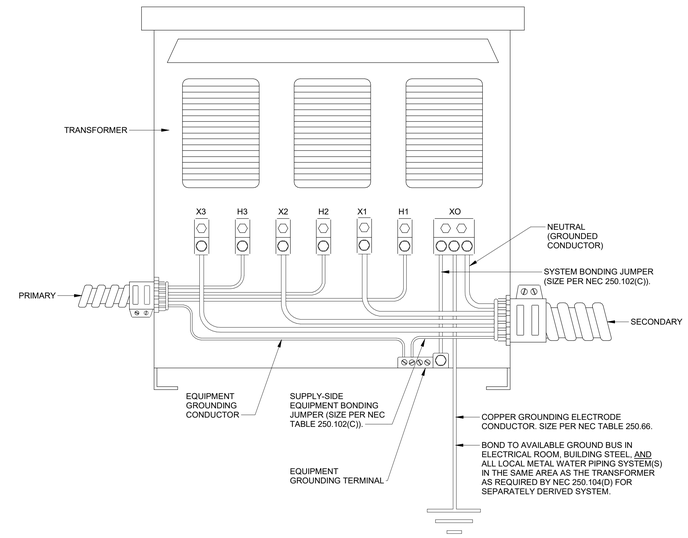


SIDE VIEW

NOTE:
1. MDF/IDF ROOMS: REFERENCE TECHNOLOGY DRAWING T501 FOR GROUND BUS TYPE AND SIZE.
2. MAIN BUILDING GROUND BUS CENTRAL ELECTRICAL ROOM 308: EQUAL TO ERICO NO. EGBA 14430CC (4" BY 30").
3. MAIN BUILDING GROUND BUS CONCESSION E002: EQUAL TO ERICO NO. 14420CC (4" BY 20").
4. TYPICAL ELECTRICAL ROOM GROUND BUS: EQUAL TO ERICO NO. 14418CC (4" BY 18").

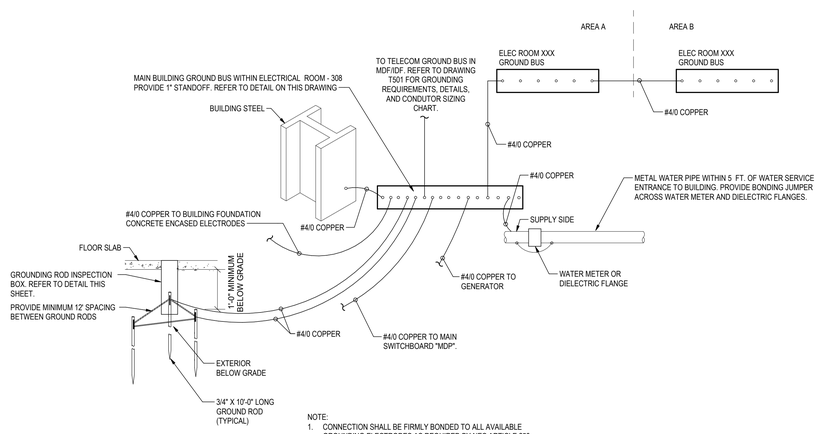
GROUND BUS DETAIL

SCALE: NONE



TRANSFORMER SYSTEM BONDING DETAIL

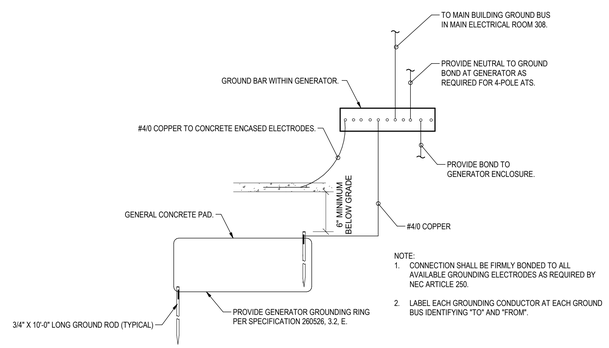
SCALE: NONE



NOTE:
1. CONNECTION SHALL BE FIRMLY BONDED TO ALL AVAILABLE GROUNDING ELECTRODES AS REQUIRED BY NEC ARTICLE 250.
2. LABEL EACH GROUNDING CONDUCTOR AT EACH GROUND BUS IDENTIFYING "TO" AND "FROM".

MAIN BUILDING GROUNDING SYSTEM DETAIL

SCALE: NONE



NOTE:
1. CONNECTION SHALL BE FIRMLY BONDED TO ALL AVAILABLE GROUNDING ELECTRODES AS REQUIRED BY NEC ARTICLE 250.
2. LABEL EACH GROUNDING CONDUCTOR AT EACH GROUND BUS IDENTIFYING "TO" AND "FROM".

GENERATOR GROUNDING SYSTEM DETAIL

SCALE: NONE

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LANSING SCHOOL DISTRICT
Mt. Hope
1210 E Mt Hope Ave, Lansing, MI 48910

ELECTRICAL DETAILS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E501

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

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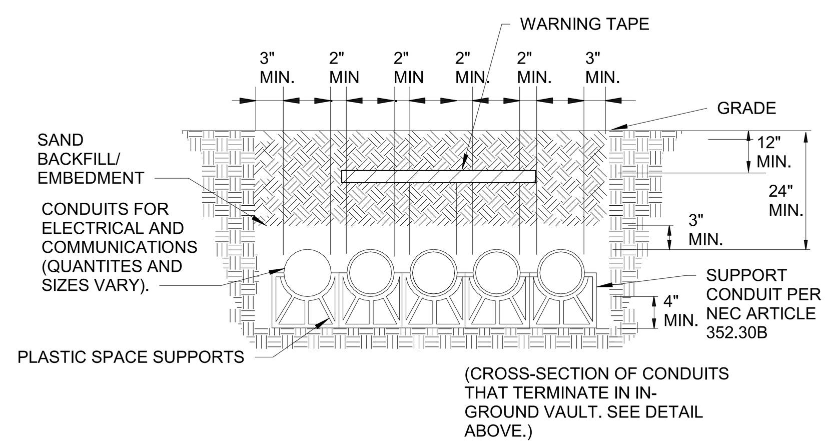
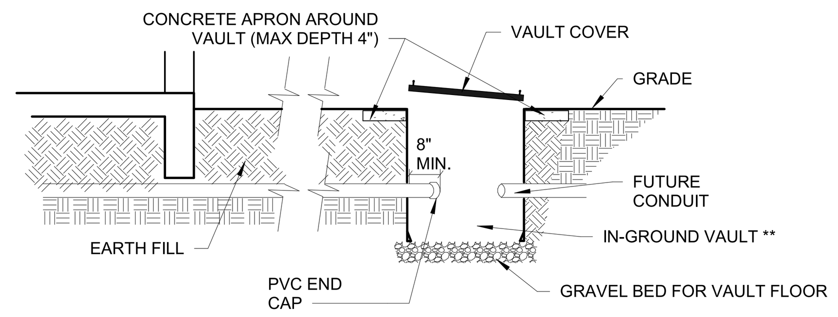


OUTDOOR PAVILION CONDUIT DETAIL

SCALE: NONE

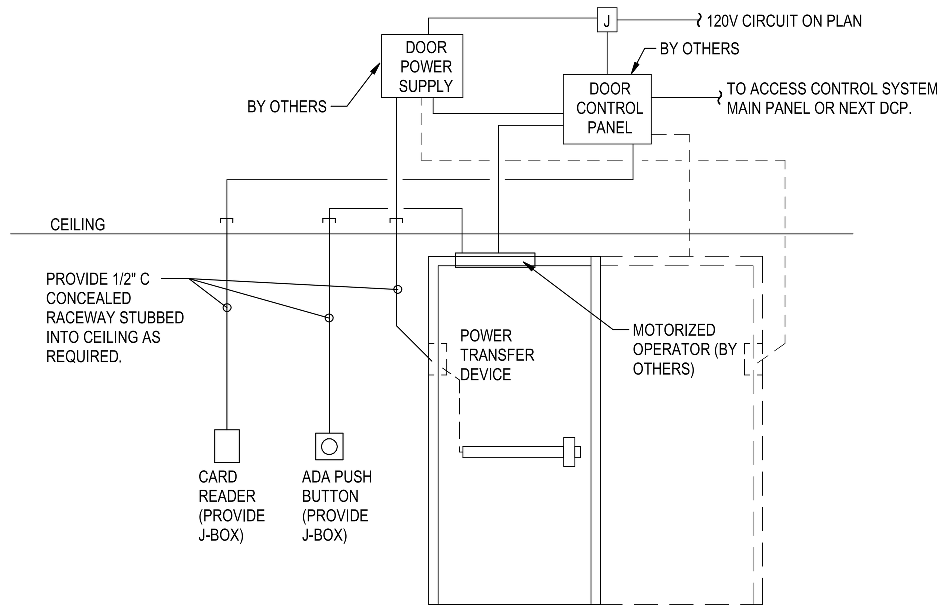


* USING A PERMANENT MARKER ON PVC ENDCAP, INDICATE THE LOCATION AT WHICH THE OPPOSITE END OF THE CONDUIT TERMINATES.

** IN-GROUND VAULT: CONSTRUCTION SHALL BE FIBERGLASS OR POLYMER-CONCRETE WITH A LOAD RATING APPROPRIATE FOR THE INSTALLED LOCATION. EACH ENCLOSURE SHALL BE AN IN-GROUND VAULT WITH A SURFACE-LEVEL COVER AND GRAVEL. THE ENCLOSURE SHOULD BE SIZED FOR THE NUMBER OF CONDUITS AND CONFIGURATION REQUIRED. HATCH COVER SHALL BE SECURED WITH AT LEAST TWO PENTAGONAL-HEAD BOLTS.

IN-GROUND VAULT DETAIL

SCALE: NONE



NOTES:
1. PROVIDE INTERCONNECTION WITH MOTORIZED OPERATOR AS REQUIRED TO PREVENT MOTOR FROM OPERATING UNTIL VALID CARD IS READ WHEN DOORS ARE IN LOCKED MODE.
2. REFER TO FLOOR PLANS AND DOOR HARDWARE SCHEDULES FOR QUANTITIES AND LOCATIONS OF DEVICES (ADA PUSH BUTTONS, CARD READERS, PANIC HARDWARE, EXIT ONLY HARDWARE, MOTORIZED DOOR OPERATORS, ETC.).
3. REFER TO TELECOM AND SECURITY DRAWINGS FOR SPECIFIC INSTALLATION REQUIREMENTS.

TYPICAL DOOR ACCESS CONTROL DETAIL

SCALE: NONE

FLOOR SERVICE FITTING AND POKE-THROUGH ASSEMBLY SCHEDULE

(NOT ALL SERVICE FITTINGS AND POKE-THROUGH ARE USED IN THIS PROJECT)

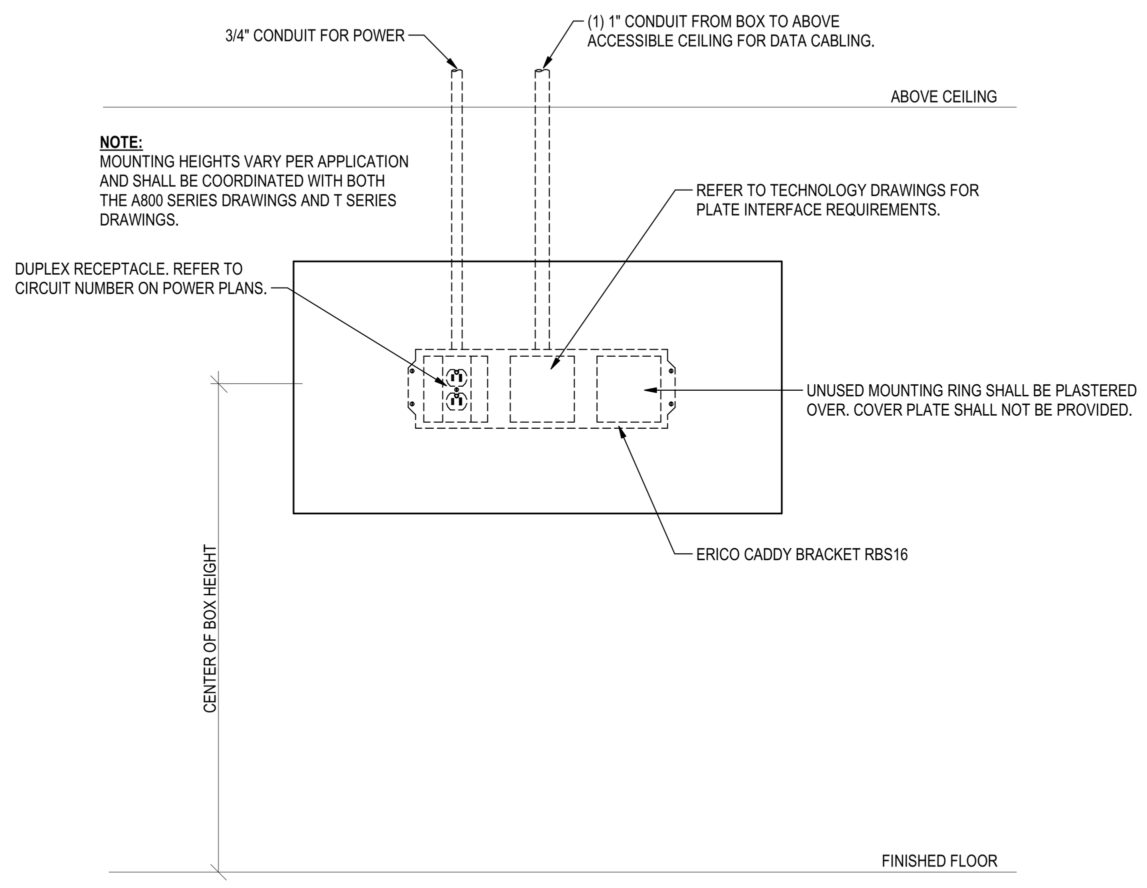
TYPE	DESCRIPTION	MANUFACTURER (SEE NOTE - 2)	DEVICE CONFIGURATION	FLANGE/COVER MATERIAL	SERVICE PLATE TYPE	MAXIMUM CONDUIT	MINIMUM DEPTH
FB1	MULTIFUNCTION EIGHT COMPARTMENT, MULTI-SERVICE, STAMPED STEEL WITH SPECIAL FINISH FOR SLAB ON GRADE APPLICATION, RECESSED FLOOR BOX, (2) DUPLEX RECEPTACLES, (2) TELECOMMUNICATION OUTLETS, (3) BLANK PLATES.	WIREMOLD EFB8 CAST-N	4D/3T/BLANKS FOR REMAINING GANGS (NOTE 5)	SELECTED BY ARCHITECT	F	2"	6"
FB2	MULTIFUNCTION FOUR COMPARTMENT, MULTI-SERVICE, STAMPED STEEL WITH SPECIAL FINISH FOR SLAB ON GRADE APPLICATION, RECESSED FLOOR BOX, (2) DUPLEX RECEPTACLES, (1) TELECOMMUNICATION OUTLETS, (1) BLANK PLATES.	WIREMOLD EFB4 CAST-N	4D/1T/BLANKS FOR REMAINING GANGS (NOTE 5)	SELECTED BY ARCHITECT	F	2"	6"

NOTES:

1. UNLESS NOTED OTHERWISE ON AVI OR TECHNOLOGY DRAWINGS, PROVIDE 1 1/4" CONDUIT FROM EACH VOICE/DATA FLOOR BOX GANG COMPARTMENT TO ABOVE ACCESSIBLE CEILING SPACE. PROVIDE 1" CONDUIT FROM EACH BLANK FLOOR BOX AND WALL BOX GANG COMPARTMENT TO ACCESSIBLE CEILING SPACE. DO NOT DAISY CHANGE CONDUIT. CONTACT ENGINEER WHEN FIELD CONDITIONS DO NOT ALLOW FOR THIS.
2. OTHER ACCEPTABLE MANUFACTURER'S ARE STEEL CITY OR HUBBELL-RACO.
3. ALL PRODUCTS IN THE SCHEDULE SHALL MEET AND EXCEED THE UL "SCRUB WATER' EXCLUSION REQUIREMENT.
4. PROVIDE ALL REQUIRED DEVICE BRACKETS AND TERMINATE ALL CABLING IN FLOOR BOX. LOOSE DANGLING CABLING INSIDE FLOOR BOX IS NOT ACCEPTABLE.
5. REFER TO TECHNOLOGY/AV PLANS FOR QUANTITY OF DATA DROPS WITHIN DATA GANGS. WHERE TWO CIRCUITS ARE SHOWN ON PLANS, HALF OF THE OUTLETS ARE CONNECTED TO ONE CIRCUIT AND THE OTHER HALF TO ANOTHER CIRCUIT. WHERE THREE CIRCUITS ARE SHOWN ON PLANS, EACH OF THE OUTLETS ARE CONNECTED TO SINGLE CIRCUIT. WHERE NO DATA IS SHOWN ON TECHNOLOGY DRAWINGS, PROVIDE BLANK COVER PLATE OVER TWO GANGS.
6. CONTRACTOR SHALL TRANSITION TO FLEXIBLE CONDUIT WITH SLACK AS NECESSARY TO SERVICE POKE THRU FROM ABOVE.

A = ALUMINUM
B = BRASS
BL = BLANK PLATE/GANG
D = DUPLEX RECEPTACLES
F = FLIP COVER
FR = FLIP LID (RECTANGULAR)
N/A = NOT APPLICABLE
PF = PARTITION FEED
SL = SLIDES
T = VOICE/DATA OPENINGS

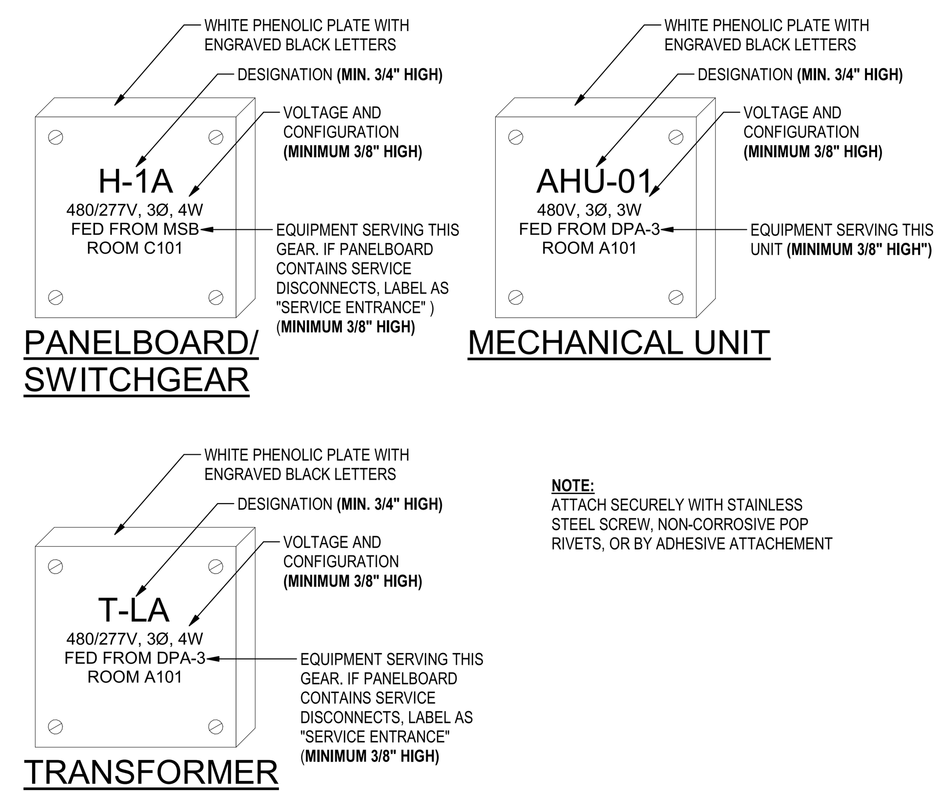
CONTRACTOR SHALL **PROTECT** INTERIOR FINISH OF ALL FLOOR BOX AND POKE-THRU FROM DIRT, DEBRIS, DAMAGE DURING CONSTRUCTION. INTERIOR FINISH SHALL LOOK LIKE NEW AT PROJECT CLOSEOUT. PROVIDE APPROPRIATE CONSTRUCTION COVER TO ENSURE BOX IS KEPT CLEAN -- NO EXCEPTIONS.



VI

DIGITAL SIGNAGE ROUGH-IN

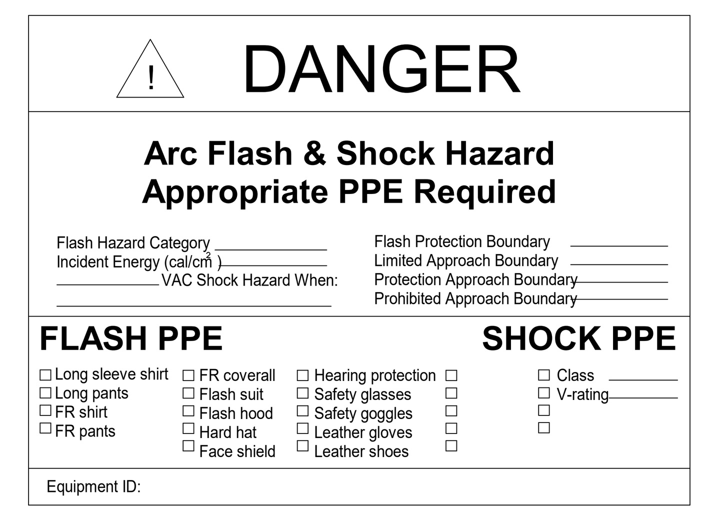
SCALE: NONE



NOTE:
ATTACH SECURELY WITH STAINLESS STEEL SCREW, NON-CORROSIVE POP RIVETS, OR BY ADHESIVE ATTACHEMENT

EQUIPMENT IDENTIFICATION

SCALE: NONE



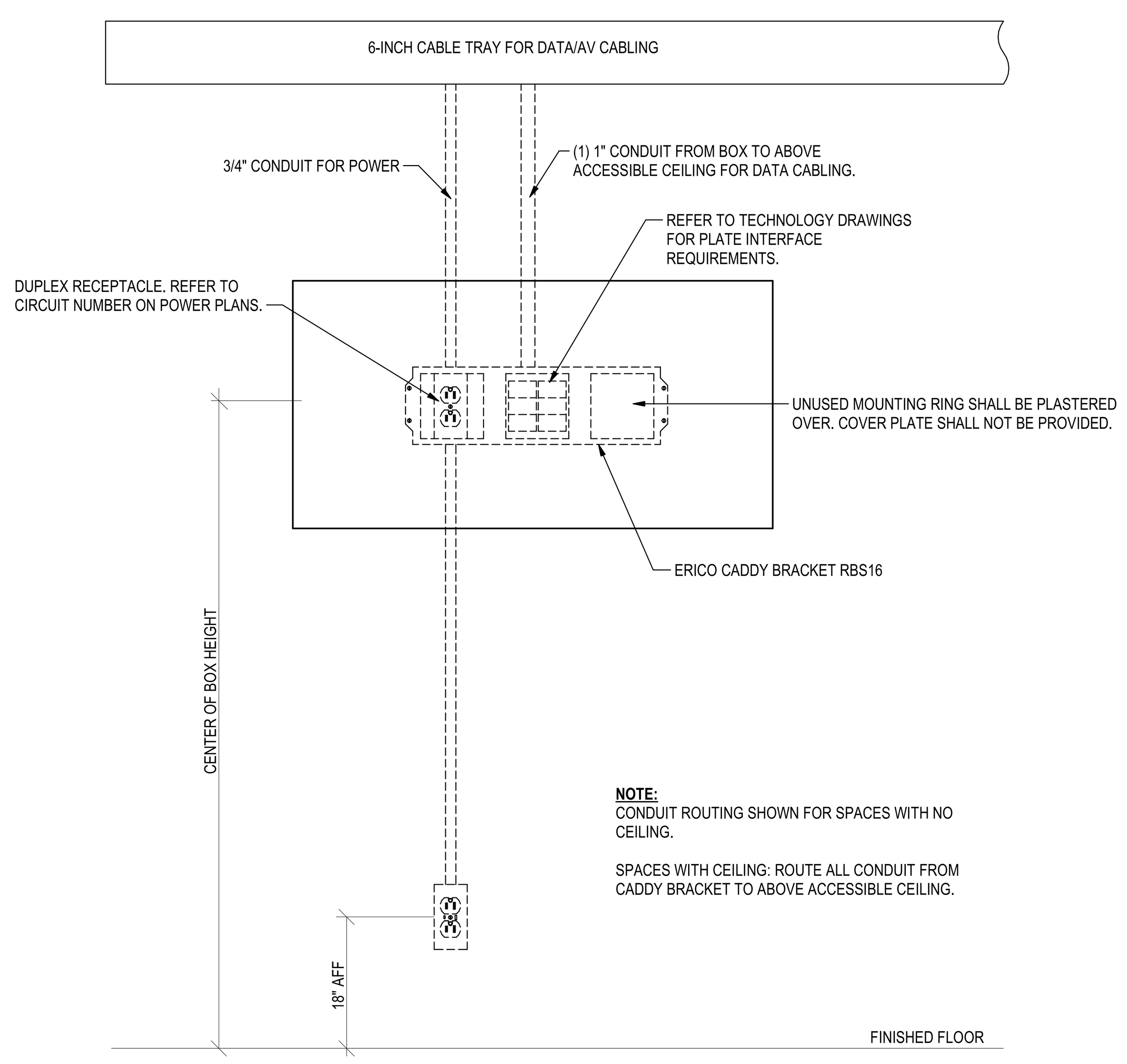
PROVIDE A 4"x6" RED LABEL ON THE OUTSIDE OF PANELS IN AREAS OPEN ONLY TO "QUALIFIED PERSONNEL" AND ON THE INSIDE PANEL DOOR OF PANELS IN "OCCUPANT AREAS". BRADY #99459 OR APPROVED EQUIVALENT.

PROVIDE A 3"x5" YELLOW LABEL ON THE OUTSIDE OF PANELS IN "OCCUPANT AREAS". BRADY #99454 OR APPROVED EQUIVALENT.

NOTE: LABELS SHALL BE COMPLIANT WITH 2020 VERSION OF NFPA 70E.

TYPICAL ARC FLASH WARNING LABELS

SCALE: NONE

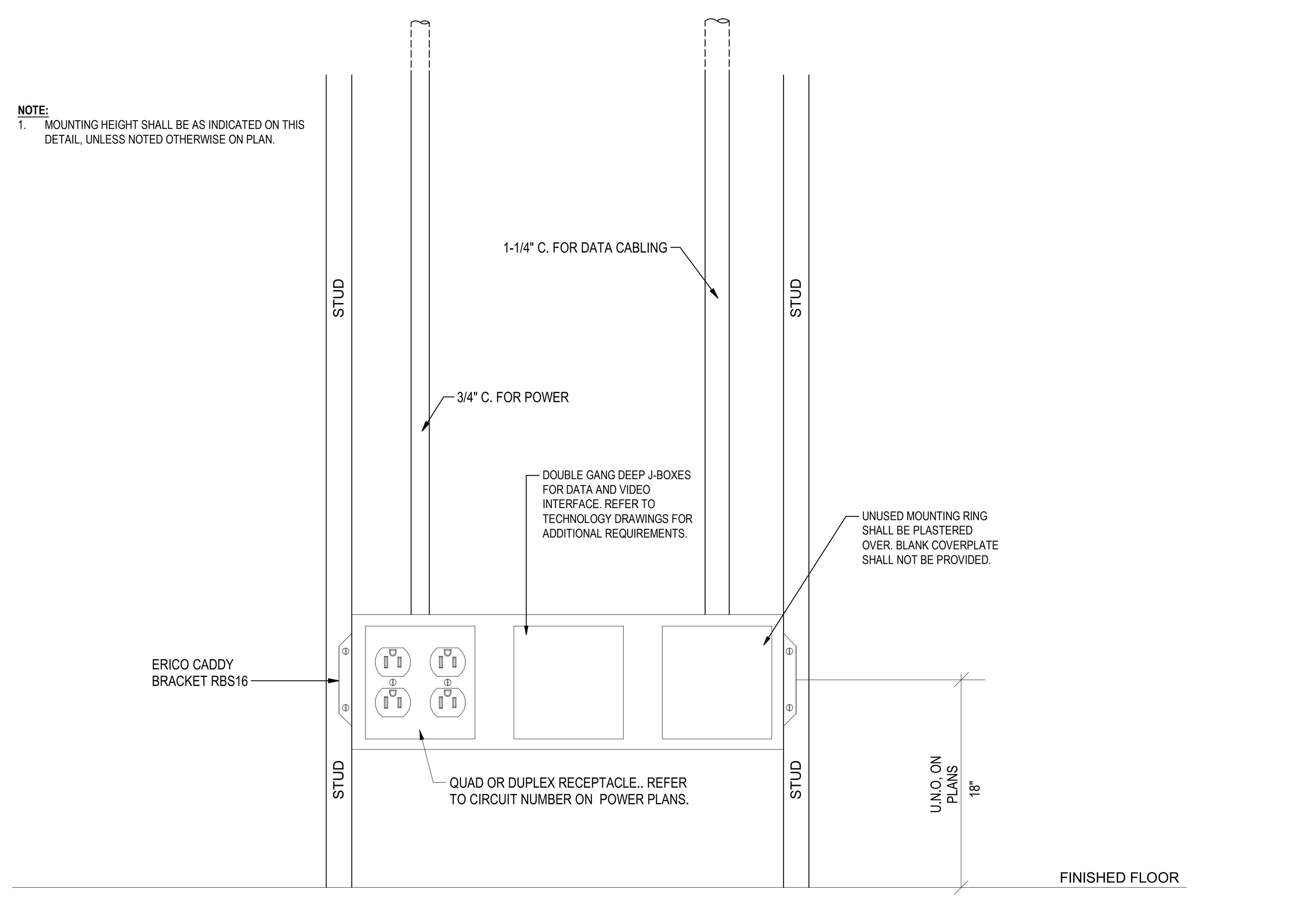


IFP

INTERACTIVE FLAT PANEL DISPLAY ROUGH-IN

SCALE: NONE

NOTE:
1. MOUNTING HEIGHT SHALL BE AS INDICATED ON THIS DETAIL, UNLESS NOTED OTHERWISE ON PLAN.

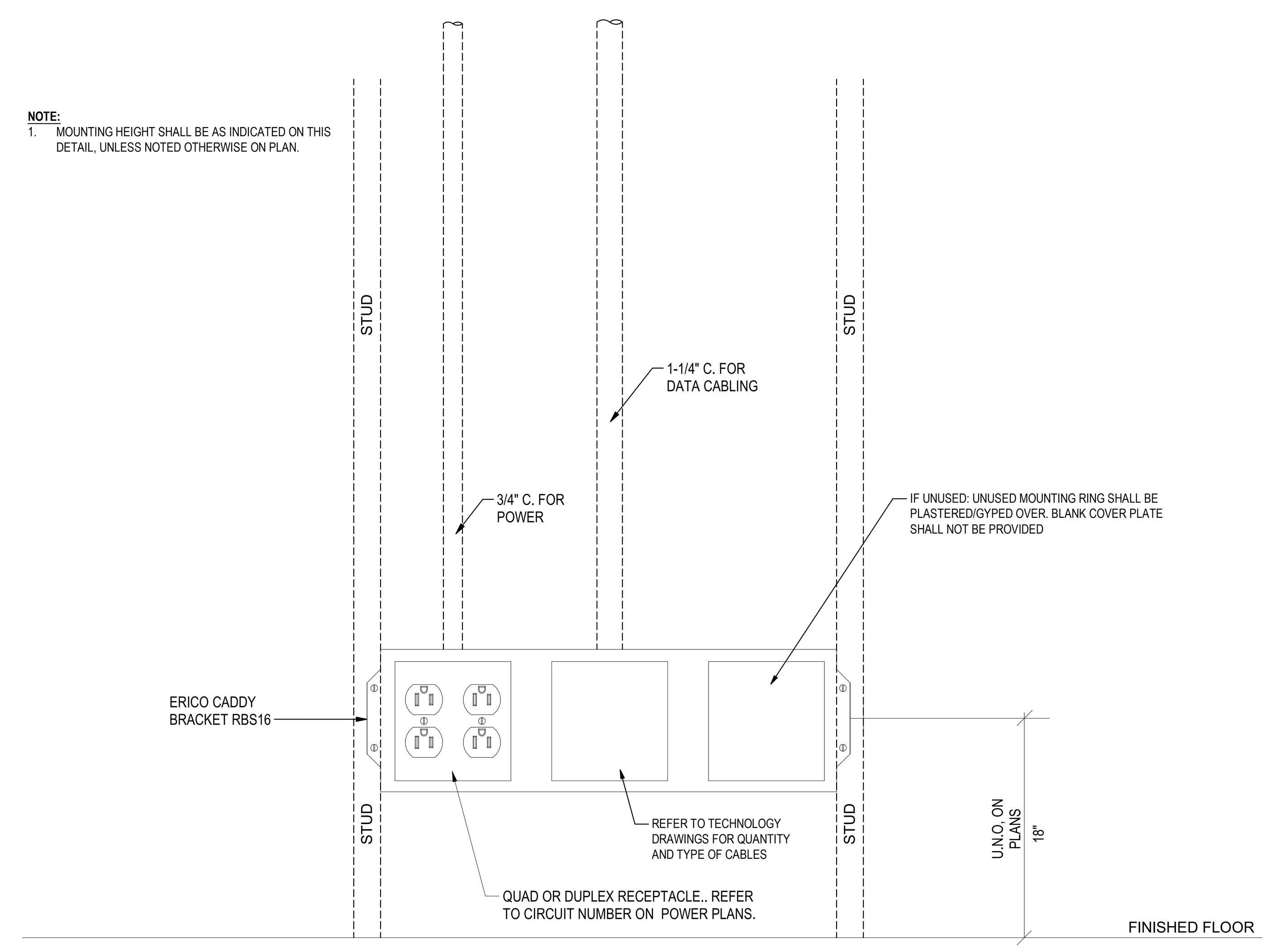


TWS

TEACHER WORKSTATION DETAIL

SCALE: NONE

NOTE:
1. MOUNTING HEIGHT SHALL BE AS INDICATED ON THIS DETAIL, UNLESS NOTED OTHERWISE ON PLAN.



WS1

RECEPTACLE / DATA COMBINATION OUTLET DETAIL

SCALE: NONE

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ELECTRICAL DETAILS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E502

100% CONSTRUCTION DOCUMENTS

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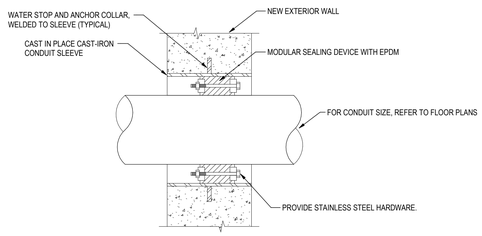
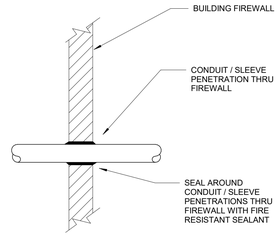
BLACK
WHITE

6/23/2023 2:20:13 PM
Autodesk Docs://220116_LSD - Mt HOPE/stn_i_elec_214100605_Mount_Hope_R22.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



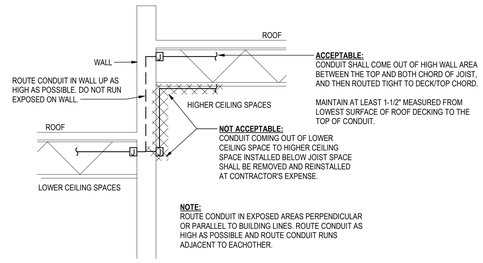
CONDUIT PENETRATION THROUGH EXTERIOR WALL DETAIL

SCALE: NONE



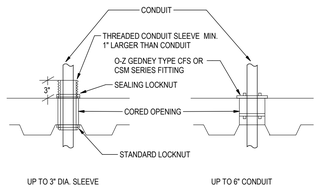
CONDUIT / SLEEVE FIREWALL PENETRATION DETAIL

SCALE: NONE



EXPOSED CONDUIT ROUTING DETAIL

SCALE: NONE



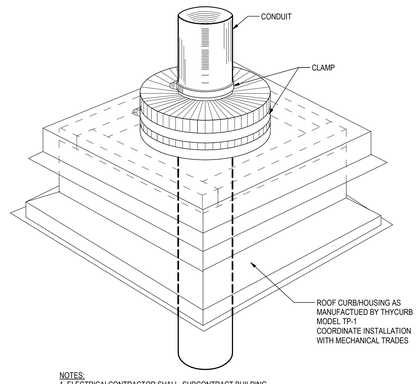
USE EITHER OPTION AS APPROPRIATE:

1. PENETRATION SHALL BE FIRE RATED WHEN PASSING THROUGH FIRE RATED FLOORS. USE FIRESTOP OR FIRE RATED FITTINGS (CFS).

2. CAST IN PLACE CONDUIT SLEEVES SHALL BE USED WHERE POSSIBLE TO LOCATED PENETRATIONS PRIOR TO FLOOR BEING POURED. TO MINIMIZE CUTTING OF REINFORCING STEEL IN FLOOR, UTILIZE CORED OPENINGS ONLY WHEN NECESSARY.

TYPICAL CONDUIT PENETRATION THROUGH CORED OPENINGS

SCALE: NONE

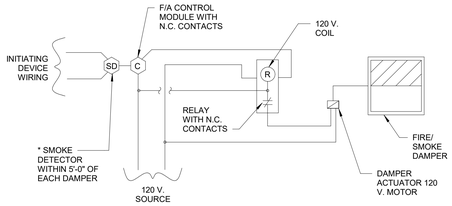


NOTES:
1. ELECTRICALCONTRACTOR SHALL SUBCONTRACT BUILDING ROOF CONTRACTOR FOR INSTALLATION OF FLASHING.

CONDUIT ROOF PENETRATION DETAIL

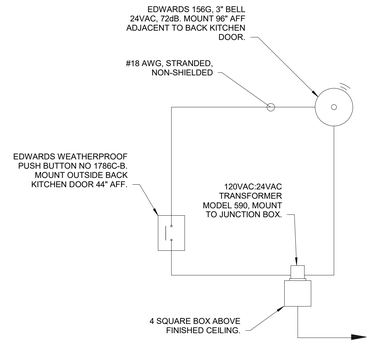
SCALE: NONE

NOTE:
1. DIVISION 26 CONTRACTOR SHALL COORDINATE WITH DIVISION 23 CONTRACTORS AND PROVIDE SMOKE DETECTOR, CONTROL MODULE, RELAY, 120 VOLT CIRCUIT AND WIRING. SEE MECHANICAL DRAWINGS FOR EXACT QUANTITY AND LOCATION. 120 VOLT CIRCUIT SHALL BE FROM 1P-20A, 120V CIRCUIT IN CORRIDOR TO CONTROLS. REFERENCE MECHANICAL/PLUMBING EQUIPMENT CONNECTION NOTES ON E002.
2. GENERAL CONTRACTOR MAY ASSIGN THE ABOVE WORK TO EACH DIVISION AS DESIRED. HE SHALL BE REQUIRED TO PROVIDE A COMPLETE, OPERATING FIRE MARSHAL APPROVED SYSTEM.
3. * WITH FULL COVERAGE SMOKE DETECTION & APPROVAL FROM FIRE MARSHALL THIS REQUIREMENT MAY BE DELETED AND DAMPER MAY BE CONTROLLED BY AN ALTERNATE SMOKE DETECTOR, LOCATION.



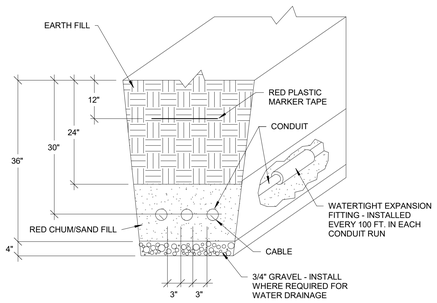
FIRE/SMOKE DAMPER WIRING DETIAL

SCALE: NONE



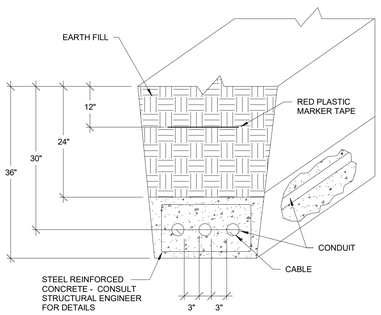
BACK DOORBELL WIRING SCHEMATIC

SCALE: NONE



INSTALLATION OF UNDERGROUND CONDUITS

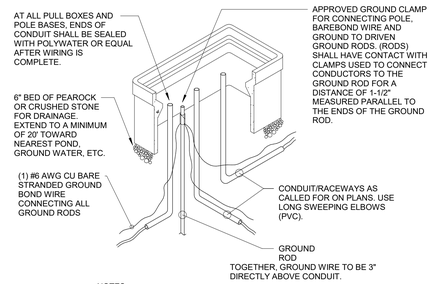
SCALE: NONE



NOTES
FOR MAIN SERVICE LATERAL CONDUCTORS

INSTALLATION OF CONCRETE ENCASED UNDERGROUND CONDUITS

SCALE: NONE



NOTES
1. CONDUITS NOT TERMINATED IN OR AT PULLBOXES NEED TO RUN THROUGH PULLBOXES UNLESS REQUIRED FOR PULLING NEC.
2. INSIDE DIMENSIONS TO BE: 10-1/2" x 17-1/4"; 13" x 24"; 17" x 28".
3. COVER TO BE PROVIDED: CAST IRON TRAFFIC COVER, CONCRETE PEDESTRIAN COVER.
4. PROVIDE EXTENSIONS AS REQUIRED.
5. PULLBOX TO BE PRECAST; BROOKS, A.C. MILLER, OR HUGHES SUPPLY.

ELECTRICAL PULL BOX DETAIL

SCALE: NONE

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ELECTRICAL DETAILS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E503

100% CONSTRUCTION DOCUMENTS

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
6/23/2023 2:09:15 PM
Autodesk Docs://220116_LSD - Mt HOPE\Mt_Hope_R22.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

WE RECYCLE
THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE BLACK

LUMINAIRE SCHEDULE

TYPE	DESCRIPTION	MOUNTING	MANUFACTURER #1 (COOPER LIGHTING)	MANUFACTURER #2 (GASSER BUSH)	LAMP TYPE	LAMP LUMENS	LAMP CRI	LAMP COLOR	LAMP FINISH	LAMP DISTRIBUTION/LENSING	INPUT WATTS	INPUT VOLTS	COMMENTS/NOTES
LA	2'X4' LED FLAT PANEL	RECESSED	COOPER: METALUX 24FP	LLITHONIA:	LED	4800	85+	4000K	MATTE DIFFUSE	WIDE DISTRIBUTION	13	UNV	
LA2	2'X2' LED FLAT PANEL	RECESSED	COOPER: METALUX 24FP	LLITHONIA:	LED	3000	85+	4000K	MATTE DIFFUSE	WIDE DISTRIBUTION	13	UNV	
LB	2'X4' LED ARCHITECTURAL VOLUMETRIC TROFFER	RECESSED	COOPER: 24RTC	LITHONIA: 2BLT4	LED	4800	85+	4000K		SMOOTH ACRYLIC CURVED LENS	34.5	UNV	HIGH EFFICIENCY FIXTURE
LD1	4" SQUARE DOWNLIGHT LED	RECESSED	COOPER: PORTFOLIO LDSQ4	GOTHAM:EVO SQ	LED	2000	85+	4000K		WIDE DISTRIBUTION	15	UNV	PROVIDE WITH WET LOCATION LISTING
LD2	4" SQUARE DOWNLIGHT LED ADJUSTABLE SLOPE	RECESSED	COOPER: PORTFOLIO LDSQA4A 4L	GOTHAM: INCITO ICO4SQADJ	LED	2000		4000K		WIDE DISTRIBUTION			
LG	2'X2' HIGH BAY, HIGH EFFICACY LED	PENDANT	METALUX OHB	HOLOPHANE: PHZ	LED	24000	80	4000K		WIDE DISTRIBUTION	170	UNV	FIXTURE SHALL BE MOUNTED UNIFORMLY AT 24'-0" AFF. PROVIDE WITH INTEGRAL OCCUPANCY SENSOR
LK	2'X4' GENERAL PURPOSE LENSED LED TROFFER	RECESSED	COOPER: 24GR LED	LITHONIA: 2TL4	LED	7200	85+	4000K		SATIN WHITE LENS	67	UNV	LENS SHALL BE MINIMUM 0.125 INCH THICK TO PREVENT SAGGING. INVERT LENS IN FIXTURE IF THERE ARE TEXTURED PRISMS ON LENS TO ENSURE THAT THE SMOOTH FACE IS FACING THE SPACE.
LL4	4" WIDE, 4' LONG RECESSED LINEAR LOW LUMEN FIXTURE	RECESSED	COOPER: NEO-RAY DEFINE 4	PRUDENTIAL: P43	LED	450 LM/FT	85+	4000K			4.5 W/FT	UNV	
LLC	4" WIDE, CONTINUOUS LINEAR LED FIXTURE	PENDANT	AXIS LIGHTING: BEAM 4	FOCAL POINT: SEEM 4	LED	1200LM/FT UP/1200LM/FT DOWN	85+	4000K		WIDE DISTRIBUTION		UNV	PROVIDE WITH INTEGRAL OCCUPANCY AND DAYLIGHT SENSORS
LLD	CURVED WAVESTREAM DIRECT / INDIRECT	PENDANT	NEO-RAY CONVERGE										
LP	LED SUSPENDED DIRECT / INDIRECT	PENDANT	CORELITE JAYLUM - J3		LED	4000	85+	4000K	WHITE				PROVIDE WITH INTEGRAL OCCUPANCY AND DAYLIGHT SENSORS
LR	PENDANT RING LED	PENDANT	COOPER: SHAPER SENSE CIRCLE	LITHONIA EQUAL	LED	8000	85+	4000K		SATIN ROUND LENS	41	UNV	
LT	GENERAL PURPOSE 4' LENSED LED STRIPLIGHT	PENDANT	COOPER: METALUX 4SNLED	LITHONIA: ZL1D	LED	5000	85+	4000K		SATIN ROUND LENS	41	UNV	
LW	GENERAL PURPOSE 4' LENSED LED STRIPLIGHT	WALL MOUNTED	METALUX SWLED	LITHONIA EQUAL	LED	675 LM/FT	85+	4000K			7 W/FT	UNV	PROVIDE WITH INTEGRAL OCCUPANCY SENSOR. REFEER TO FLOOR PLANS FOR MOUNTING HEIGHT
OA	WALL SURFACE, 4' LONG DUAL DRIVER, 2.5"X2.5" SQUARE PROFILE, MULLION MOUNTED LINEAR EXTERIOR FIXTURE	MULLION MOUNTED	COOPER LIGHTING EQUAL	LITHONIA: WSR	LED	197 LM/FT	N/A	4000K	BLACK	TYPE III	60W	UNV	CONTRACTOR SHALL MOUNT LINEAR FIXTURES TIGHT TO LOWER MULLION OF CURTAIN WALL AND PROVIDE ALL ACCESSORIES REQUIRED TO MOUNT FIXTURE TO MULLION. FIXTURE SHALL BE PROVIDED WITH ADJUSTABLE MOUNTING BRACKETS TO ALLOW FOR AIMING AFTER INSTALLATION. FIXTURES TO BE INSTALLED END-TO-END TO ALLOW FOR NO SHADOWS BETWEEN UNITS. ROUTE POWER UTILIZING MC CABLE WITHIN AND CONCEALED IN MULLION. FIXTURE SHALL BE PROVIDED WITH GLARE SHIELD TO PREVENT OCCUPANTS IN ADJACENT SPACE FROM SEEING LED LAMPS. CONTRACTOR SHALL AIM FIXTURES SO THAT LIGHTING IS DIRECTED AT UPPER FACADE SURFACE.
OB	EXTERIOR TRAPEZOIDAL LED WALL PACK	WALL MOUNTED	COOPER: IST	LITHONIA: WST	LED	3000	85+	4000K		WIDE DISTRIBUTION	25	UNV	WET LOCATION LISTED. MOUNT FIXTURE AT 12' 9" ABOVE GRADE UNLESS OTHERWISE NOTED.
X1	EDGE-LIT LED ACRYLIC EMERGENCY EXIT SIGN	CEILING MOUNTED	COOPER: SURE-LITES EUX	LITHONIA: EDG-EDGR	GREEN LED	N/A	85+	N/A		ACRYLIC EMERGENCY EXIT SIGN	3	UNV	BOTH SINGLE AND DOUBLE FACED EXIT SIGNS ARE REQUIRED ON THE PROJECT. THE CONTRACTOR SHALL REFERENCE THE LIGHTING SYMBOL LEGEND ON E001 AND UTILIZE THE LEGEND AND FLOOR PLANS TO DETERMINE THE EXACT NUMBER OF SINGLE AND DOUBLE FACED SIGNS REQUIRED.
X2	EDGE-LIT LED ACRYLIC EMERGENCY EXIT SIGN	WALL MOUNTED - FACE	COOPER: SURE-LITES EUX	LITHONIA: EDG-EDGR	GREEN LED	N/A	85+	N/A		ACRYLIC EMERGENCY EXIT SIGN	3	UNV	BOTH SINGLE AND DOUBLE FACED EXIT SIGNS ARE REQUIRED ON THE PROJECT. THE CONTRACTOR SHALL REFERENCE THE LIGHTING SYMBOL LEGEND ON E001 AND UTILIZE THE LEGEND AND FLOOR PLANS TO DETERMINE THE EXACT NUMBER OF SINGLE AND DOUBLE FACED SIGNS REQUIRED.
X3	EDGE-LIT LED ACRYLIC EMERGENCY EXIT SIGN	WALL MOUNTED - SIDEWALL	COOPER: SURE-LITES EUX	LITHONIA: EDG-EDGR	GREEN LED	N/A	85+	N/A		ACRYLIC EMERGENCY EXIT SIGN	3	UNV	BOTH SINGLE AND DOUBLE FACED EXIT SIGNS ARE REQUIRED ON THE PROJECT. THE CONTRACTOR SHALL REFERENCE THE LIGHTING SYMBOL LEGEND ON E001 AND UTILIZE THE LEGEND AND FLOOR PLANS TO DETERMINE THE EXACT NUMBER OF SINGLE AND DOUBLE FACED SIGNS REQUIRED.

LIGHTING LUMINAIRE SCHEDULE NOTES

GENERAL NOTES

1. FIXTURE FINISH WILL BE SELECTED IN SUBMITTAL PHASE, UNLESS OTHERWISE SPECIFIED.
2. VERIFY MOUNTING AND PROVIDE REQUIRED CHEVERON(S) AS SHOWN ON ELECTRICAL PLANS.
3. PROVIDE ALL LED FIXTURES WITH A MAXIMUM CCT OF 3500 DEGREES KELVIN AND A MINIMUM CRI OF 85 UNLESS OTHERWISE SPECIFIED.
4. CONTRACTOR TO VERIFY SPECIFIED FIXTURE MOUNTING IS COMPATIBLE WITH CEILING TYPE BEFORE ORDERING.
5. CONTRACTOR TO VERIFY MOUNTING HEIGHT WITH ARCHITECT BEFORE INSTALLING.
6. CONTRACTOR TO FIELD VERIFY OVERALL LENGTH BEFORE ORDERING.
7. PROVIDE FIXTURES WITH DIMMING BALLASTS WHERE SHOWN CIRCUITED TO DIMMING CONTROLS. DIMMING BALLASTS TO BE COMPATIBLE WITH OVERALL DIMMING CONTROL SYSTEM.
8. PROVIDE FACTORY CONNECTED ROW-MOUNTED FIXTURE WHERE APPLICABLE.
9. PROVIDE ALL PARKING LOT POLES WITH FIXTURE MONTED PIRH BI-LEVEL MOTION/AMBIENT SENSOR, 15-30' MOUNTING HEIGHT. AMBIENT SENSOR ENABLED AT 5FC FOR LOCAL CONTROL.

LIGHTING CONTROL NARRATIVE

1. ALL LOW VOLTAGE WIRING SHALL BE PLENUM RATED IN ENTIRE PROJECT.
2. ALL LOW VOLTAGE WIRING TERMINATIONS SHALL BE MADE WITHIN A JUNCTION BOX. NO EXPOSED SPLICING PERMITTED.
3. ALL LIGHTING CONTROLS SHALL COMPLY WITH 2013 ASHRAE 90.1.
4. BASIS OF DESIGN IS ACUITY NLIGHT.

SEQUENCE OF OPERATION:

1. RAISE/LOWER = 0-10V DIMMING AND REQUIRES 0-10V WIRING.
2. OCCUPANCY SENSORS ARE ALL DUAL TECHNOLOGY TYPE SET TO 20 MINUTES AUTO OFF/MANUAL ON. EXCEPT WHERE NOTED OTHERWISE BELOW.
3. COORDINATE WITH MECHANICAL SOO AND CONTROLS DIAGRAMS. BAS CONTRACTOR SHALL PROVIDE GRAPHIC INTERFACE WITHIN THE BAS SYSTEM AND MAP ALL LIGHTING CONTROL PANEL CONTROL POINTS TO EASILY ALLOW OWNER TO REVISE SCHEDULING, OCCUPANCY SENSOR ADJUSTMENTS, ETC. THROUGH BAS INTERFACE. PROVIDE ALL REQUIRED LIGHTING CONTROL SYSTEM COMPONENTS TO ALL FOR THIS INTERCONNECTION VIA BACnet COMMUNICATION.
4. LIGHTING WITHIN BUILDING SHALL BE NETWORKED.
5. UPON ACTIVATION OF FIRE ALARM SYSTEM OR SECURITY ALARM SYSTEM, ALL NETWORKED INTERIOR AND EXTERIOR LIGHTING SHALL TURN ON.
6. PROVIDE PHOTOCELL ON ROOF AND AIM NORTH FOR CONTROL OF ALL EXTERIOR LUMINAIRES TIE IN TO RELAY PANEL FOR ACCESS TO NETWORKED CONTROL.
7. PROVIDE OCCUPANCY SENSORS WITH AUXILIARY CONTACT FOR ALL BUILDING SPACES FOR BUILDING AUTOMATION SYSTEM (BAS) TO MONITOR STATUS AND SET BACK HVAC SYSTEM WHEN NOT OCCUPIED.

OFFICES / CONFERENCE:
- a. MANUAL: ON/OFF/RAISE/LOWER LIGHTING CONTROLS FOR EACH RESPECTIVE ZONE.
- b. AUTOMATIC: OCCUPANCY SENSOR SET TO AUTO OFF/MANUAL ON.

CLASSROOMS:
- a. MANUAL: ON/OFF/RAISE/LOWER LIGHTING CONTROLS FOR EACH RESPECTIVE ZONE.
- b. AUTOMATIC: INTEGRAL OCCUPANCY SENSOR SET TO AUTO OFF/MANUAL ON.
- c. DAYLIGHT HARVESTING: AS INDICATED ON FLOOR PLANS FOR DAYLIGHT ZONES.

LARGE VOLUME SPACE (CAFETERIA, MEDIA CENTER, GYM)
- a. MANUAL: ON/OFF/RAISE/LOWER LIGHTING CONTROLS FOR EACH RESPECTIVE ZONE.
- b. AUTOMATIC: OCCUPANCY SENSORS WITH 50% DIMMING WHEN NOT OCCUPIED. MANUAL ON.
- c. DAYLIGHT HARVESTING: AS INDICATED ON FLOOR PLANS FOR DAYLIGHT ZONES.

CORRIDORS / VESTIBULES:
- a. MANUAL: ON/OFF LOW VOLTAGE CONTROL STATION LOCATED IN CORRIDOR NEAR MAIN ENTRY AS INDICATED ON FLOOR PLAN. STATION SHALL HAVE PILOT LIGHT.
- b. DURING BUILDING OPERATION: CONTROL BY TIME SCHEDULE WITH LIGHTING CONTROL PANELS. OCCUPANCY SENSORS WITH 50% DIMMING WHEN NOT OCCUPIED.
- c. AFTER HOURS: OCCUPANCY SENSORS SET TO AUTO 50% ON/AUTO OFF. BE ZONED BY CORRIDOR SECTION WITH MAXIMUMS AS DEFINED BY IECC.
- d. COORDINATE WITH MECHANICAL SEQUENCE OF OPERATIONS AND CONTROLS DIAGRAMS. BAS CONTRACTOR SHALL PROVIDE GRAPHIC INTERFACE WITHIN THE BAS SYSTEM AND MAP ALL LIGHTING CONTROL PANEL CONTROL POINTS TO EASILY ALLOW OWNER TO REVISE SCHEDULING, OCCUPANCY SENSOR ADJUSTMENTS, ETC. THROUGH BAS INTERFACE. PROVIDE ALL REQUIRED LIGHTING CONTROL SYSTEM COMPONENTS TO ALL FOR THIS INTERCONNECTION VIA BACnet COMMUNICATION. LIGHTING SHALL BE CAPABLE OF BEING OVERRIDDEN TO TURN ON LIGHTING DURING OFF HOURS VIA OVERRIDE CONTROL STATION LOCATED NEAR SCHOOL ENTRY.

LARGE RESTROOMS / TOILET ROOMS:
- a. MANUAL: KEY OPERATED LOW VOLTAGE MOMENTARY SWITCH.
- b. AUTOMATIC: DUAL SENSING OCCUPANCY SENSORS WITH FULL COVERAGE TO AVOID LIGHTS SHUTTING OFF WHILE SPACES ARE OCCUPIED. SET TO AUTO ON WITH EITHER SENSING METHOD / AUTO OFF WITH MAX TIMER SETTING AND VACANCY FOR BOTH SENSING METHODS.
- c. DAYLIGHT HARVESTING: NONE.

SMALL TOILET ROOMS:
- a. WALL MOUNTED OCCUPANCY SENSOR SWITCH SET TO AUTO ON / AUTO OFF.
- b. SENSOR SHALL BE LOW VOLTAGE WITH SEPARATE POWER PACKS FOR LIGHTING AND FAN CONTROL WHERE APPLICABLE. REFER TO MECHANICAL SCHEDULES M600 SERIES.

MDF / IDF:
- a. WALL MOUNTED TOGGLE ON / OFF SWITCH.

ELECTRICAL / MECHANICAL:
- a. WALL MOUNTED TOGGLE ON / OFF SWITCH.

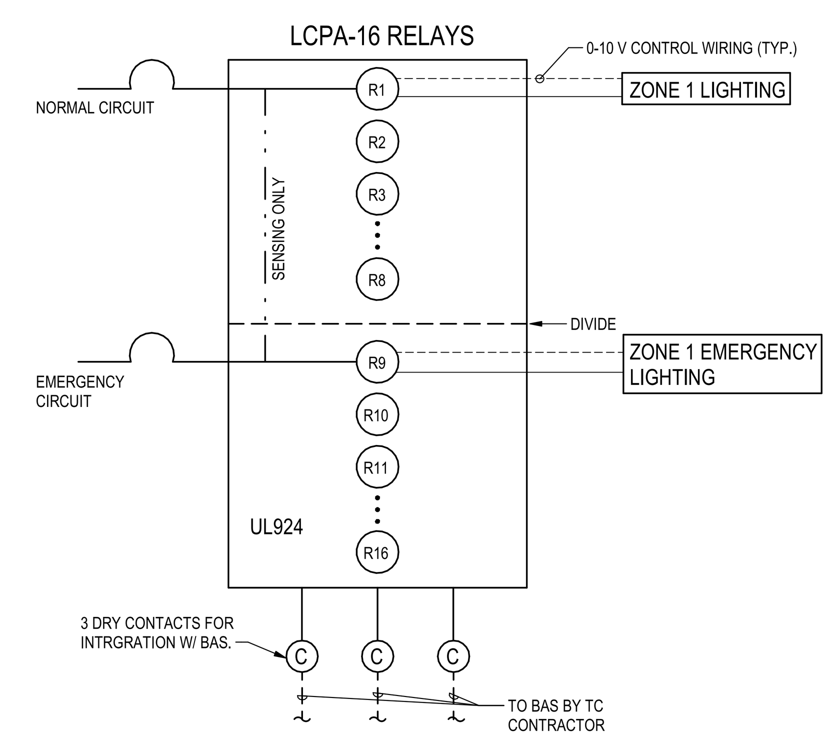
STORAGE / JANITOR CLOSETS:
- a. WALL MOUNTED OCCUPANCY SENSOR SWITCH SET TO AUTO ON / AUTO OFF.

LOUNGE / BREAK ROOM/ WORK ROOM:
- a. MANUAL: ON/OFF/RAISE/LOWER LIGHTING CONTROLS FOR EACH RESPECTIVE ZONE.
- b. AUTOMATIC: OCCUPANCY SENSOR SET TO AUTO OFF / MANUAL ON.

FOOD PREP & KITCHEN AREA:
- a. MANUAL: ON/OFF/RAISE/LOWER LIGHTING CONTROLS FOR EACH RESPECTIVE ZONE.
- b. AUTOMATIC: OCCUPANCY SENSOR SET TO AUTO OFF / AUTO ON.

EXTERIOR BUILDING LIGHTING:
- a. MANUAL: OVERRIDE STATION LOCATED IN ELECTRICAL ROOM ADJACENT TO RESPECTIVE LIGHTING CONTROL PANEL.
- b. AUTOMATIC: CONTROLLED VIA LIGHTING CONTROL RELAYS.
- c. COORDINATE WITH MECHANICAL SOO AND CONTROLS DIAGRAMS. BAS CONTRACTOR SHALL PROVIDE GRAPHIC INTERFACE WITHIN THE BAS SYSTEM AND MAP ALL LIGHTING CONTROL PANEL CONTROL POINTS TO EASILY ALLOW OWNER TO REVISE SCHEDULING, OCCUPANCY SENSOR ADJUSTMENTS, ETC. THROUGH BAS INTERFACE. PROVIDE ALL REQUIRED LIGHTING CONTROL SYSTEM COMPONENTS TO ALL FOR THIS INTERCONNECTION VIA BACnet COMMUNICATION. LIGHTING SHALL BE CAPABLE OF BEING OVERRIDDEN VIA OVERRIDE CONTROL STATION LOCATED ADJACENT TO LIGHTING CONTROL PANEL.

FLAG POLE LIGHTING
- a. MANUAL: OVERRIDE STATION LOCATED IN ELECTRICAL ROOM ADJACENT TO LIGHTING CONTROL PANEL.
- b. AUTOMATIC: PHOTOCELL ON AND TIME-CLOCK OFF
- c. COORDINATE WITH MECHANICAL SOO AND CONTROLS DIAGRAMS. BAS CONTRACTOR SHALL PROVIDE GRAPHIC INTERFACE WITHIN THE BAS SYSTEM AND MAP ALL LIGHTING CONTROL PANEL CONTROL POINTS TO EASILY ALLOW OWNER TO REVISE SCHEDULING, OCCUPANCY SENSOR ADJUSTMENTS, ETC. THROUGH BAS INTERFACE. PROVIDE ALL REQUIRED LIGHTING CONTROL SYSTEM COMPONENTS TO ALL FOR THIS INTERCONNECTION VIA BACnet COMMUNICATION. LIGHTING SHALL BE CAPABLE OF BEING OVERRIDDEN AND CONTROLLED VIA OVERRIDE CONTROL STATION ADJACENT TO LIGHTING CONTROL PANEL.



NOTES:

1. REFER TO SPECIFICAITON 26 09 43 FOR ADDITIONAL REQUIREMENTS.

CORRIDOR LIGHTING CONTROL PANEL

SCALE: NONE

LIGHTING CONTROL PANEL (LCP) - RELAY SCHEDULE

SOURCE CIRCUIT	RELAY #	RELAY TYPE	UL924 (YES/NO)	VOLTAGE	ZONE DESCRIPTION
LP-21	1	DIMMING	NO	277	CORRIDOR LIGHTING
LP-23	2	DIMMING	NO	277	FRONT BUILDING & SOFFIT LIGHTING
LP-25	3	DIMMING	NO	277	SOUTH BUILDING LIGHTING
LP-27	4	DIMMING	NO	277	WEST BUILDING LIGHTING
LP-29	5	DIMMING	NO	277	NORTH BUILDING LIGHTING
LP-31	6	DIMMING	NO	277	FLAG POLE LIGHTING
RP3-21	7	DIMMING	---	120	MARQUEE SIGN LTG
---	8	DIMMING	---	277	SPARE
---	9	DIMMING	---	277	SPARE
LPLS-5	10	DIMMING	YES	277	CORRIDOR LIGHTING
LP-LS-7	11	DIMMING	YES	277	FRONT BUILDING & SOFFIT EGRESS...
LP-LS-9	12	DIMMING	YES	277	WEST AND NORTH EGRESS BUILDING...
---	13	DIMMING	YES	277	SPARE
---	14	DIMMING	YES	277	SPARE
---	15	DIMMING	YES	277	SPARE
---	16	DIMMING	---	277	SPARE

SCHEDULE NOTES:

1. REFER TO SEQUENCE OF OPERATION FOR RELAY CONTROLS REQUIREMENTS.

2. PROVIDE A DIMMING RELAY WHERE INDICATED. EXTEND PHOTOSENSOR TO LIGHTING CONTROLS PANEL (IF APPLICABLE FOR DAYLIGHT HARVESTING) AND ALL 0-10V WIRING TO LED LIGHT FIXTURES FOR DIMMING CONTROLS.

3. EXTEND ALL OCCUPANCY SENSOR WIRING ONLY FROM SPACES CONTROLLED BY RELAY PANEL BACK TO RELAY PANEL FOR OCCUPANCY SENSOR INTERFACE PER MANUFACTURER'S REQUIREMENTS.

4. PROVIDE 3 DRY CONTACTS AND INTERCONNECT TO BAS FOR OVERRIDE OF LIGHTING THRU BAS. REFER TO SEQUENCE OF OPERATIONS ON THIS SHEET.

5. WHERE ONE CIRCUIT FEEDS MULTIPLE RELAYS, CIRCUIT SHALL BE ROUTED THROUGH RELAY FOR THAT PARTICULAR ZONE/GROUP.

6. PROVIDE A 4 BUTTON LOW VOLTAGE CONTROLS STATION ADJACENT TO RELAY PANEL IN ELECTRICAL ROOM. EACH BUTTON SHALL BE PROGRAMMED FOR OVERRIDE ON/OFF OF RELAY GROUPING AS DIRECTED BY OWNER DURING STARTUP. LABEL EACH BUTTON BY GROUPING.

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Mt. Hope
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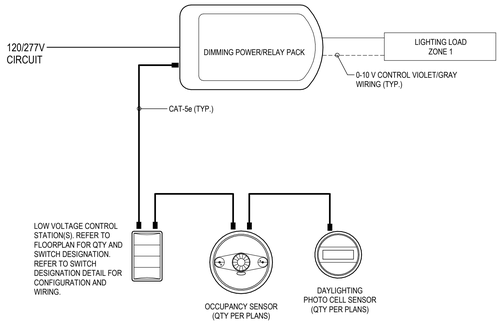
LIGHTING FIXTURE SCHEDULE

REVISIONS
REV | DESCRIPTION | DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E601

100% CONSTRUCTION DOCUMENTS

6/23/2023 2:20:17 PM
Autodesk Docs://220116_LSD - Mt HOPE/stn_i_elec_214100605_Mount_Hope_R22.rvt
DESIGNED BY: EB
CHECKED BY: Checker APPROVED BY: SC

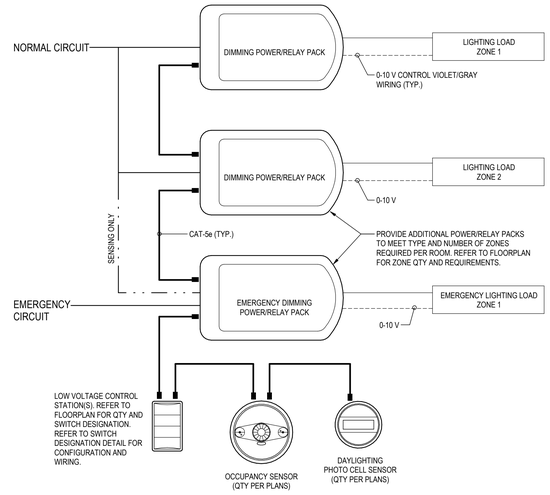


NOTES:

1. REFER TO SPECIFICAITON 26 09 43 FOR SEQUENCE OF OPERATION AND ADDITIONAL REQUIREMENTS.
2. MOUNT PER MANUFACTURERS RECOMMENDATIONS.
3. ADJUST SENSITIVITY AND TIME DELAYS PER OWNER'S DIRECTION.
4. PROVIDE QTY OF OCCUPANCY SENSORS AS REQUIRED FOR OPTIMUM COVERAGE. OCCUPANCY SENSORS SHALL BE DIGITAL TYPE. REFER TO SPECIFICATION 26 09 23 FOR ADDITIONAL INFORMATION.
5. PROVIDE CUSTOM LABELING OF CONTROL STATIONS.
6. PROVIDE PHOTO CELL WHEN APPLICABLE AND SHOWN ON PLANS.

SINGLE ZONE ROOM DIGITAL CONTROLS WIRING DIAGRAM

SCALE: NONE

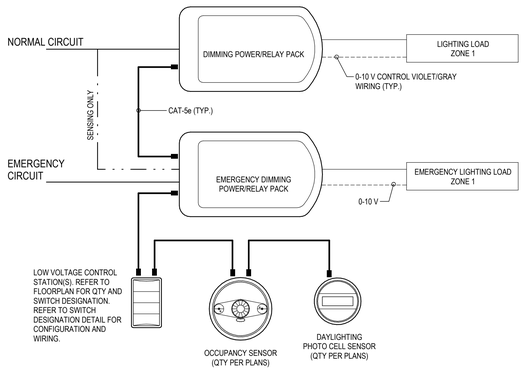


NOTES:

1. REFER TO SPECIFICAITON 26 09 43 FOR ADDITIONAL REQUIREMENTS.
2. MOUNT PER MANUFACTURERS RECOMMENDATIONS.
3. ADJUST SENSITIVITY AND TIME DELAYS PER OWNER'S DIRECTION.
4. PROVIDE QTY OF OCCUPANCY SENSORS AS REQUIRED FOR OPTIMUM COVERAGE.
5. PROVIDE PHOTO CELL WHEN APPLICABLE AND SHOWN ON PLANS.
6. LOW VOLTAGE (0-10V) CABLING SHALL BE ROUTED IN CONDUIT AND RATE EQUAL TO LINE VOLTAGE AS REQUIRED BY NEC.

MULTI-ZONE ROOM WITH EMERGENCY LIGHTING DIGITAL CONTROLS WIRING DIAGRAM

SCALE: NONE

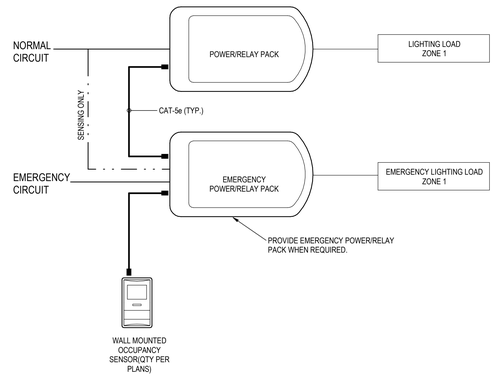


NOTES:

1. REFER TO SPECIFICAITON 26 09 43 FOR ADDITIONAL REQUIREMENTS.
2. MOUNT PER MANUFACTURERS RECOMMENDATIONS.
3. ADJUST SENSITIVITY AND TIME DELAYS PER OWNER'S DIRECTION.
4. PROVIDE QTY OF OCCUPANCY SENSORS AS REQUIRED FOR OPTIMUM COVERAGE.
5. PROVIDE PHOTO CELL WHEN APPLICABLE AND SHOWN ON PLANS.
6. LOW VOLTAGE (0-10V) CABLING SHALL BE ROUTED IN CONDUIT AND RATE EQUAL TO LINE VOLTAGE AS REQUIRED BY NEC.

SINGLE ZONE ROOM WITH EMERGENCY LIGHTING DIGITAL CONTROLS WIRING DIAGRAM

SCALE: NONE



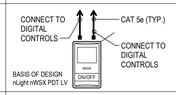
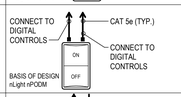
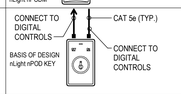
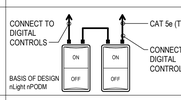
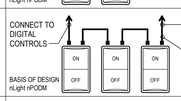
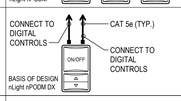
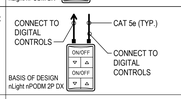
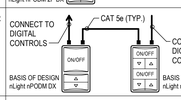
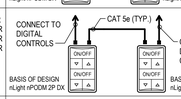
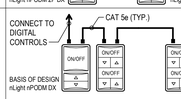
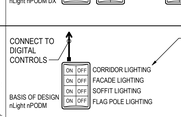
NOTES:

1. REFER TO SPECIFICATON 26 09 43 FOR ADDITIONAL REQUIREMENTS.
2. MOUNT PER MANUFACTURERS RECOMMENDATIONS.
3. ADJUST SENSITIVITY AND TIME DELAYS PER OWNER'S DIRECTION.
4. PROVIDE QTY OF OCCUPANCY SENSORS AS REQUIRED FOR OPTIMUM COVERAGE.

OCW LIGHTING DIGITAL CONTROLS WIRING DIAGRAM

SCALE: NONE

LOW VOLTAGE CONTROL STATION SWITCH DESIGNATION*

TYPE	FUNCTION**	WIRING DIAGRAM
$O	• WALL MOUNTED OCCUPANCY SENSOR • SINGLE ZONE: ON/OFF	
$L1	• SINGLE ZONE: ON/OFF	
$K	• SINGLE ZONE: ON/OFF/RAISE/LOWER	
$L2	• ZONE 1 (Z1): ON/OFF • ZONE 2 (Z2): ON/OFF	
$L3	• ZONE 1 (Z1): ON/OFF • ZONE 2 (Z2): ON/OFF • ZONE 3 (Z3): ON/OFF	
$LD1	• SINGLE ZONE: ON/OFF/RAISE/LOWER	
$LD2	• ZONE 1 (Z1): ON/OFF/RAISE/LOWER • ZONE 2 (Z2): ON/OFF/RAISE/LOWER	
$LD3	• ZONE 1 (Z1): ON/OFF/RAISE/LOWER • ZONE 2 (Z2): ON/OFF/RAISE/LOWER • ZONE 3 (Z3): ON/OFF/RAISE/LOWER	
$LD4	• ZONE 1 (Z1): ON/OFF/RAISE/LOWER • ZONE 2 (Z2): ON/OFF/RAISE/LOWER • ZONE 3 (Z3): ON/OFF/RAISE/LOWER • ZONE 4 (Z4): ON/OFF/RAISE/LOWER	
$LD5	• ZONE 1 (Z1): ON/OFF/RAISE/LOWER • ZONE 2 (Z2): ON/OFF/RAISE/LOWER • ZONE 3 (Z3): ON/OFF/RAISE/LOWER • ZONE 4 (Z4): ON/OFF/RAISE/LOWER • ZONE 5 (Z5): ON/OFF/RAISE/LOWER	
$OR	• ZONE 1 (Z1): ON/OFF • ZONE 2 (Z2): ON/OFF • ZONE 3 (Z3): ON/OFF • ZONE 4 (Z4): ON/OFF • OVERRIDE SWITCH FOR EXTERIOR ZONES AND CORRIDORS. LOCATE IN ELECTRICAL ROOM. PROVIDE LABEL INDICATING CONTROL AREA.	

NOTE:
*CONTRACTOR AND CONTROLS MANUFACTURER SHALL REFER TO SHEET E601 FOR SEQUENCE OF OPERATIONS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO SHARE THIS SPECIFICATION WITH THE MANFUCTURER IN ORDER TO PROVIDE COMPREHENSIVE SHOP DRAWING SUBMITTAL FOR REVIEW.

**PROVIDE THE REQUIRED NUMBER OF BUTTONS TO ACHIEVE FUNCTIONALITY FOR EACH ZONE

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LIGHTING CONTROL DETAILS

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E602

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

6/23/2023 2:20:18 PM
Autodesk Docs://220116_LSD_MtHOPE/Ph_I_eMc_214100905_Mount_Hope_R22.rvt
DESIGNED BY: EB
CHECKED BY: Chase APPROVED BY: SC

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE

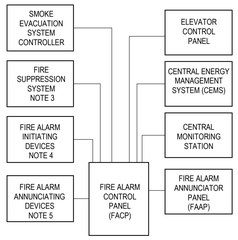
THE RECYCLE

SYSTEM OUTPUTS

SYSTEM INPUTS		FIRE ALARM EVACUATION SIGNAL															SIGNAL INITIATION							
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1	MANUAL PULL STATION	●	●	●	●	●	●			●		●		●	●		●			●		●		
2	SMOKE DETECTOR IN THE ATRIUM & COMMUNICATING SPACES	●	●	●	●	●	●			●		●	●	●	●	●	●	●	●	●		●		
3	SMOKE DETECTOR OTHER THAN THE ATRIUM	●	●	●	●	●	●			●		●	●	●	●		●	●	●	●		●		
4	DUCT DETECTORS	●	●	●	●	●	●			●		●	●	●	●		●			●		●		
5	HEAT DETECTORS	●	●	●	●	●	●			●		●		●	●		●			●		●		
6	WATERFLOW ALARM	●	●	●	●	●	●			●		●	●	●	●		●	●		●		●		
7	SPRINKLER SUPERVISORY ALARM			●										●	●			●						
8	GENERATOR RUNNING			●														●						
9	GENRATOR FAILURE TO START			●														●	●					
10	GENERATOR COMMON ALARM			●														●	●					
11	FIRE ALARM AC POWER FAILURE			●														●	●					
12	FIRE ALARM SYSTEM LOW BATTERY			●														●	●					
13	OPEN CIRCUIT																		●					
14	GROUND FAULT																		●					
15	NOTIFICATION APPLIANCE SHORT CIRCUIT																		●					
16	ABNORMAL AC VOLTAGE																		●					
17	BREAK IN STANDBY BATTERY CIRCUITRY																		●					
18	FAILURE OF BATTERY CHARGING																		●					
19	ABNORMAL SWITCH POSITION IN FACP																		●					
20	DIRTY SMOKE DETECTOR																		●					
21	DIRTY HEAT DETECTOR																		●					
22	OPERATION OF KITCHEN HOOD SUPPRESSION SYSTEM			●														●						
23	SYSTEM TROUBLE																		●					
24	OPERATION OF TAMPER SWITCH VALVE			●														●						
25	WATER FLOW IN ELEVATOR SHAFT			●														●			●			
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	

● DENOTES PART OF STANDARD SYSTEMS
ALARM, SUPERVISORY AND TROUBLE SHALL ANNUNCIATE AT THE FACP AND FAA.

FIRE ALARM MATRIX



NOTES:

1. REFER TO THE FIRE ALARM MATRIX.
2. COORDINATE WITH SUPPRESSION SUPPLIER. MAKE CONNECTION TO EACH ALARM INITIATING AND SUPERVISION DEVICES.
3. MAKE CONNECTION TO EACH FIRE ALARM INITIATING DEVICE. SEE THE FIRE ALARM MATRIX AND REFER TO THE PLANS AND SPECIFICATION.
4. MAKE CONNECTION TO EACH FIRE ALARM ANNUNCIATING DEVICE. SEE THE FIRE ALARM MATRIX AND REFER TO THE PLANS AND SPECIFICATION. PROVIDE ADDITIONAL POWER SUPPLIES AS REQUIRED.

FIRE ALARM SYSTEM CONFIGURATION

SCALE: NONE

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FIRE ALARM RISERS AND DIAGRAM

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
E611

100% CONSTRUCTION DOCUMENTS

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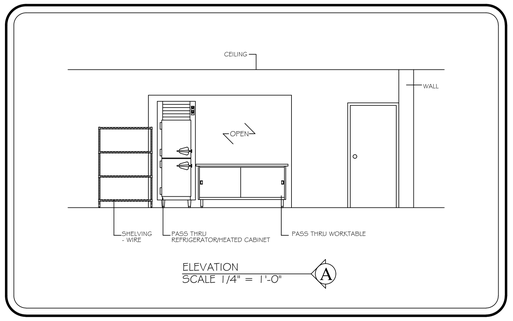
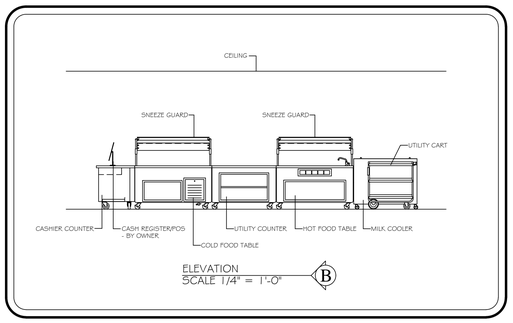
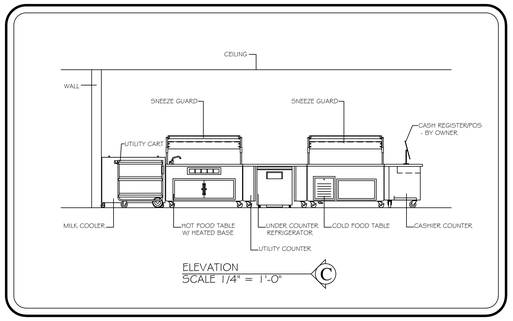
DESIGNED BY: DDNH
CHECKED BY: KC APPROVED BY: Approver



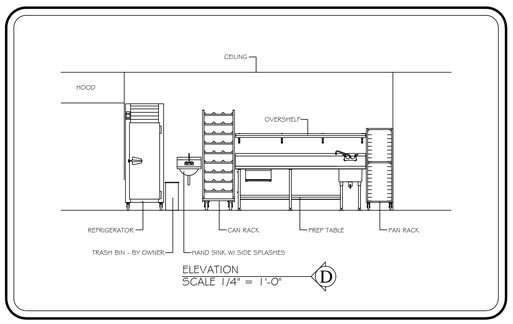
ELEVATION
SCALE 1/4" = 1'-0" (A)



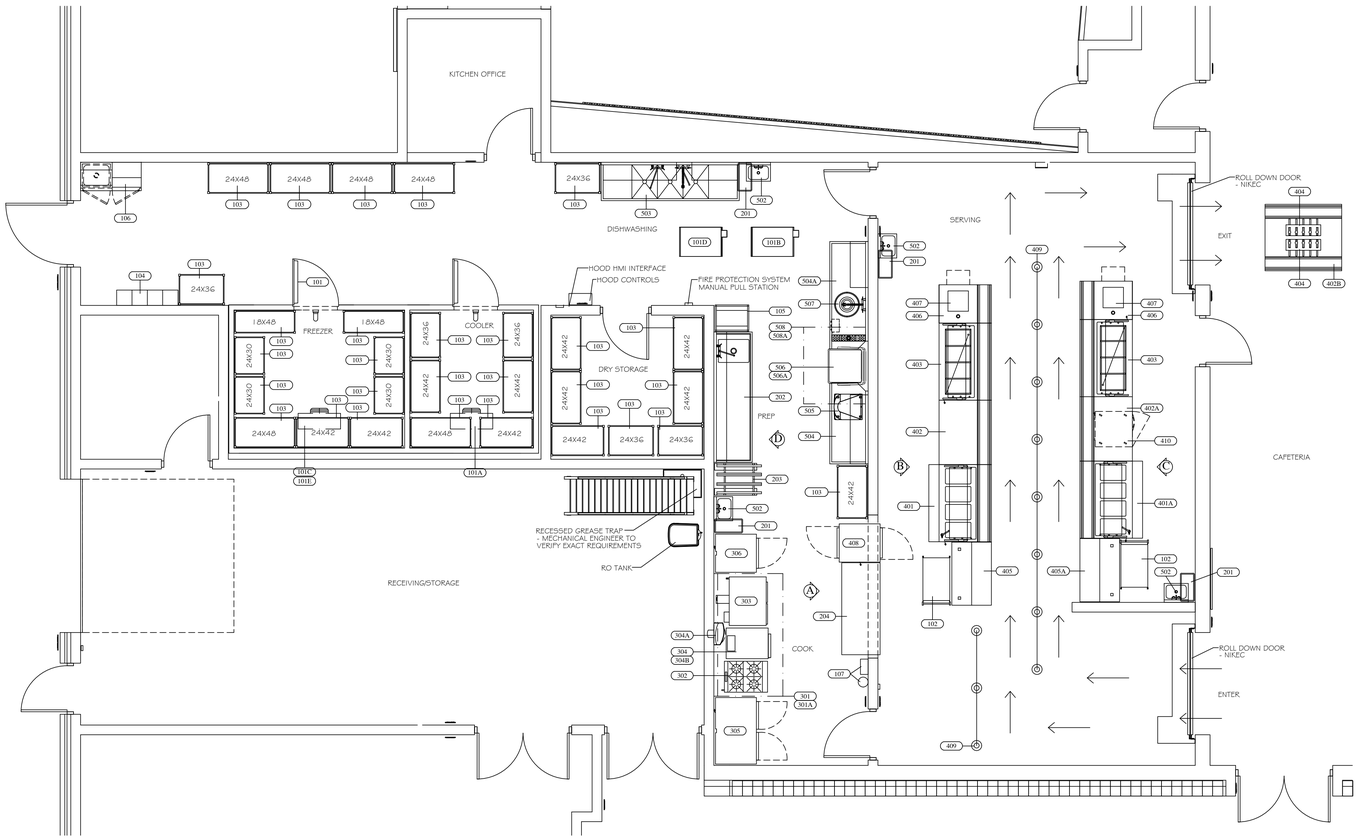
ELEVATION
SCALE 1/4" = 1'-0" (B)



ELEVATION
SCALE 1/4" = 1'-0" (C)



ELEVATION
SCALE 1/4" = 1'-0" (D)



FOODSERVICE DESIGN BY:

JRA
Food Service Consultants
JRA FOOD SERVICE CONSULTANTS, LLC
401 HALL STREET SW - SUITE 185H
GRAND RAPIDS, MI 49503
PH: (616) 454-4433

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FOOD SERVICE EQUIPMENT FLOOR PLAN
SCALE 1/4" = 1'-0"

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
FSE-1

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WHITE
WE RECYCLE

12/8/2022 12:50:41 PM
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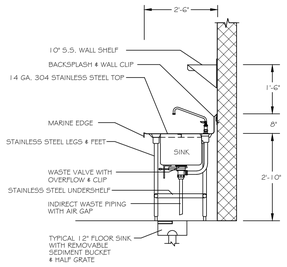
DESIGNED BY: CM
CHECKED BY: JR
APPROVED BY: JR

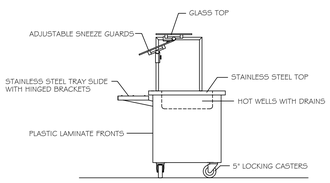


TYPICAL PREP TABLE SECTION - ITEM #202

SCALE: 1/2" = 1'-0"

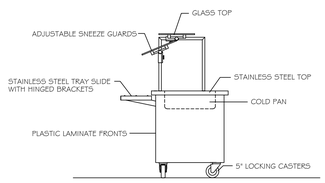
EQUIPMENT SCHEDULE

Item	Qty	DESCRIPTION	CW (in)	HW (in)	INDIRECT DRAIN	DIRECT DRAIN (IN)	GAS (in)	MBTUH	EXH DUCT	EXH CFM	MUA DUCT	MUA CFM	Volts	Ph	Amps load	Equipment Remarks
101	1	WALK-IN COOLER/FREEZER											120	1	(2) 8.0	INSULATED FLOOR: SEE REFRIGERATION PLAN
101A	1	COOLER COIL			FFD								120	1	5.0	
101B	1	COOLER COMPRESSOR											208	3	10.0	ROOF CURBS BY FSEC
101C	1	FREEZER COIL			FFD								208	1	15.0	
101D	1	FREEZER COMPRESSOR											208	3	15.0	ROOF CURBS BY FSEC
101E	1	FREEZER COIL HEAT TAPE											120	1	5.0	
102	2	UTILITY CART														
103	29	SHELVING - POLYMER														
104	1	LOCKERS - NIKEC														
105	1	PAN RACK														
106	1	MOP SINK CABINET	0.5	0.5		2										
107	1	FIRE PROTECTION SYSTEM											120	1	10.0	GAS SHUT OFF VALVE BY FSEC
201	4	TRASH BIN - BY OWNER														
202	1	PREP TABLE	0.5	0.5	FL SK											
203	1	CAN RACK														
204	1	PASS THRU WORKTABLE														
301	1	HOOD							14" X 15"				120	1	10.0	WIRE LIGHTS & HEAT SENSOR
301A	1	EXHAUST FAN & CURB - NIKEC								2,200						
302	1	RANGE - FOUR BURNER					0.75	177								
303	1	CONVECTION OVEN - DOUBLE DECK					(2) 0.75	90					120	1	(2) 8.9	
304	1	STEAMER	(2) 0.5		FL SK		0.75	125					120	1	2.0	PIPE CW THRU RO SYSTEM THEN TO STEAMER
304A	1	REVERSE OSMOSIS SYSTEM	0.5		FL SK											PIPE CW THRU RO SYSTEM THEN TO STEAMER
304B	1	DRAIN WATER TEMPERING KIT	0.5		FL SK											TRADES TO INSTALL
305	1	FREEZER											120	1	11.2	
306	1	REFRIGERATOR											120	1	4.9	
401	1	HOT FOOD TABLE		0.5	FL SK								208	1	20.4	
401A	1	HOT FOOD TABLE W/ HEATED BASE		0.5	FL SK								208	1	20.4	
402	1	UTILITY COUNTER														
402A	1	UTILITY COUNTER														
402B	1	CONDIMENT COUNTER														
403	2	COLD FOOD TABLE			FL SK								120	1	9.5	
404	2	CONDIMENT DISPENSER														
405	1	MILK COOLER											120	1	3.0	
405A	1	MILK COOLER											120	1	3.0	
406	2	CASHIER COUNTER														
407	2	CASH REGISTER/POS - BY OWNER											120	1	10.0	DEDICATED CIRCUIT & DATA
408	1	PASS THRU REFRIGERATOR/HEATED CABINET											120/208	1	11.0	
409	2	PORTABLE CROWD CONTROL BARRIER														
410	1	UNDER COUNTER REFRIGERATOR											120	1	2.0	
501	1	SPARE NUMBER														
502	4	HAND SINK W/ SIDE SPLASHES	0.5	0.5		1.5										SOAP & TOWEL DISPENSER - BY OWNER
503	1	POT SINK	(2) 0.5	(2) 0.5	FL SK	2										PIPE 2" DIRECT WASTE TO GREASE TRAP
504	1	CLEAN DISHTABLE														S.S. UNDERSHELF
504A	1	SOILED DISHTABLE			FL SK											
505	1	WATER SOFTENER & FILTRATION		0.5	FL SK											
506	1	DISHWASHER & BOOSTER HEATER		0.75	FL SK								208	3	45.4	45 GPH 120° HW
506A	1	DRAIN WATER TEMPERING KIT	0.5		FL SK								120	1	5.0	TRADES TO INSTALL
507	1	DISPOSAL	0.75	0.5		2							208	3	6.6	
508	1	DISHWASHER HOOD							8" X 8"							S.S. DUCT BY FSEC
508A	1	EXHAUST FAN - NIKEC								600						ROOF CURB NIKEC



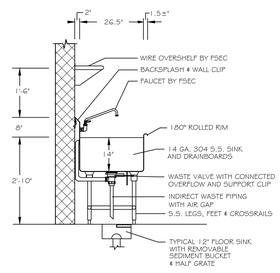
TYPICAL HOT FOOD TABLE SECTION - ITEM #401

SCALE: 1/2" = 1'-0"



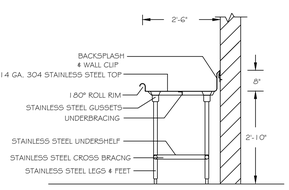
TYPICAL COLD FOOD TABLE SECTION - ITEM #403

SCALE: 1/2" = 1'-0"



TYPICAL POT SINK SECTION - ITEM #503

SCALE: 1/2" = 1'-0"



TYPICAL CLEAN DISHTABLE SECTION - ITEM #504

SCALE: 1/2" = 1'-0"

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FOOD SERVICE EQUIPMENT SCHEDULE
SCALE 1/4" = 1'-0"

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
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SHEET
FSE-2

100% CONSTRUCTION DOCUMENTS

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WHITE
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DESIGNED BY: CM
CHECKED BY: JR
APPROVED BY: JR

TRADE & FSEC NOTES:

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2. DO NOT ROUGH-IN FROM THIS DRAWING. REFER TO F.S.E.C. DIMENSIONED ROUGH-IN DRAWINGS AND SHOP DRAWINGS FOR ACTUAL REQUIREMENTS.
3. TRADES SHALL MAKE ALL FINAL CONNECTIONS BETWEEN EQUIPMENT AND ROUGH-IN POINT, AND FURNISH ALL WIRING, SWITCHES, CONTROLS, SERVICE VALVES, PIPING, ETC AS REQUIRED. FSEC SHALL FURNISH DRAIN WATER TEMPERING KIT(S), TRADES SHALL INSTALL.
4. FSEC SHALL FURNISH AND TRADES SHALL INSTALL ALL ACCESSORIES (FAUCETS, SWITCHES, CORDS, VALVES, GAS HOSES, ETC.).
5. SLOPES TO FDS SHOULD BE HELD TO A MINIMUM DIMENSION.
6. ALL "ROUGH-INS" SHOULD BE "UP-WITHIN" AND THEN "OUT-OF" WALLS WHERE POSSIBLE TO KEEP FLOORS AS CLEAN AS POSSIBLE. ROUGH-INS ARE SHOWN AT TERMINATION POINT TO ALLOW WIRING/PIPING TO FIXTURE BY TRADES.
7. TRADES TO PROVIDE CHASES/REWORK OF WALLS, FLOORS, CEILINGS FOR UTILITIES, FLOOR GRATES, WALKINS, DUCTS, ETC.
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9. TRADES SHALL PROVIDE VENTILATION STRUCTURAL SUPPORT, CEILING WORK, ROOF PENETRATIONS AND FIRE PROOFING AS REQUIRED.
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21. TRADES & FSEC TO VERIFY VENTILATION DATA WITH HOOD MFG. SHOP DRAWINGS.

MECHANICAL / ELECTRICAL NOTES

		120 V - 20 AMP DUPLEX RECEPTACLE - GFIC VERTICALLY MOUNTED
		120 V - 20 AMP SIMPLEX OUTLET - GFIC VERTICALLY MOUNTED
		120 VOLT - 30 AMP QUAD OUTLET
	SR	SPECIAL RECEPTACLE - 120 VOLT
	SR	SPECIAL RECEPTACLE - 208/240 VOLT
		W.T. FLUSH FLOOR POWER/COMMUNICATIONS RECEPTACLE
		DATA CONNECTION
		WATERTIGHT FLUSH FLOOR DUPLEX - 20 AMP - GFIC
JB	JB	JUNCTION BOX
	LT	LIGHT FIXTURE
	A	AMPS
	AFF	ABOVE FINISHED FLOOR
	BTC	BRANCH TO CONNECTION BY TRADES
	DFA	DROP FROM ABOVE
	GP	GENERAL PURPOSE
	HP	HORSEPOWER
	IW	INDIRECT/AIR GAPPED WASTE TO FL DR OR FL SK
	KW	KILOWATT
	PH	PHASE
	UON	UNLESS OTHERWISE NOTED
	VIF	VERIFY IN FIELD
	V	VOLTS
	HW	HOT WATER - 25 PSI - 115 DEGREES
	CW	COLD WATER - 25 PSI
	G	NATURAL GAS - 7" W.C. OR LP GAS - 11" W.C. - VIF
	W	WASTE DRAIN - DIRECT CONNECTION
	FD	FLOOR DRAIN - 3" MINIMUM DRAIN - MINIMUM PITCH
	FFD	FUNNEL FLOOR DRAIN FOR IW - 3" MINIMUM DRAIN
	FL SK	FLOOR SINK FOR IW - 12" SQ. - HALF GRATE - 3" MIN.
	EVC	EXHAUST VENT CONNECTION
	MUA	MAKE UP AIR DUCT CONNECTION
	CFM	CUBIC FEET MINUTE
	SP	STATIC PRESSURE
	BC	BEVERAGE CONDUIT WITH 18" SWEEP ENDS BY TRADES - VIF
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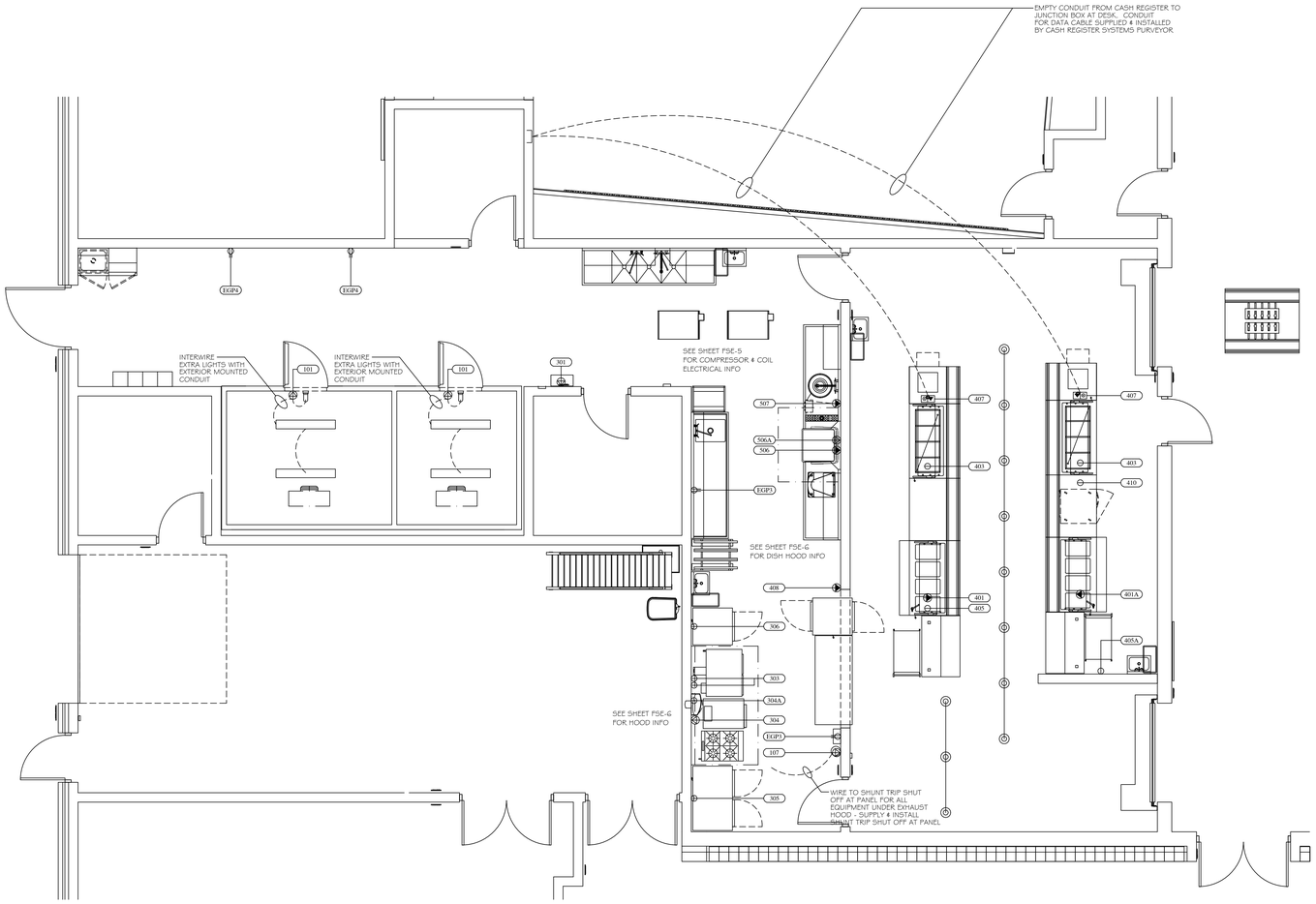
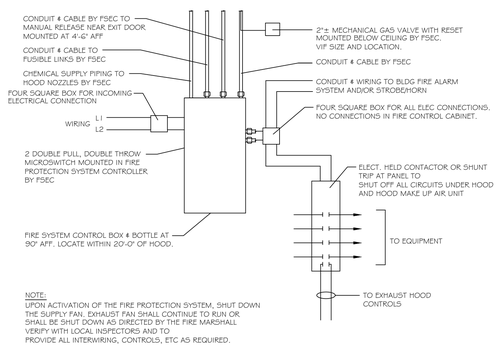
	NIKEC	NOT IN KITCHEN EQUIPMENT CONTRACT

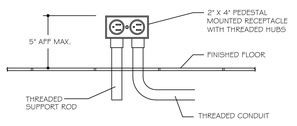




NOTE:
UPON ACTIVATION OF THE FIRE PROTECTION SYSTEM, SHUT DOWN THE SUPPLY FAN. EXHAUST FAN SHALL CONTINUE TO RUN OR SHALL BE SHUT DOWN AS DIRECTED BY THE FIRE MARSHALL VERIFY WITH LOCAL INSPECTORS AND TO PROVIDE ALL INTERWIRING, CONTROLS, ETC AS REQUIRED.

FIRE PROTECTION SYSTEM - ITEM #107

TYPICAL FIRE PROTECTION SYSTEM CONTROL DIAGRAM
SEE FSEC SHOP DRAWINGS FOR EXACT REQUIREMENTS



TYPICAL PEDESTAL MOUNTED RECEPTACLE

SCALE: N.T.S.

EQUIPMENT SCHEDULE

Item	EQUIPMENT DESCRIPTION	VOLTS	PH	AMPS LOAD	DIRECT BY EC	CORDSET BY FSEC	AFF (in)	REMARKS
101	WALK-IN COOLER/FREEZER	120	1	8.0	X		DFA	WIRE TO JB FOR LIGHTS, DOOR HEATER
107	FIRE PROTECTION SYSTEM	120	1	10.0	X		DFA	WIRE TO SHUT OFF IN PANEL
301	HOOD	120	1	10.0	X		DFA	WIRE LIGHTS & HEAT SENSOR
303	CONVECTION OVEN - DOUBLE DECK	120	1	8.9		X	24	
304	STEAMER	120	1	2.0	X		24	
304A	REVERSE OSMOSIS SYSTEM	120	1	2.0		X	24	
305	FREEZER	120	1	11.2		X	90	
306	REFRIGERATOR	120	1	4.9		X	90	
401	HOT FOOD TABLE	208	1	20.4		X	5	PEDESTAL MOUNTED RECEPTACLE
401A	HOT FOOD TABLE W/ HEATED BASE	208	1	20.4		X	5	PEDESTAL MOUNTED RECEPTACLE
403	COLD FOOD TABLE	120	1	9.5		X	5	PEDESTAL MOUNTED RECEPTACLE
405	MILK COOLER	120	1	3.0		X	5	PEDESTAL MOUNTED RECEPTACLE
405A	MILK COOLER	120	1	3.0		X	16	
407	CASH REGISTER/POS - BY OWNER	120	1	10.0		X	5	INTERWIRE TO OFFICE/CPU - VIF
408	PASS THRU REFRIGERATOR/HEATED CABINET	120/208	1	11.0		X	90	
410	UNDER COUNTER REFRIGERATOR	120	1	2.0		X	5	PEDESTAL MOUNTED RECEPTACLE
506	DISHWASHER & BOOSTER HEATER	208	3	45.4	X		16	
506A	DRAIN WATER TEMPERING KIT	120	1	5.0	X		16	
507	DISPOSAL	208	3	6.6	X		16	
EGP3	GENERAL PURPOSE DUPLEX	120	1	10.0		X	48	
EGP4	GENERAL PURPOSE DUPLEX	120	1	10.0		X	16	

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FOOD SERVICE ELECTRICAL FLOOR PLAN
SCALE 1/4" = 1'-0"

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WHITE
BLACK

12/8/2022 12:06:51 PM
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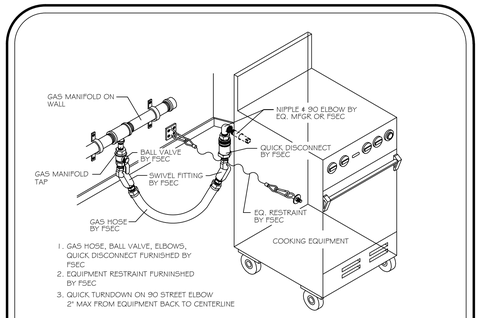
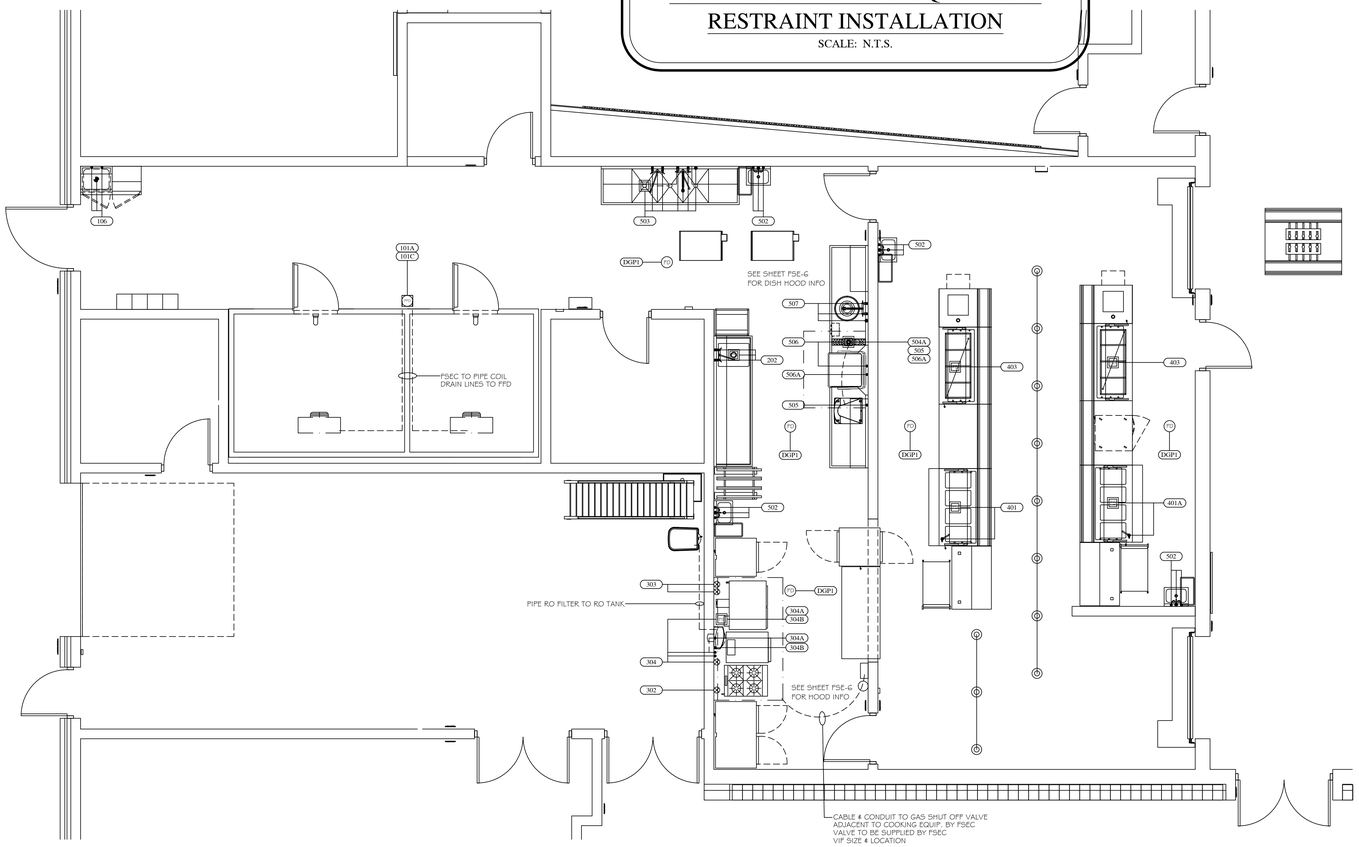
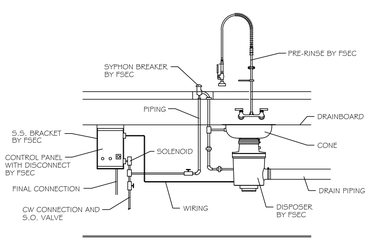


TYPICAL GAS HOSE & EQUIPMENT RESTRAINT INSTALLATION

SCALE: N.T.S.





TYPICAL DISPOSER INSTALLATION

SCALE: N.T.S.

CONNECT DIRECTLY TO WASTE LINE AND NOT THROUGH GREASE TRAP.
PLUMBING FITTINGS, ELECTRICAL WIRING AND PIPE SHALL BE INCLUDED.
INSTALLATION SHOULD BE MADE IN ACCORDANCE WITH LOCAL CODES.

EQUIPMENT SCHEDULE

Item	EQUIPMENT DESCRIPTION	CW (in)	HW (in)	AFF (in)	DIRECT DRAIN (in)	AFF (in)	INDIRECT AIR GAP	GAS (in)	AFF (in)	MBTUH	REMARKS
101A	COOLER COIL						FFD				FSEC PIPE COIL TO FFD
101C	FREEZER COIL						FFD				FSEC PIPE COIL TO FFD
106	MOP SINK CABINET	0.5	0.5	36	2	IN FLOOR					
202	PREP TABLE	0.5	0.5	16			FL SK				
302	RANGE - FOUR BURNER							0.75	10	177	
303	CONVECTION OVEN - DOUBLE DECK							0.75	10	90	
304	STEAMER	0.5		36			FL SK	0.75	10	125	PIPE CW THRU RO SYSTEM THEN TO STEAMER
304A	REVERSE OSMOSIS SYSTEM	0.5		36			FL SK				PIPE CW THRU RO SYSTEM THEN TO STEAMER
304B	DRAIN WATER TEMPERING KIT	0.5		16			FL SK				TRADES TO INSTALL
401	HOT FOOD TABLE		0.5	5			FL SK				
401A	HOT FOOD TABLE W/ HEATED BASE		0.5	5			FL SK				
403	COLD FOOD TABLE						FL SK				
502	HAND SINK W/ SIDE SPLASHES	0.5	0.5	18	1.5	16					SOAP & TOWEL DISPENSER - BY OWNER
503	POT SINK	0.5	0.5	16	2	12	FL SK				PIPE 2" DIRECT WASTE TO GREASE TRAP
504A	SOILED DISHTABLE						FL SK				
505	WATER SOFTENER & FILTRATION		0.5	18			FL SK				
506	DISHWASHER & BOOSTER HEATER		0.75	60			FL SK				45 GPH 120° HW
506A	DRAIN WATER TEMPERING KIT	0.5		18			FL SK				TRADES TO INSTALL
507	DISPOSAL	0.75	0.5	18	2	12					
DGP1	GENERAL PURPOSE FLOOR DRAIN				3	IN FLOOR					

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Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FOOD SERVICE
PLUMBING
FLOOR PLAN
SCALE 1/4" = 1'-0"

REVISIONS

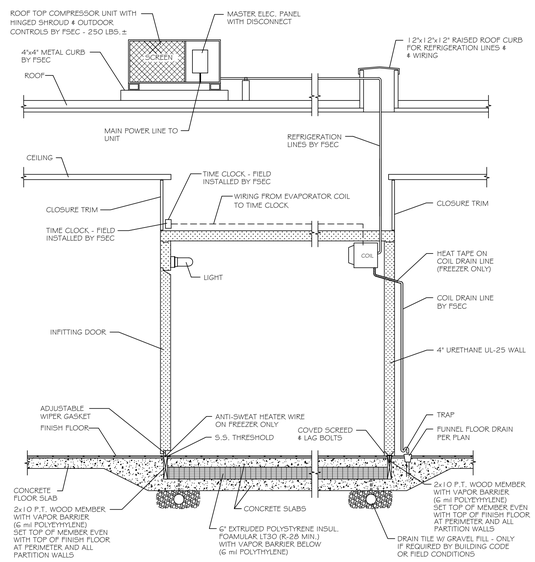
REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
FSE-4

100% CONSTRUCTION DOCUMENTS

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO 50% BLACK
WHITE
BLACK
WE RECYCLE

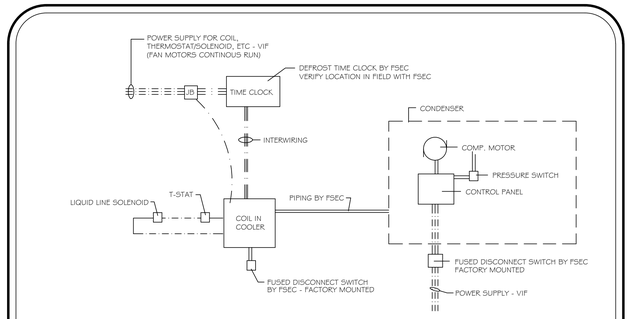
DESIGNED BY: CM
CHECKED BY: JR
APPROVED BY: JR



TYPICAL WALKIN DETAIL

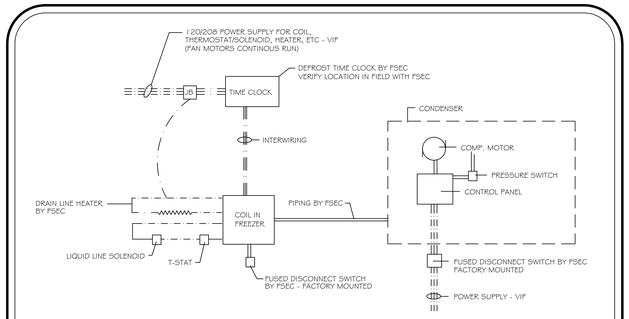
SCALE: 1/2" = 1'-0"

DETAIL IS FOR BIDDING PURPOSES ONLY.
ALL TRADES TO VERIFY REQUIREMENTS
WITH MANUFACTURER'S SHOP DRAWINGS



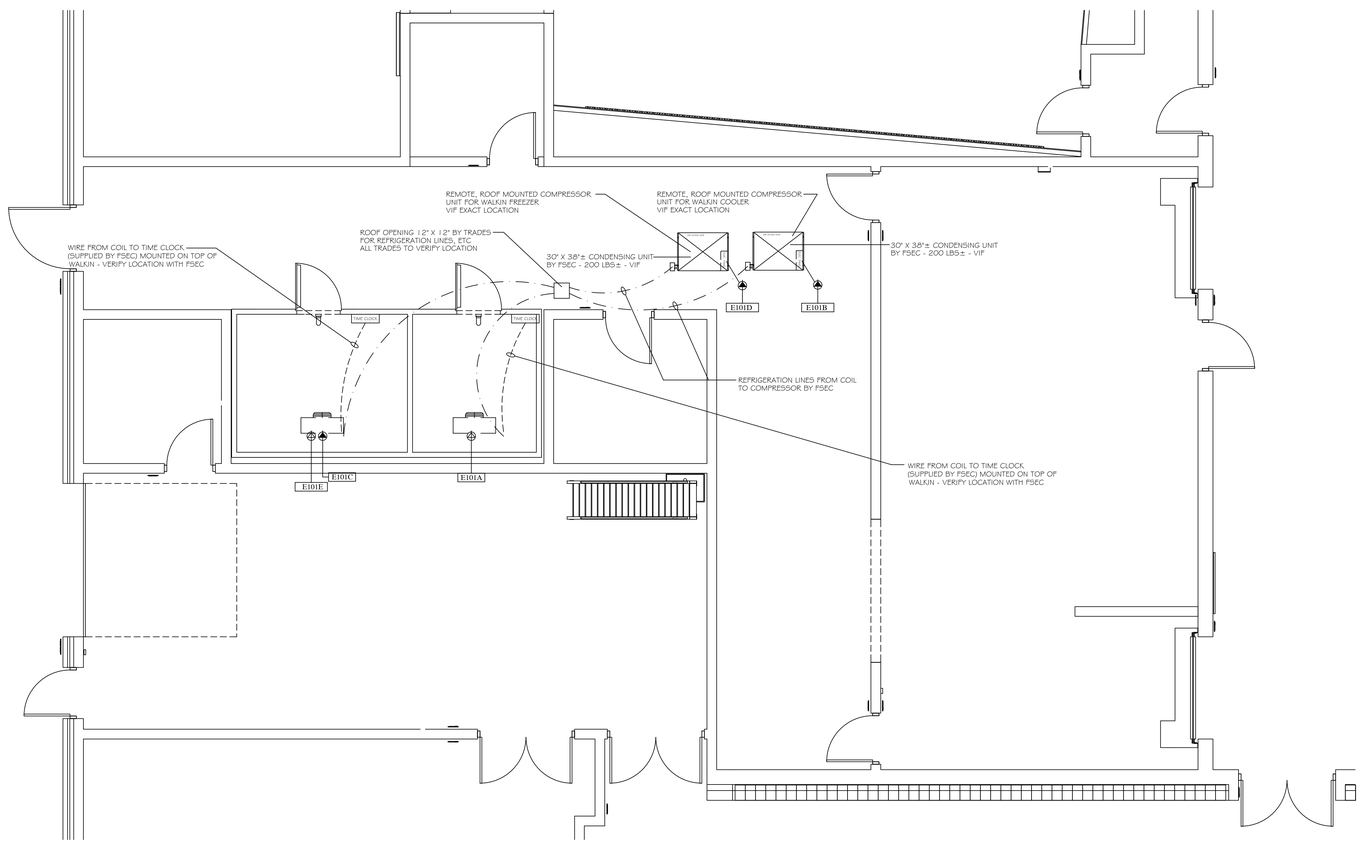
TYPICAL WALK-IN COOLER WIRING SCHEMATIC

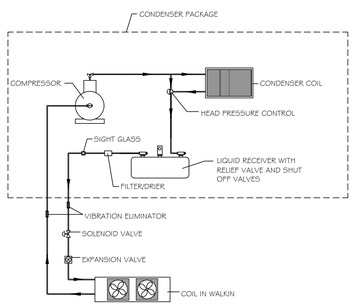
SEE FSEC SHOP DRAWINGS FOR EXACT REQUIREMENTS



TYPICAL WALK-IN FREEZER WIRING SCHEMATIC

SEE FSEC SHOP DRAWINGS FOR EXACT REQUIREMENTS





TYPICAL PIPING DETAIL

SEE FSEC SHOP DRAWINGS FOR EXACT REQUIREMENTS

REFRIGERATION NOTES

1. FOODSERVICE EQUIPMENT TRADES
   - A. FSEC SHALL PROVIDE AND INSTALL WALKIN AND REFRIGERATION SYSTEM WITH COIL, CONDENSER, INSULATED LINES, OUTDOOR CONTROL PACKAGE, HINGED SHROUD, CONTROLS, CURBS, ETC. EVACUATE, CHARGE, TEST, ADJUST, ETC. PER G.S..
   - B. PROVIDE DIRECT EXPANSION TYPE COILS WITH ELECTRIC DEFROST SIMILAR TO BOHN CO. "LET" SERIES WITH LIQUID LINE SOLENOID VALVE, SUCTION LINE "P" TRAP, AND THERMOSTAT PIPED AND WIRED TO THE JUNCTION BOX FOR POSITIVE PUMP DOWN. PROVIDE TRAPPED COIL DRAIN LINES.
   - C. PROVIDE AIR COOLED CONDENSER PACKAGE SIMILAR TO COPELAND CO. "C" SERIES WITH OUTDOOR CONTROLS, HINGED SHROUD, AND FLOODED HEAD PRESSURE CONTROL SYSTEM. ALL INTERNAL PIPING SHALL BE PRE-PIPED TO OUTSIDE OF ENCLOSURE WITH DRIER, SIGHT GLASS AND VIBRATION ELIMINATORS FOR SUCTION AND LIQUID LINES.
   - D. PROVIDE INSULATED, REFRIGERANT GRADE OR TYPE "L" COPPER LINE SETS WITH SILVER SOLDER.
   - E. ALL LINES SHALL BE SECURELY SUPPORTED AND ANCHORED WITH CLAMPS FSEC TO VERIFY ALL DIMENSIONS AND DATA IN FIELD
2. GENERAL TRADES
   - A. PROVIDE 12" X 12" ROOF OPENING AND RAISED CURB - VIF.
   - B. PROVIDE STRUCTURAL SUPPORT FOR CONDENSOR UNIT - VIF.
   - C. PROVIDE FLOOR CONSTRUCTION AND INSULATION AS PER PLAN
   - D. PROVIDE PRESSURE TREATED WOOD THERMAL BREAKS UNDER ALL WALKIN WALLS UP THRU AND 1/8" ABOVE QUARRY TILE FLOOR TO TOUCH SCREEDS.
   - E. PROVIDE A MINIMUM OF 4" FROM CENTERLINE OF THERMAL BREAK TO ADJACENT BUILDING WALLS (TO CREATE AIR SPACE TO WALKIN WALL).
   - F. PROVIDE THREE LAYERS OF 2" OWENS/CORNING FOAMULAR 150 SERIES EXTRUDED POLYSTYRENE WITH R-VALUE OF 10 EACH AND DENSITY TO SUPPORT CONCRETE.
   - G. INSULATION MUST BE TIGHT AGAINST ALL THERMAL BREAKS AFTER CONCRETE IS POURED.
   - H. PROVIDE A 6 MIL POLYETHYLENE SHEET WATERTIGHT SEAL UNDER THE ENTIRE INSULATED SUBFLOOR AND UP ALL VERTICAL EXTERIOR SIDES IN CONTACT WITH THERMAL BREAKS.
   - I. PROVIDE POWER AND WIRING PER CODE FOR REFRIGERATION SYSTEM AND CONNECT TO CONTROL PANEL AND DISCONNECT (BY FSEC) ON ROOF TOP CONDENSING UNIT.
   - J. INSTALL ALL WIRING PER CODE TO SUPPLY POWER FOR COILS, TIME CLOCKS, SOLENOID/THERMOSTAT, DRAIN LINE HEATER, ETC - VIF
   - K. PROVIDE POWER AND INTERWIRE INTERIOR LIGHTS WITH EXTERIOR CONDUIT.
   - L. CONNECT DRAIN LINE HEATER (PROVIDED BY FSEC) IN FREEZER THROUGH J.B.
   - M. PROVIDE FUNNEL FLOOR DRAINS PER PLAN WITH MINIMUM PITCH 4" FROM WALKIN WALLS. PIPING SHALL NOT INTERFERE WITH INSULATED SUBFLOOR.

ELECTRICAL CONNECTIONS SCHEDULE

CONN.	VOLTS	PH	KW	HP	AMPS	CONNECTION	HEIGHT	REMARKS
E101A	120	1			5.0	DIRECT	DFA	WIRING FROM COIL TO TIME CLOCK
E101B	208	3			10.0	DIRECT	ROOF	
E101C	208	1			15.0	DIRECT	DFA	WIRING FROM COIL TO TIME CLOCK
E101D	208	3			15.0	DIRECT	ROOF	
E101E	120	1			5.0	DIRECT	DFA	FREEZER COIL HEAT TAPE

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FOOD SERVICE
REFRIGERATION
FLOOR PLAN
SCALE 1/4" = 1'-0"

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116
DATE: 23-JUNE-2023
SHEET
FSE-5

100% CONSTRUCTION DOCUMENTS

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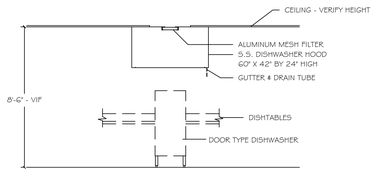
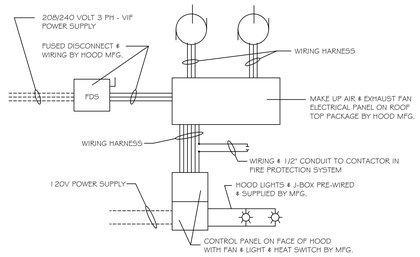


TYPICAL DISHWASHER EXHAUST HOOD ELEVATION - ITEM #508

SCALE: N.T.S.

DETAIL IS FOR BIDDING PURPOSES ONLY.
ALL TRADES TO VERIFY REQUIREMENTS
WITH MANUFACTURER'S SHOP DRAWINGS

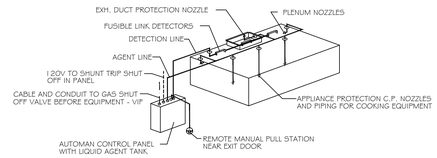


HOOD WIRING DIAGRAM - SEE FSEC

SCALE: N.T.S.

SEE SHOP DRAWINGS FOR EXACT REQUIREMENTS

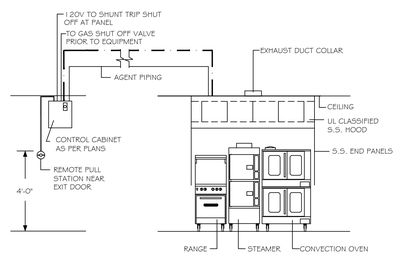
UPON ACTIVATION OF THE FIRE PROTECTION SYSTEM, SHUT DOWN THE SUPPLY FAN. EXHAUST FAN SHALL CONTINUE TO RUN OR SHALL BE SHUT DOWN AS DIRECTED BY THE FIRE MARSHALL AND/OR THE HEALTH DEPARTMENT. VERIFY WITH LOCAL INSPECTORS. TRADES TO WIRE AS REQUIRED.



TYPICAL FIRE PROTECTION SYSTEM - UL 300

SCALE: N.T.S.

SEE FSEC SHOP DRAWINGS FOR EXACT REQUIREMENTS



TYPICAL COOKING EQUIPMENT ELEVATION

SCALE: N.T.S.

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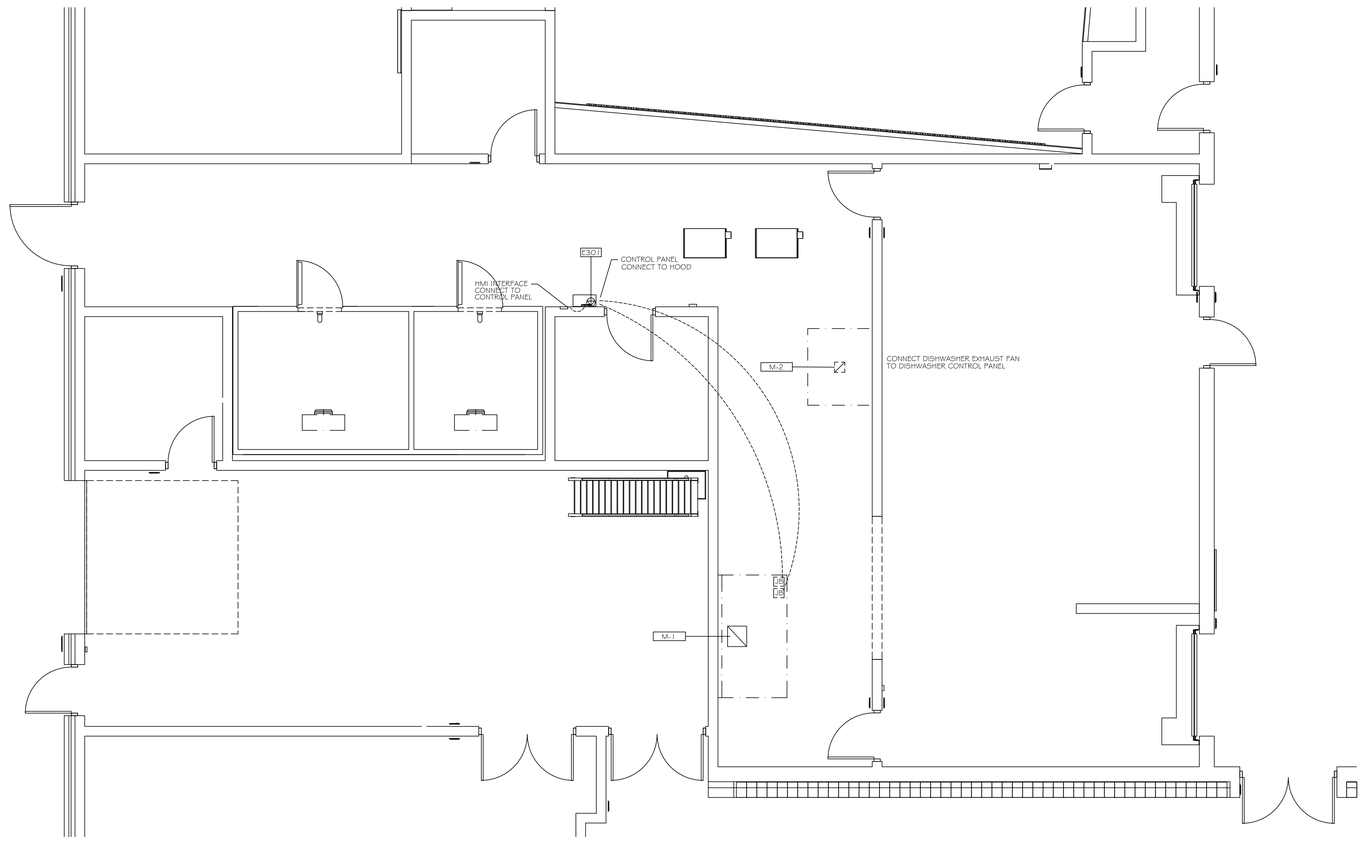

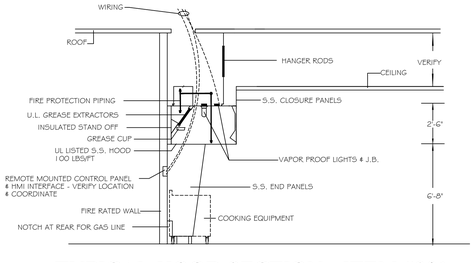

TYPICAL HOOD SECTION - ITEM #301

SCALE: N.T.S.

DETAIL IS FOR BIDDING PURPOSES ONLY.
ALL TRADES TO VERIFY REQUIREMENTS
WITH MANUFACTURER'S SHOP DRAWINGS

MECHANICAL CONNECTION SCHEDULE

NO.	GAS	BTU	EXH	MUA	CFM	VOLTS	PH	AMPS	REMARKS
E301						120	1	10.0	LIGHTS & HEAT SENSOR
M-1			14" X 15"		2200				EXHAUST DUCT - 2 HR RATED BY FSEC IF REQD BY CODE
M-2			8" X 8"		600				DUCT COLLAR - ONE REQUIRED

VENTILATION DATA - 508

18 GA. S.S. HOOD - 50 LBS/FT	4'-0" X 5'-0" X 0"	ONE MESH FILTER
EXHAUST DUCT COLLARS	8" X 8"	ONE REQUIRED
EXH. DUCT - 18 GA. S.S. WELDED	8" X 8"	1,137 FPM - DUCT VELOCITY
EXHAUST FAN & CURB - 200± LBS	NIKEC	CONNECT DISHWASHER EXH FAN TO DISHWASHER CONTROL PANEL
EXHAUST CFM	600	
TOTAL SYSTEM STATIC PRESSURE	0.40 WG	
M.U.A. CFM - TEMPERED	600	FROM BLDG HVAC
ROOF OPENING	ONE REQUIRED - VIF	NIKEC

VENTILATION DATA - 301

18 GA. S.S. HOOD - 100 LBS/FT	8'-0" X 4'-0" X 24"	6" OVERHANG
UL LISTED GREASE EXTRACTOR FILTERS	4 - 16" BY 20"	321 FPM - FACE VELOCITY
EXHAUST DUCT COLLARS ON HOOD	14" X 15"	ONE REQUIRED
S.S. END PANELS	40" X 46"	TWO REQUIRED
TOTAL SYSTEM STATIC PRESSURE	1.00 WG	
EXHAUST FAN & CURB		NIKEC
EXHAUST CFM - UL LISTING	2200	
EXH. DUCT - 16 GA. WELDED	14" X 15"	1509 FPM - DUCT VELOCITY
ROOF OPENINGS	ONE REQUIRED - VIF	NIKEC

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

FOOD SERVICE VENTILATION FLOOR PLAN
SCALE 1/4" = 1'-0"

REVISIONS

REV	DESCRIPTION	DATE

PROJ. #: 220116

DATE: 23-JUNE-2023

SHEET

FSE-6

100% CONSTRUCTION DOCUMENTS

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DESIGNED BY: CM
CHECKED BY: JR
APPROVED BY: JR

GENERAL TECHNOLOGY NOTES:

1. THESE DRAWINGS ARE DIAGRAMMATIC AND INDICATE THE GENERAL EXTENT OF THE WORK. CONTRACTORS SHALL PROVIDE ALL INCIDENTAL MATERIALS AND LABOR FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
2. PRIOR TO BEGINNING WORK, CONTRACTORS ARE TO REVIEW BUILDING PLANS, INSTALLATION LOCATIONS, AND SITE CONDITIONS. NOTIFY THE TECHNOLOGY DESIGNER OF ANY CONDITIONS THAT MAY PREVENT PROPER INSTALLATION AND OPTIMAL PERFORMANCE OF THE SYSTEMS; VOID THE MANUFACTURER'S WARRANTY; OR THAT CONFLICT WITH THE INTENT OF THE PROJECT. PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN RESOLVED. THE CONTRACTOR IS RESPONSIBLE FOR ANY ADDITIONAL WORK RELATED TO CORRECTING UNREPORTED CONFLICTS AND ISSUES, AT NO ADDITIONAL COST TO THE OWNER.
3. FIELD VERIFY LOCATIONS, CONDITIONS AND LENGTHS PRIOR TO INSTALLATION.
4. CONTRACTOR IS REQUIRED TO PROVIDE THEIR OWN PENETRATIONS, SLEEVES, AND CORES THROUGH ALL WALLS AND FLOORS. ALL SLEEVES SHALL HAVE NYLON BUSHINGS.
5. CONTRACTOR SHALL PROVIDE FIRESTOPPING ON PENETRATIONS PASSING THROUGH WALLS AND FLOORS IN WHICH THEY WORK.
6. CONTRACTOR SHALL COORDINATE TELECOMMUNICATION ROOM LAYOUTS WITH ALL IMPACTED CONTRACTORS PRIOR TO INSTALLATION.
7. CONTRACTOR SHALL COORDINATE ALL EQUIPMENT LOCATIONS AND ROUGH-IN REQUIREMENTS WITH ALL IMPACTED CONTRACTORS PRIOR TO INSTALLATIONS.
8. CONTRACTOR SHALL PROVIDE FACEPLATES AND INSERTS FOR THEIR DEVICES.
9. CONTRACTOR SHALL PROVIDE PROTECTIVE GUARDS ON THEIR DEVICES (CLOCKS, PHONES, ACCESS POINTS, MOTION DETECTORS, ETC.) SUBJECT TO ABUSE IN THE GYMNASIUM.
10. WHEN COLOR / FINISH OPTIONS ARE AVAILABLE, CONTRACTOR SHALL CONFIRM COLOR / FINISH WITH ARCHITECT PRIOR TO ORDERING.

T3 SHEETS - STRUCTURED CABLING

STRUCTURED CABLING COLOR CODE:

- BLUE - GENERAL DATA
- ORANGE - WIRELESS ACCESS
- GREEN - SECURITY
- BLACK - AUDIOVISUAL

SYMBOL STYLES & ABBREVIATIONS:

CABLING OUTLET / WALL PLATE

- LOCATED IN FLOOR BOX
- LOCATED ON WALL, LOW HEIGHT (18" AFF)
- LOCATED ON WALL, MID HEIGHT (36"-84" AFF)
- LOCATED ON WALL, HIGH HEIGHT (84"+ AFF)
- LOCATED AT CEILING

OUTLET / PLATE ABBREVIATIONS

- # NUMBER OF DATA DROPS
- WP WALL PHONE LOCATION, INCLUDE 1 DATA DROP & WALL PHONE PLATE
- AP WIRELESS ACCESS POINT, INCLUDE 1 CAT6A DATA DROP
  ACCESSIBLE CEILING: TERMINATE TO BISCUIT JACK IN CEILING; ACCESS POINT WILL MOUNT TO CEILING
- VS VIDEO SURVEILLANCE CAMERA LOCATION, INCLUDE 1 DATA DROP
  WALL / HARD CEILING: TERMINATE TO JACK INSIDE BOX; CAMERA WILL MOUNT OVER BOX
  ACCESSIBLE CEILING: TERMINATE TO BISCUIT JACK IN CEILING; CAMERA WILL MOUNT TO CEILING, OR TO EXTERIOR WALL (COORDINATE PENETRATION AND LOCATION WITH VIDEO SURVEILLANCE CONTRACTOR)

DEVICES:

- AP WIRELESS ACCESS POINT, CEILING MOUNTED
- AP WIRELESS ACCESS POINT, WALL MOUNTED

STRUCTURED CABLING PROJECT NOTES:

1. COORDINATE DEVICE DROP LOCATIONS WITH DEVICE INSTALLATION CONTRACTOR. DEVICE INSTALLATION CONTRACTORS SHALL SUPPLY PATCH CABLES FROM THE DEVICE TO THE DATA DROP.
2. CABLING CONTRACTOR TO INSTALL OWNER-PROVIDED WIRELESS ACCESS POINTS. TERMINATE DROPS FOR CLASSROOM AP'S IN THE CORRIDOR. PROVIDE CONDUIT AND PATCH CABLE TO THE AP LOCATION. LABEL AP'S WITH OWNER-PROVIDED AT NUMBER AND THE DATA DROP LABEL.
3. CABLING CONTRACTOR TO TRANSPORT AND INSTALL THE OWNER'S 2 SERVER CABINETS CURRENTLY STORED AT THEIR WAREHOUSE.
4. INSTALL OWNER-FURNISHED UPS'S, SWITCHES, AND PHONE EQUIPMENT IN TELECOMMUNICATION ROOM CABINETS. CONTRACTOR OT PATCH ALL TERMINATED PATCH PANEL PORTS 1:1 TO THE SWITCHES. FOLLOW PATCH CABLE COLOR CODING.

T4 SHEETS - CLOCK SYSTEM & PUBLIC ADDRESS SYSTEM

CLOCK SYSTEM DEVICES:

- DC DIGITAL CLOCK, SINGLE-FACE, WALL MOUNTED
- DC DIGITAL CLOCK, DOUBLE-FACE, WALL MOUNTED

CLOCK SYSTEM PROJECT NOTES:

1. HEAD END LOCATED IN MDF.
2. ALL CLOCK DEVICES ARE IP / PoE.

PUBLIC ADDRESS SYSTEM DEVICES:

- MC MASTER CONSOLE
- PA PUBLIC ADDRESS SPEAKER, CEILING MOUNTED, CUT-IN
- PA PUBLIC ADDRESS SPEAKER, CEILING MOUNTED, PROVIDE ENCLOSURE FOR EXPOSED CEILING
- PA PUBLIC ADDRESS SPEAKER, WALL MOUNTED
- HN PUBLIC ADDRESS HORN, WALL MOUNTED
- CB CALL BUTTON

PUBLIC ADDRESS SYSTEM PROJECT NOTES:

1. HEAD END LOCATED IN MDF.
2. CLASSROOM PA WILL UTILIZE CLASSROOM SOUNDFIELD AUDIO SYSTEM (BASE BID).
3. TAP EACH SPEAKER AT THE FOLLOWING WATTAGE BASED ON SPACE / USE:
   - 3.1. 2 WATTS - SMALL ROOMS AND OFFICES, LESS THAN 200 SQFT.
   - 3.2. 5 WATTS - MEDIUM ROOMS, 200 - 500 SQFT., CORRIDORS
   - 3.3. 5 WATTS - CLASSROOM (ALTERNATE)
   - 3.4. 15 WATTS - BOILER ROOM HORN
   - 3.5. 30 WATTS - EXTERIOR HORNS & SPEAKERS, GYMNASIUM & CAFETERIA CEILING SPEAKERS
4. SIZE AMPLIFIERS WITH 40% ADDITIONAL POWER PER ZONE, ALLOWING FOR 20% ADDITIONAL POWER TAPS AND 20% OVERALL HEADHROOM.

PUBLIC ADDRESS SYSTEM ALTERNATE:

BASE BID IS AN AUDIO ENHANCEMENT EPIC SYSTEM THAT UTILIZES THE CLASSROOM SOUNDFIELD AUDIO SYSTEM. ALTERNATE IS TO PROVIDE A CAREHAWK PA SYSTEM. CONTRACTOR WILL NEED TO ADD AN ADDITIONAL CEILING SPEAKER IN ALL AREAS SHOWN WITH SOUNDFIELD SPEAKERS BUT NO SEPARATE PA SPEAKERS.

T5 SHEETS - AUDIOVISUAL SYSTEMS

OUTLET STYLES & ABBREVIATIONS:

CABLING OUTLET / WALL PLATE

- LOCATED IN FLOOR BOX
- LOCATED ON WALL, LOW HEIGHT (0"-36" AFF)
- LOCATED ON WALL, MID HEIGHT (36"-84" AFF)
- LOCATED ON WALL, HIGH HEIGHT (84"+ AFF)
- LOCATED AT CEILING

OUTLET / PLATE ABBREVIATIONS

- T TEACHER STATION LOCATION: HDMI & USB TO IFP
- A AUDIO INPUT LOCATION - SEE SCHEMATIC OR CALLOUT
- V AUDIO AND/OR VIDEO INPUT LOCATION - SEE SCHEMATIC OR CALLOUT

DEVICES:

- IFP INTERACTIVE FLAT PANEL & SOUNDFIELD AMPLIFIER LOCATION, WALL MOUNTED
- FP FLAT PANEL DISPLAY, SIZE AS NOTED, WALL MOUNTED
- DS DIGITAL SIGNAGE DISPLAY & SIGNAGE PLAYER, SIZE AS NOTED, WALL MOUNTED
- PJ PROJECTOR, WALL MOUNTED
- SF SOUNDFIELD SPEAKER, LAY-IN CEILING STYLE
- SF SOUNDFIELD SPEAKER, SURFACE MOUNTED TO CEILING
- SFA SOUNDFIELD AMPLIFIER LOCATION

AUDIOVISUAL SYSTEMS PROJECT NOTES:

1. ALL IFP'S ARE 75" (CLEVERTOUCH IMPACT PLUS) UNLESS SIZE NOTED OTHERWISE.
2. PROVIDE HEIGHT-ADJUSTABLE WALL MOUNTS FOR IFP'S IN ALL CLASSROOMS / INSTRUCTIONAL SPACES.
3. INSTALL OWNER-FURNISHED DIGITAL SIGNAGE EQUIPMENT BEHIND ALL DS DISPLAYS.

T6 SHEETS - ACCESS CONTROL & INTRUSION DETECTION SYSTEM

ACCESS CONTROL SYSTEM DEVICES:

- VI VIDEO INTERCOM
- CR CARD READER, WALL MOUNTED
- DC CARD READER, DOOR HANDLE
- DC DOOR CONTACT
- ME MOTION REQUEST TO EXIT DEVICE

INTRUSION DETECTION SYSTEM DEVICES:

- KP KEYPAD
- MS MOTION SENSOR; SHADING INDICATES DIRECTION OF VIEW, NOT COVERAGE

ACCESS CONTROL & INTRUSION DETECTION SYSTEM PROJECT NOTES:

1. CARD READERS WILL BE PROVIDED BY THE DOOR HARDWARE CONTRACTOR. REFER TO DOOR HARDWARE SCHEDULE AND SPECIFICATIONS FOR FINAL COUNT AND LOCATIONS - NOT ALL ARE SHOWN ON THESE DRAWINGS.
2. WHEN BUILDING LOCKDOWN IS ENGAGED, ALL DOORS WITH ACCESS CONTROL SHALL LOCK. OVERRIDING ANY SCHEDULE AND PROHIBITING ACCESS FROM MOST CARDS. ONLY STAFF IN AN EMERGENCY ACCESS USER GROUP WILL HAVE ACCESS WITH THEIR CARDS. INTERIOR DOORS ARE TO BE PROGRAMMED WITH A PIN CODE THAT WOULD ONLY BECOME ACTIVE WHEN LOCKDOWN IS ENGAGED. LOCKDOWN MUST ALSO SEND AN EMAIL OR TEXT ALERT TO IDENTIFIED STAFF.
3. CONFIGURE SYSTEM TO SEND ALERTS WHEN EXTERIOR DOORS ARE PROPPED OPEN.
4. CONFIGURE INTRUSION DETECTION SYSTEM TO CALL EPS SECURITY, THE CURRENT MONITORING COMPANY.

T7 SHEETS - VIDEO SURVEILLANCE SYSTEM

SYMBOL STYLES & ABBREVIATIONS:

- CAM VIDEO SURVEILLANCE CAMERA; SHADING INDICATES DIRECTION OF VIEW, NOT COVERAGE

- A ONE LENS / SENSOR
- B TWO LENS / SENSOR
- C THREE LENS / SENSOR
- D FOUR LENS / SENSOR
- F FISHEYE LENS / SENSOR
- # TOTAL MEGAPIXELS FOR CAMERA; DIVIDE BY NUMBER OF SENSORS FOR MINIMUM PER SENSOR
- VI VIDEO INTERCOM STATION (BY ACCESS CONTROL CONTRACTOR); INCLUDE FOR VIDEO RECORDING

PROJECT NOTES:

1. CONFIRM ALL MOUNTING LOCATIONS WITH TECHNOLOGY DESIGNER PRIOR TO INSTALLATION.
2. REVIEW AND CONFIRM ALL CAMERA VIEWS AND SETTINGS WITH TECHNOLOGY DESIGNER AND OWNER PRIOR TO ACCEPTANCE; ADJUST AS NECESSARY.
3. ALL EXTERIOR CAMERAS SHALL BE RATED FOR SUCH USE AND BE PROVIDED WITH HOUSING, HEATER, AND BLOWER AS NECESSARY TO OPERATE IN THE INTENDED CLIMATE.
4. ALL EXTERIOR SINGLE-LENS CAMERAS SHALL DOME-STYLE WITH A SUN SHADE.
5. INCLUDE PENDANT ARM MOUNTS FOR EXTERIOR MULTI-LENS CAMERAS DUE TO FIELD CONDITIONS OR TO OBTAIN THE DESIRED VIEW.
6. VIDEO SURVEILLANCE CONTRACTOR TO PROVIDE PATCH CABLES BETWEEN CAMERA AND DATA JACK SUPPLIED BY OTHERS. COORDINATE JACK LOCATIONS WITH STRUCTURED CABLING CONTRACTOR.
7. THE OWNER'S EXISTING SERVERS WILL BE USED FOR THE ADDITIONAL CAMERAS.

Barton Malow

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26500 American Drive
Southfield, MI 48034

248.436.5000
www.bartonmalow.com

Owner:

Lansing School District
Lansing, Michigan

Project Number: TBD
Project Manager: Paul Twigg
Drawn By: Bill Dawson
Checked By: Paul Twigg

Issued For	Date
BID	06/23/2023

Key Plan:

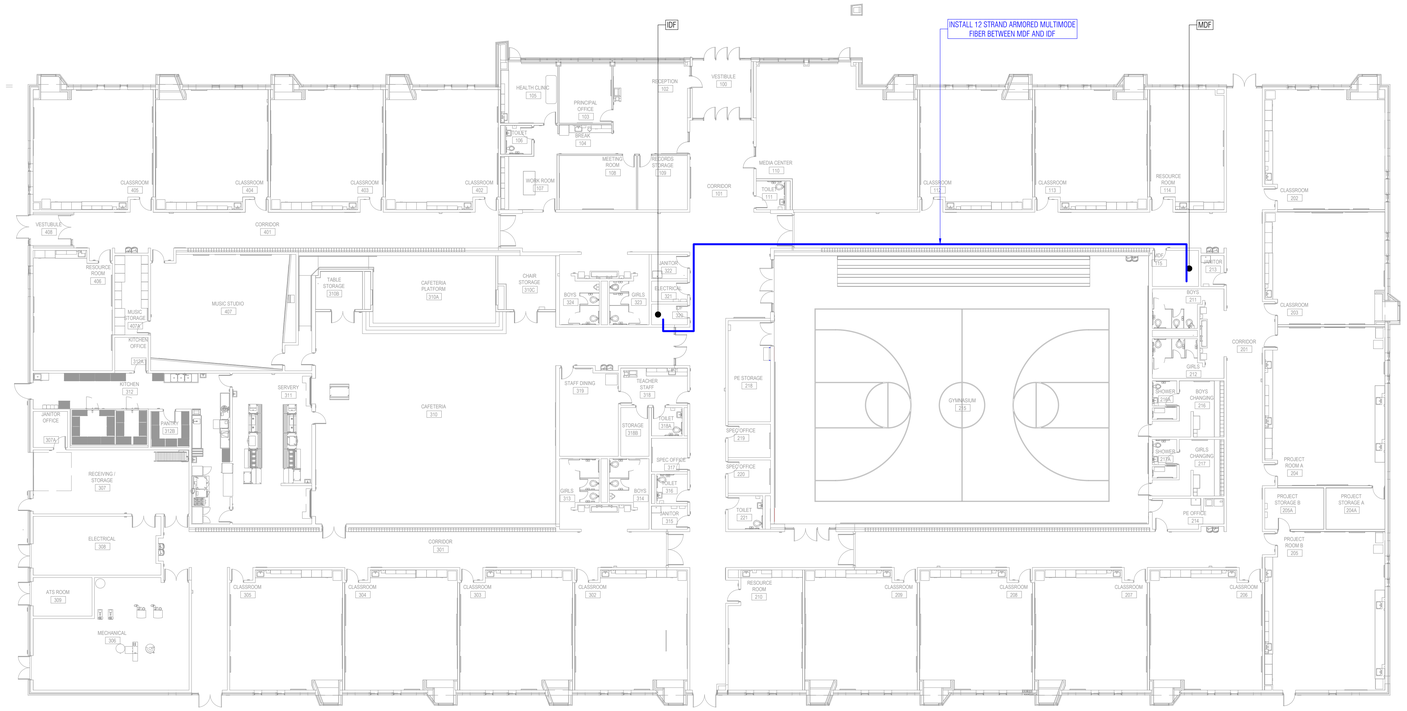
Native Page Size: 42" X 30"

Scale: None

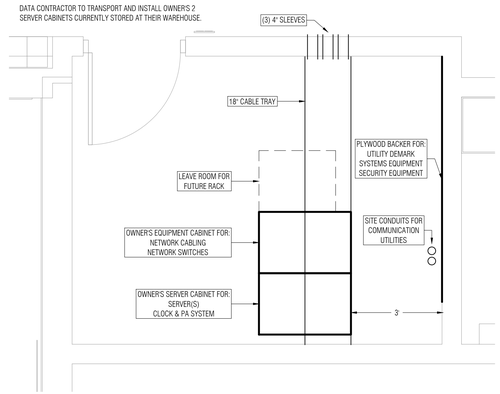
Bid Package SB-1785
Mt. Hope

Technology Systems

T0



Composite Floor Plan & Technology Infrastructure
SCALE: 1/16" = 1'



MDF Plan
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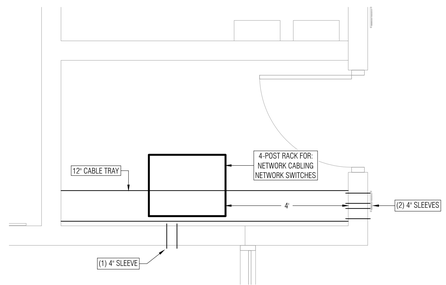

IDF Plan
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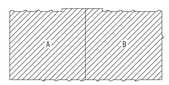

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Scale: As Noted

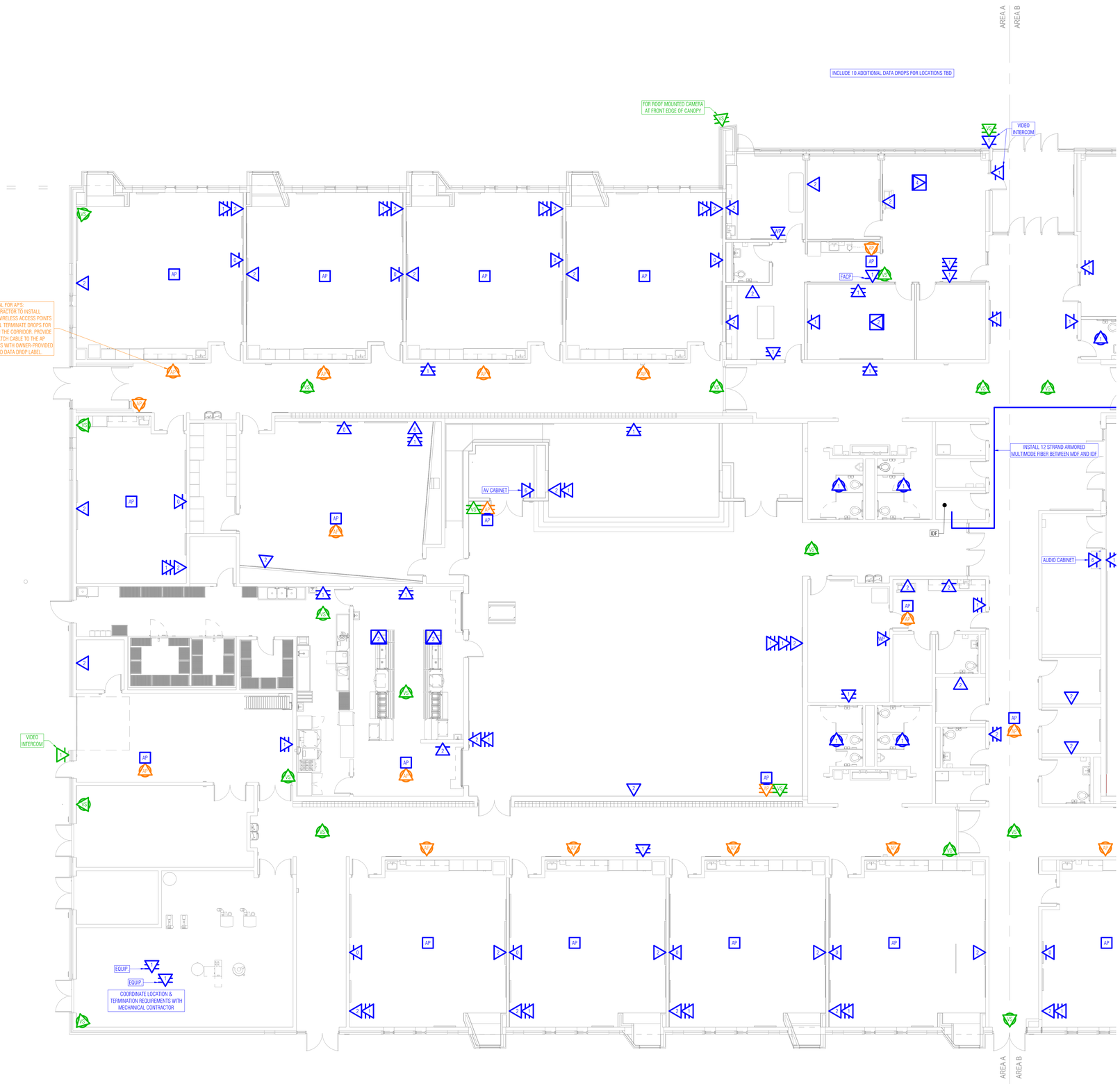
Bid Package SB-1785
Mt. Hope

Mt. Hope

1st Floor Composite
Floor Plan
Technology Infrastructure
MDF & IDF Layouts

N

T1.1



Structured Cabling - Area A

GENERAL TECHNOLOGY NOTES:

1. THESE DRAWINGS ARE DIAGRAMMATIC AND INDICATE THE GENERAL EXTENT OF THE WORK. CONTRACTORS SHALL PROVIDE ALL INCIDENTAL MATERIALS AND LABOR FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
2. PRIOR TO BEGINNING WORK, CONTRACTORS ARE TO REVIEW BUILDING PLANS, INSTALLATION LOCATIONS, AND SITE CONDITIONS. NOTIFY THE TECHNOLOGY DESIGNER OF ANY CONDITIONS THAT MAY: PREVENT PROPER INSTALLATION AND OPTIMAL PERFORMANCE OF THE SYSTEMS; VOID THE MANUFACTURER'S WARRANTY; OR THAT CONFLICT WITH THE INTENT OF THE PROJECT. PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN RESOLVED. THE CONTRACTOR IS RESPONSIBLE FOR ANY ADDITIONAL WORK RELATED TO CORRECTING UNREPORTED CONFLICTS AND ISSUES, AT NO ADDITIONAL COST TO THE OWNER.
3. FIELD VERIFY LOCATIONS, CONDITIONS AND LENGTHS PRIOR TO INSTALLATION.
4. CONTRACTOR IS REQUIRED TO PROVIDE THEIR OWN PENETRATIONS, SLEEVES, AND CORES THROUGH ALL WALLS AND FLOORS. ALL SLEEVES SHALL HAVE NYLON BUSHINGS.
5. CONTRACTOR SHALL PROVIDE FIRESTOPPING ON PENETRATIONS PASSING THROUGH WALLS AND FLOORS IN WHICH THEY WORK.
6. CONTRACTOR SHALL COORDINATE TELECOMMUNICATION ROOM LAYOUTS WITH ALL IMPACTED CONTRACTORS PRIOR TO INSTALLATION.
7. CONTRACTOR SHALL COORDINATE ALL EQUIPMENT LOCATIONS AND ROUGH-IN REQUIREMENTS WITH ALL IMPACTED CONTRACTORS PRIOR TO INSTALLATIONS.
8. CONTRACTOR SHALL PROVIDE FACEPLATES AND INSERTS FOR THEIR DEVICES.
9. CONTRACTOR SHALL PROVIDE PROTECTIVE GUARDS ON THEIR DEVICES (CLOCKS, PHONES, ACCESS POINTS, MOTION DETECTORS, ETC.) SUBJECT TO ABUSE IN THE GYMNASIUM.
10. WHEN COLOR / FINISH OPTIONS ARE AVAILABLE, CONTRACTOR SHALL CONFIRM COLOR / FINISH WITH ARCHITECT PRIOR TO ORDERING.

STRUCTURED CABLING COLOR CODE:

- BLUE - GENERAL DATA
- ORANGE - WIRELESS ACCESS
- GREEN - SECURITY
- BLACK - AUDIOVISUAL

SYMBOL STYLES & ABBREVIATIONS:

CABLING OUTLET / WALL PLATE

- LOCATED IN FLOOR BOX
- LOCATED ON WALL, LOW HEIGHT (18" AFF)
- LOCATED ON WALL, MID HEIGHT (36"-84" AFF)
- LOCATED ON WALL, HIGH HEIGHT (84"+ AFF)
- LOCATED AT CEILING

OUTLET / PLATE ABBREVIATIONS

- # NUMBER OF DATA DROPS
- WP WALL PHONE LOCATION, INCLUDE 1 DATA DROP & WALL PHONE PLATE
- AP WIRELESS ACCESS POINT, INCLUDE 1 CAT6A DATA DROP
  ACCESSIBLE CEILING: TERMINATE TO BISCUIT JACK IN CEILING; ACCESS POINT WILL MOUNT TO CEILING
- VS VIDEO SURVEILLANCE CAMERA LOCATION, INCLUDE 1 DATA DROP
  WALL / HARD CEILING: TERMINATE TO JACK INSIDE BOX; CAMERA WILL MOUNT OVER BOX
  ACCESSIBLE CEILING: TERMINATE TO BISCUIT JACK IN CEILING; CAMERA WILL MOUNT TO CEILING, OR TO EXTERIOR WALL (COORDINATE PENETRATION AND LOCATION WITH VIDEO SURVEILLANCE CONTRACTOR)

DEVICES:

- AP WIRELESS ACCESS POINT, CEILING MOUNTED
- AP WIRELESS ACCESS POINT, WALL MOUNTED

STRUCTURED CABLING PROJECT NOTES:

1. COORDINATE DEVICE DROP LOCATIONS WITH DEVICE INSTALLATION CONTRACTOR. DEVICE INSTALLATION CONTRACTORS SHALL SUPPLY PATCH CABLES FROM THE DEVICE TO THE DATA DROP.
2. CABLING CONTRACTOR TO INSTALL OWNER-PROVIDED WIRELESS ACCESS POINTS. TERMINATE DROPS FOR CLASSROOM AP'S IN THE CORRIDOR. PROVIDE CONDUIT AND PATCH CABLE TO THE AP LOCATION. LABEL AP'S WITH OWNER-PROVIDED AT NUMBER AND THE DATA DROP LABEL.
3. CABLING CONTRACTOR TO TRANSPORT AND INSTALL THE OWNER'S 2 SERVER CABINETS CURRENTLY STORED AT THEIR WAREHOUSE.
4. INSTALL OWNER-FURNISHED UPS'S, SWITCHES, AND PHONE EQUIPMENT IN TELECOMMUNICATION ROOM CABINETS. CONTRACTOR OT PATCH ALL TERMINATED PATCH PANEL PORTS 1:1 TO THE SWITCHES. FOLLOW PATCH CABLE COLOR CODING.

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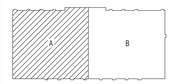

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Mt. Hope

Mt. Hope

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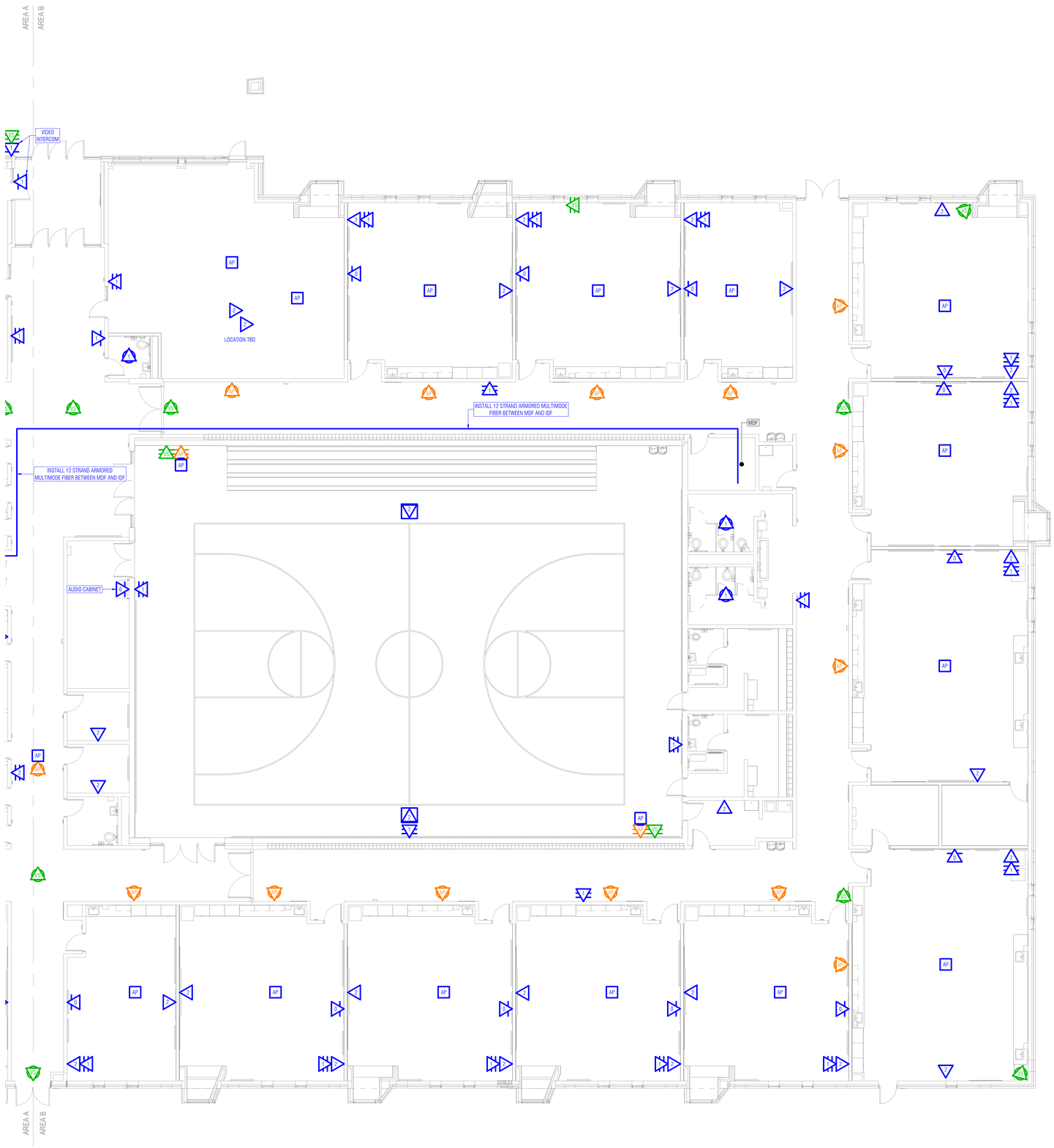
T3.1A



Structured Cabling - Area B

GENERAL TECHNOLOGY NOTES:

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STRUCTURED CABLING COLOR CODE:

- BLUE - GENERAL DATA
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- GREEN - SECURITY
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SYMBOL STYLES & ABBREVIATIONS:

CABLING OUTLET / WALL PLATE

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DEVICES:

- AP WIRELESS ACCESS POINT, CEILING MOUNTED
- AP WIRELESS ACCESS POINT, WALL MOUNTED

STRUCTURED CABLING PROJECT NOTES:

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N

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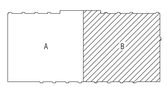

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0' 2' 4' 8' 16'

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Mt. Hope

Mt. Hope

1st Floor Unit B
Structured Cabling

T3.1B

Clock & Public Address System - Area A

GENERAL TECHNOLOGY NOTES:

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9. CONTRACTOR SHALL PROVIDE PROTECTIVE GUARDS ON THEIR DEVICES (CLOCKS, PHONES, ACCESS POINTS, MOTION DETECTORS, ETC.) SUBJECT TO ABUSE IN THE GYMNASIUM.

CLOCK SYSTEM DEVICES:

- DN — DIGITAL CLOCK, SINGLE-FACE, WALL MOUNTED
- DC — DIGITAL CLOCK, DOUBLE-FACE, WALL MOUNTED

CLOCK SYSTEM PROJECT NOTES:

1. HEAD END LOCATED IN MDF.
2. ALL CLOCK DEVICES ARE IP / PoE.

PUBLIC ADDRESS SYSTEM DEVICES:

- MC — MASTER CONSOLE
- PX — PUBLIC ADDRESS SPEAKER, CEILING MOUNTED, CUT-IN
- PA — PUBLIC ADDRESS SPEAKER, CEILING MOUNTED, PROVIDE ENCLOSURE FOR EXPOSED CEILING
- PW — PUBLIC ADDRESS SPEAKER, WALL MOUNTED
- HN — PUBLIC ADDRESS HORN, WALL MOUNTED
- CB — CALL BUTTON

PUBLIC ADDRESS SYSTEM PROJECT NOTES:

1. HEAD END LOCATED IN MDF.
2. CLASSROOM PA WILL UTILIZE CLASSROOM SOUNDFIELD AUDIO SYSTEM (BASE BID).
3. TAP EACH SPEAKER AT THE FOLLOWING WATTAGE BASED ON SPACE / USE:
   - 3.1. 2 WATTS - SMALL ROOMS AND OFFICES, LESS THAN 200 SQFT.
   - 3.2. 5 WATTS - MEDIUM ROOMS, 200 - 500 SQFT., CORRIDORS
   - 3.3. 5 WATTS - CLASSROOM (ALTERNATE)
   - 3.4. 15 WATTS - BOILER ROOM HORN
   - 3.5. 30 WATTS - EXTERIOR HORNS & SPEAKERS, GYMNASIUM & CAFETERIA CEILING SPEAKERS
4. SIZE AMPLIFIERS WITH 40% ADDITIONAL POWER PER ZONE, ALLOWING FOR 20% ADDITIONAL POWER TAPS AND 20% OVERALL HEADHROOM.

PUBLIC ADDRESS SYSTEM ALTERNATE:

BASE BID IS AN AUDIO ENHANCEMENT EPIC SYSTEM THAT UTILIZES THE CLASSROOM SOUNDFIELD AUDIO SYSTEM. ALTERNATE IS TO PROVIDE A CAREHAWK PA SYSTEM. CONTRACTOR WILL NEED TO ADD AN ADDITIONAL CEILING SPEAKER IN ALL AREAS SHOWN WITH SOUNDFIELD SPEAKERS BUT NO SEPARATE PA SPEAKERS.

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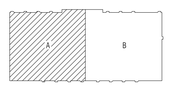

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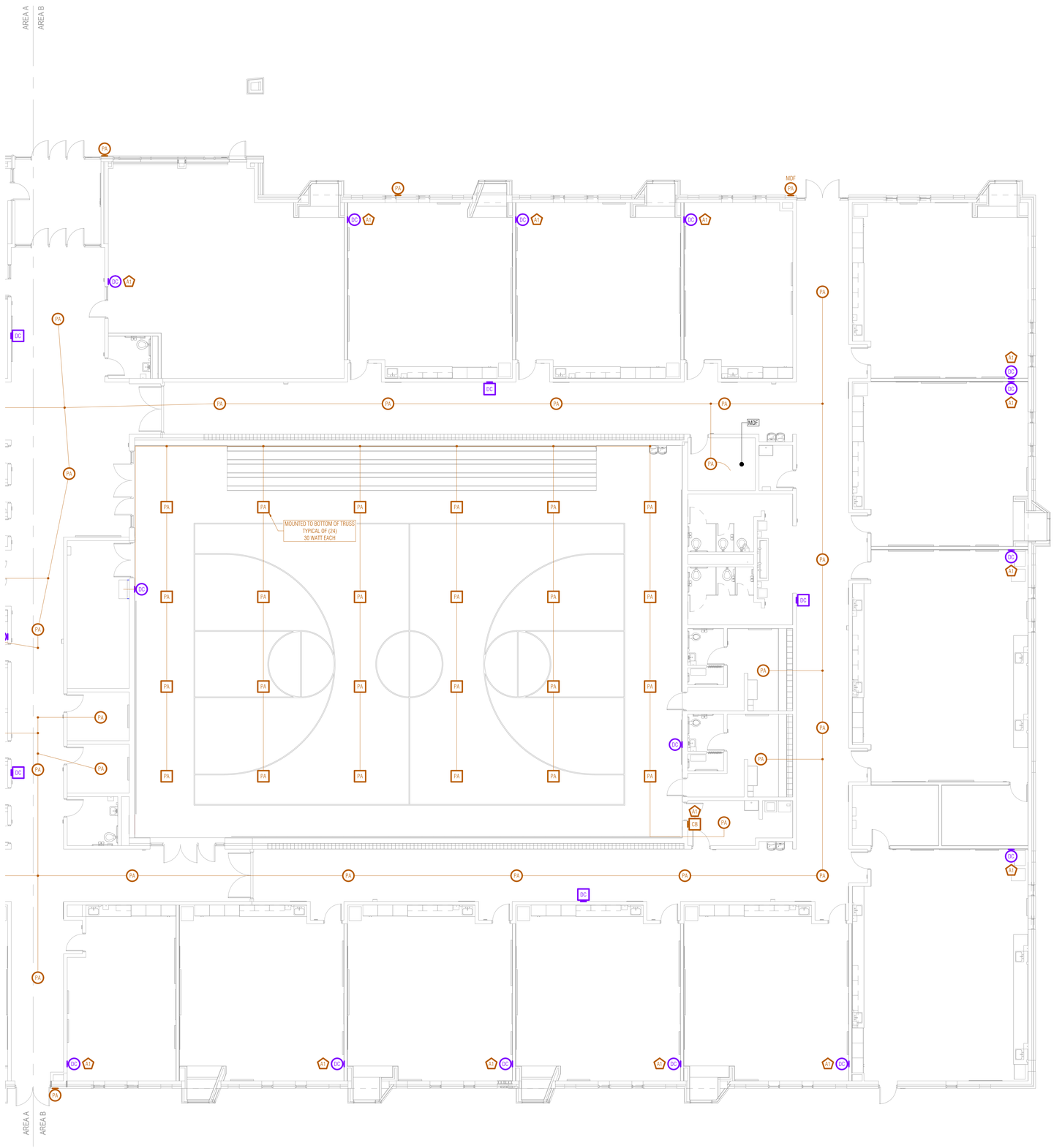
Mt. Hope

1st Floor Unit A
Clock System
Public Address System

T4.1A



Clock & Public Address Systems - Area B

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CLOCK SYSTEM DEVICES:

- DK DIGITAL CLOCK, SINGLE-FACE, WALL MOUNTED
- DC DIGITAL CLOCK, DOUBLE-FACE, WALL MOUNTED

CLOCK SYSTEM PROJECT NOTES:

1. HEAD END LOCATED IN MDF.
2. ALL CLOCK DEVICES ARE IP / PoE.

PUBLIC ADDRESS SYSTEM DEVICES:

- MC MASTER CONSOLE
- PA PUBLIC ADDRESS SPEAKER, CEILING MOUNTED, CUT-IN
- PA PUBLIC ADDRESS SPEAKER, CEILING MOUNTED, PROVIDE ENCLOSURE FOR EXPOSED CEILING
- PA PUBLIC ADDRESS SPEAKER, WALL MOUNTED
- HN PUBLIC ADDRESS HORN, WALL MOUNTED
- CB CALL BUTTON

PUBLIC ADDRESS SYSTEM PROJECT NOTES:

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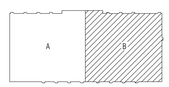

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Bid Package SB-1785
Mt. Hope

Mt. Hope

1st Floor Unit B
Clock System
Public Address System

T4.1B

Audiovisual Systems - Area A

GENERAL TECHNOLOGY NOTES:

1. THESE DRAWINGS ARE DIAGRAMMATIC AND INDICATE THE GENERAL EXTENT OF THE WORK. CONTRACTORS SHALL PROVIDE ALL INCIDENTAL MATERIALS AND LABOR FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
2. PRIOR TO BEGINNING WORK, CONTRACTORS ARE TO REVIEW BUILDING PLANS, INSTALLATION LOCATIONS, AND SITE CONDITIONS. NOTIFY THE TECHNOLOGY DESIGNER OF ANY CONDITIONS THAT MAY: PREVENT PROPER INSTALLATION AND OPTIMAL PERFORMANCE OF THE SYSTEMS; VOID THE MANUFACTURER'S WARRANTY; OR THAT CONFLICT WITH THE INTENT OF THE PROJECT. PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN RESOLVED. THE CONTRACTOR IS RESPONSIBLE FOR ANY ADDITIONAL WORK RELATED TO CORRECTING UNREPORTED CONFLICTS AND ISSUES, AT NO ADDITIONAL COST TO THE OWNER.
3. FIELD VERIFY LOCATIONS, CONDITIONS AND LENGTHS PRIOR TO INSTALLATION.
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OUTLET STYLES & ABBREVIATIONS:

CABLING OUTLET / WALL PLATE

- LOCATED IN FLOOR BOX
- LOCATED ON WALL, LOW HEIGHT (0"-36" AFF)
- LOCATED ON WALL, MID HEIGHT (36"-84" AFF)
- LOCATED ON WALL, HIGH HEIGHT (84"+ AFF)
- LOCATED AT CEILING

OUTLET / PLATE ABBREVIATIONS

T TEACHER STATION LOCATION: HDMI & USB TO IFP
A AUDIO INPUT LOCATION - SEE SCHEMATIC OR CALLOUT
V AUDIO AND/OR VIDEO INPUT LOCATION - SEE SCHEMATIC OR CALLOUT

DEVICES:

- IFP INTERACTIVE FLAT PANEL & SOUNDFIELD AMPLIFIER LOCATION, WALL MOUNTED
- FP FLAT PANEL DISPLAY, SIZE AS NOTED, WALL MOUNTED
- DS DIGITAL SIGNAGE DISPLAY & SIGNAGE PLAYER, SIZE AS NOTED, WALL MOUNTED
- PJ PROJECTOR, WALL MOUNTED
- SP SOUNDFIELD SPEAKER, LAY-IN CEILING STYLE
- SF SOUNDFIELD SPEAKER, SURFACE MOUNTED TO CEILING
- SFA SOUNDFIELD AMPLIFIER LOCATION

AUDIOVISUAL SYSTEMS PROJECT NOTES:

1. ALL IFPS ARE 75" (CLEVERTOUCH IMPACT PLUS) UNLESS SIZE NOTED OTHERWISE.
2. PROVIDE HEIGHT-ADJUSTABLE WALL MOUNTS FOR IFP'S IN ALL CLASSROOMS / INSTRUCTIONAL SPACES.
3. INSTALL OWNER-FURNISHED DIGITAL SIGNAGE EQUIPMENT BEHIND ALL DS DISPLAYS.

Barton Malow

Barton Malow Builders
26500 American Drive
Southfield, MI 48034

248.436.5000
www.bartonmalow.com

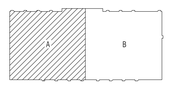
Owner:

Lansing School District
Lansing, Michigan

Project Number: TBD
Project Manager: Paul Twigg
Drawn By: Bill Dawson
Checked By: Paul Twigg

Issued For	Date
BID	06/23/2023

Key Plan:



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Scale: 1/8" = 1'

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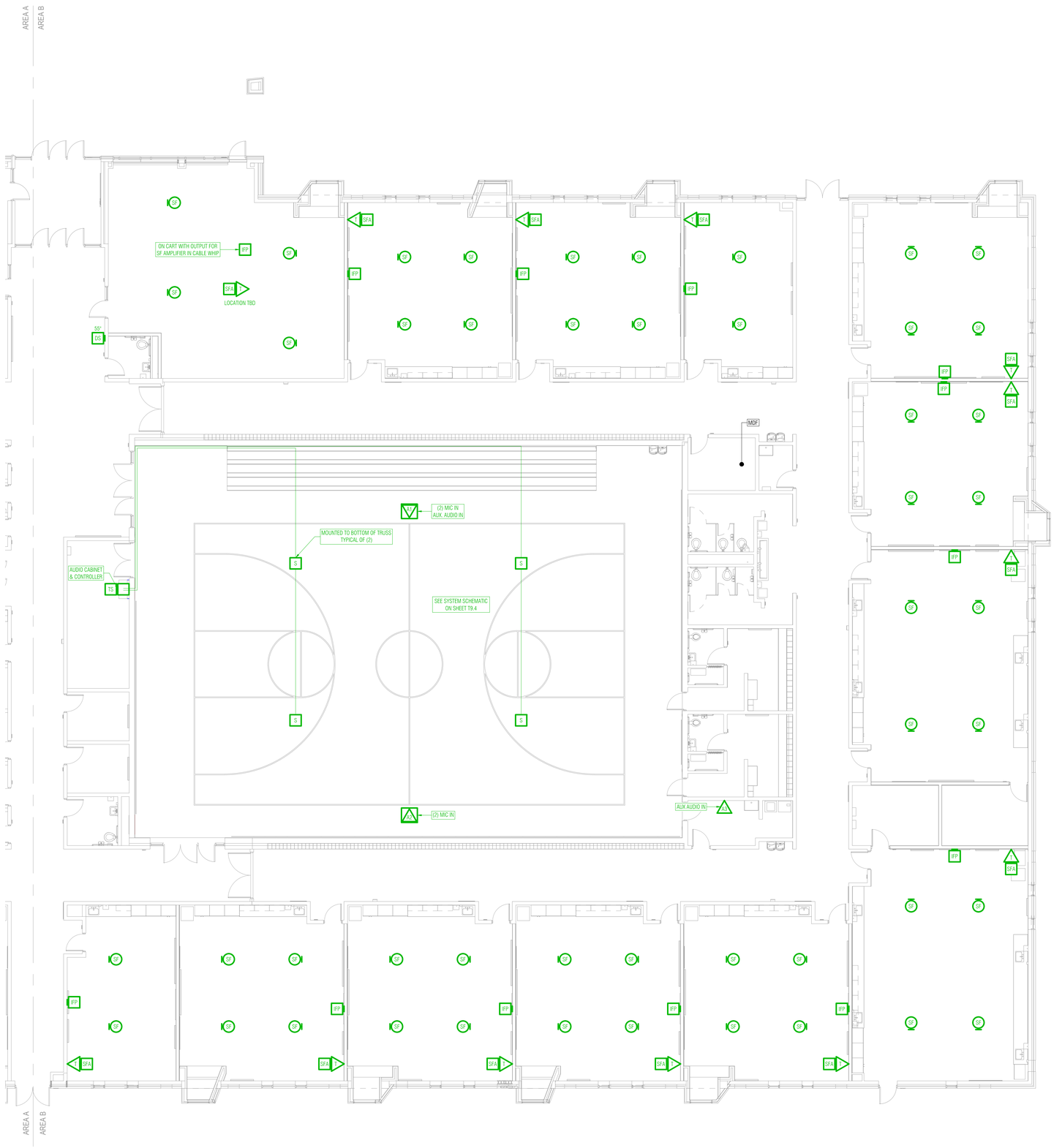
Bid Package SB-1785
Mt. Hope

Mt. Hope

1st Floor Unit A
Audiovisual Systems

T5.1A

N



Audiovisual Systems - Area B

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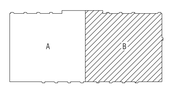

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Scale: 1/8" = 1'

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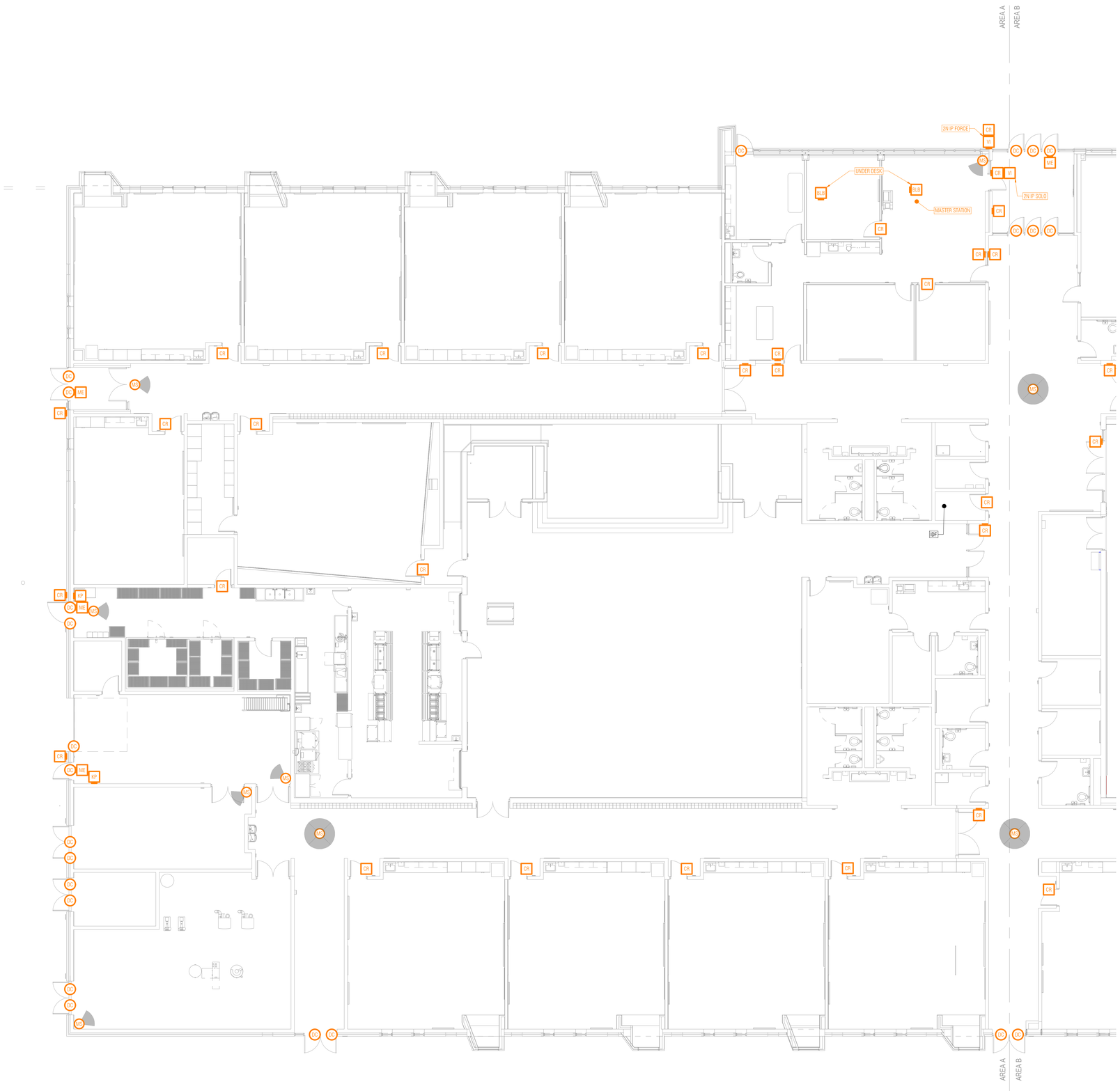
Bid Package SB-1785
Mt. Hope

Mt. Hope

1st Floor Unit B
Audiovisual Systems

T5.1B

N



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ACCESS CONTROL SYSTEM DEVICES:

- VI — VIDEO INTERCOM
- CR — CARD READER, WALL MOUNTED
- BC — CARD READER, DOOR HANDLE
- DC — DOOR CONTACT
- ME — MOTION REQUEST TO EXIT DEVICE

INTRUSION DETECTION SYSTEM DEVICES:

- KP — KEYPAD
- MS — MOTION SENSOR; SHADING INDICATES DIRECTION OF VIEW, NOT COVERAGE

ACCESS CONTROL & INTRUSION DETECTION SYSTEM PROJECT NOTES:

1. CARD READERS WILL BE PROVIDED BY THE DOOR HARDWARE CONTRACTOR. REFER TO DOOR HARDWARE SCHEDULE AND SPECIFICATIONS FOR FINAL COUNT AND LOCATIONS - NOT ALL ARE SHOWN ON THESE DRAWINGS.
2. WHEN BUILDING LOCKDOWN IS ENGAGED, ALL DOORS WITH ACCESS CONTROL SHALL LOCK, OVERRIDING ANY SCHEDULE AND PROHIBITING ACCESS FROM MOST CARDS. ONLY STAFF IN AN EMERGENCY ACCESS USER GROUP WILL HAVE ACCESS WITH THEIR CARDS. INTERIOR DOORS ARE TO BE PROGRAMMED WITH A PIN CODE THAT WOULD ONLY BECOME ACTIVE WHEN LOCKDOWN IS ENGAGED. LOCKDOWN MUST ALSO SEND AN EMAIL OR TEXT ALERT TO IDENTIFIED STAFF.
3. CONFIGURE SYSTEM TO SEND ALERTS WHEN EXTERIOR DOORS ARE PROPPED OPEN.
4. CONFIGURE INTRUSION DETECTION SYSTEM TO CALL EPS SECURITY, THE CURRENT MONITORING COMPANY.

Access Control & Intrusion Detection Systems - Area A

N

Barton Malow

Barton Malow Builders
26500 American Drive
Southfield, MI 48034

248.436.5000
www.bartonmalow.com

Owner:

Lansing School District
Lansing, Michigan

Project Number: TBD
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Drawn By: Bill Dawson
Checked By: Paul Twigg

Issued For	Date
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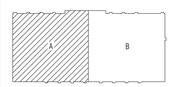

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Scale: 1/8" = 1'

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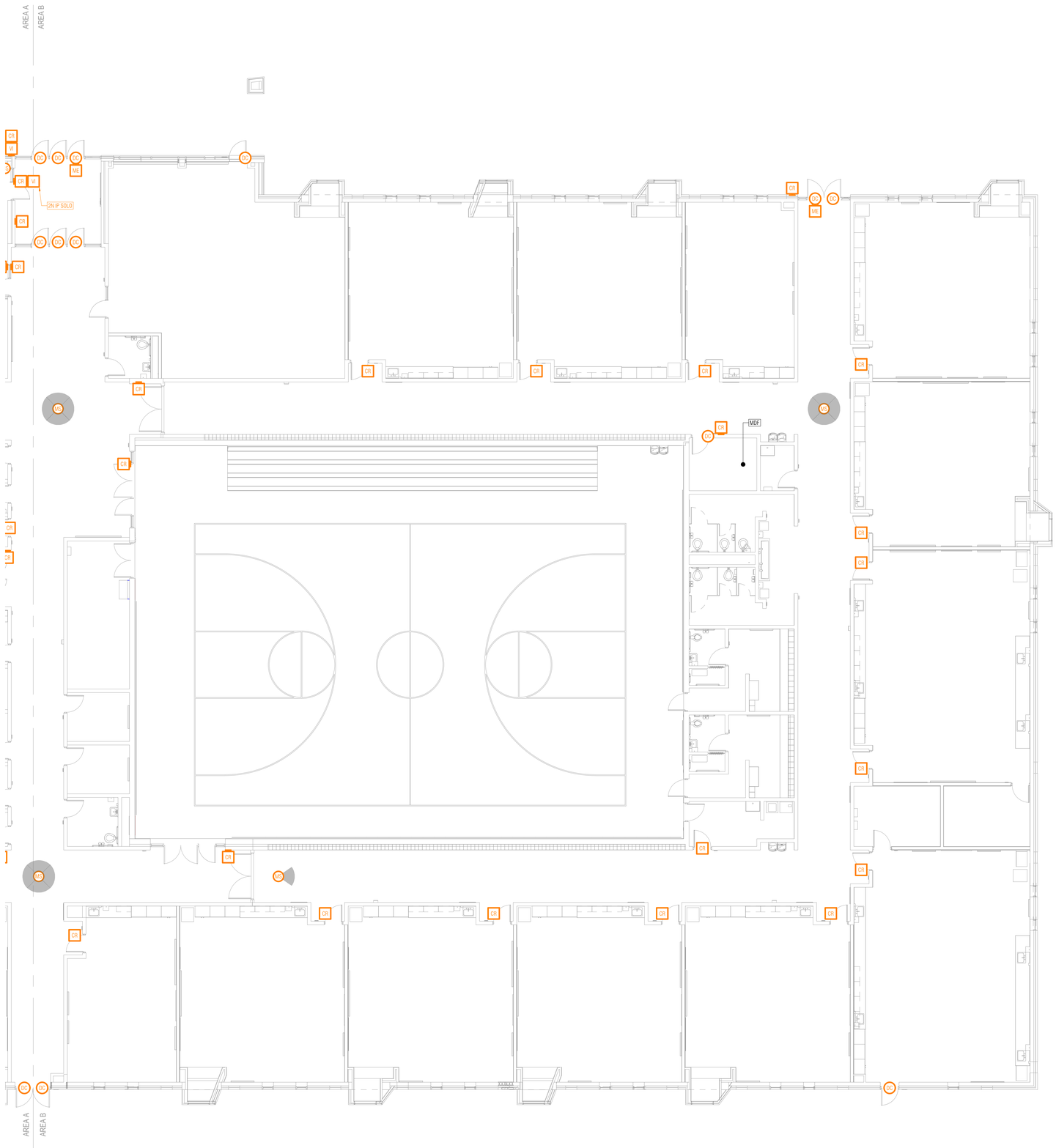
Bid Package SB-1785
Mt. Hope

Mt. Hope

1st Floor Unit A
Access Control &
Intrusion Detection System

T6.1A



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Access Control & Intrusion Detection Systems - Area B

N

Barton Malow

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Southfield, MI 48034

248.436.5000
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Owner:

Lansing School District
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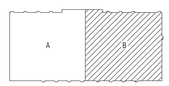


Native Page Size: 42" X 30"

Scale: 1/8" = 1'

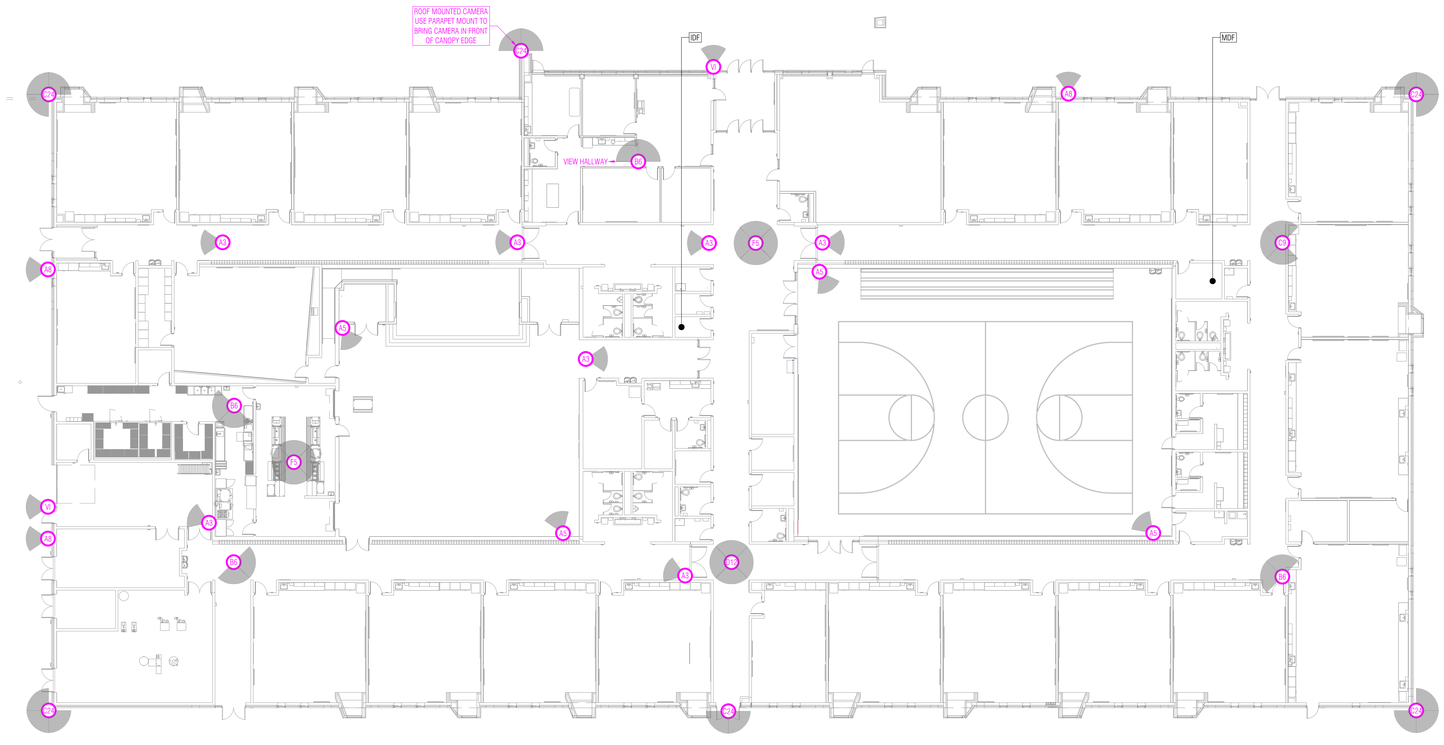
0' 2' 4' 8' 16'

Bid Package SB-1785
Mt. Hope

Mt. Hope

1st Floor Unit B
Access Control &
Intrusion Detection System

T6.1B



Video Surveillance System

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SYMBOL STYLES & ABBREVIATIONS:

VIDEO SURVEILLANCE CAMERA; SHADING INDICATES DIRECTION OF VIEW, NOT COVERAGE

A ONE LENS / SENSOR
B TWO LENS / SENSOR
C THREE LENS / SENSOR
D FOUR LENS / SENSOR
F FISHEYE LENS / SENSOR
TOTAL MEGAPIXELS FOR CAMERA; DIVIDE BY NUMBER OF SENSORS FOR MINIMUM PER SENSOR
VI VIDEO INTERCOM STATION (BY ACCESS CONTROL CONTRACTOR); INCLUDE FOR VIDEO RECORDING

PROJECT NOTES:

1. CONFIRM ALL MOUNTING LOCATIONS WITH TECHNOLOGY DESIGNER PRIOR TO INSTALLATION.

2. REVIEW AND CONFIRM ALL CAMERA VIEWS AND SETTINGS WITH TECHNOLOGY DESIGNER AND OWNER PRIOR TO ACCEPTANCE; ADJUST AS NECESSARY.

3. ALL EXTERIOR CAMERAS SHALL BE RATED FOR SUCH USE AND BE PROVIDED WITH HOUSING, HEATER, AND BLOWER AS NECESSARY TO OPERATE IN THE INTENDED CLIMATE.

4. ALL EXTERIOR SINGLE-LENS CAMERAS SHALL DOME-STYLE WITH A SUN SHADE.

5. INCLUDE PENDANT ARM MOUNTS FOR EXTERIOR MULTI-LENS CAMERAS DUE TO FIELD CONDITIONS OR TO OBTAIN THE DESIRED VIEW.

6. VIDEO SURVEILLANCE CONTRACTOR TO PROVIDE PATCH CABLES BETWEEN CAMERA AND DATA JACK SUPPLIED BY OTHERS. COORDINATE JACK LOCATIONS WITH STRUCTURED CABLING CONTRACTOR.

7. THE OWNER'S EXISTING SERVERS WILL BE USED FOR THE ADDITIONAL CAMERAS.

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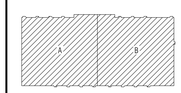

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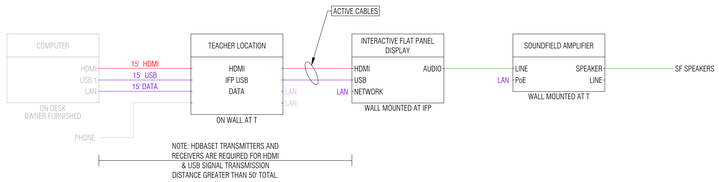
Bid Package SB-1785
Mt. Hope

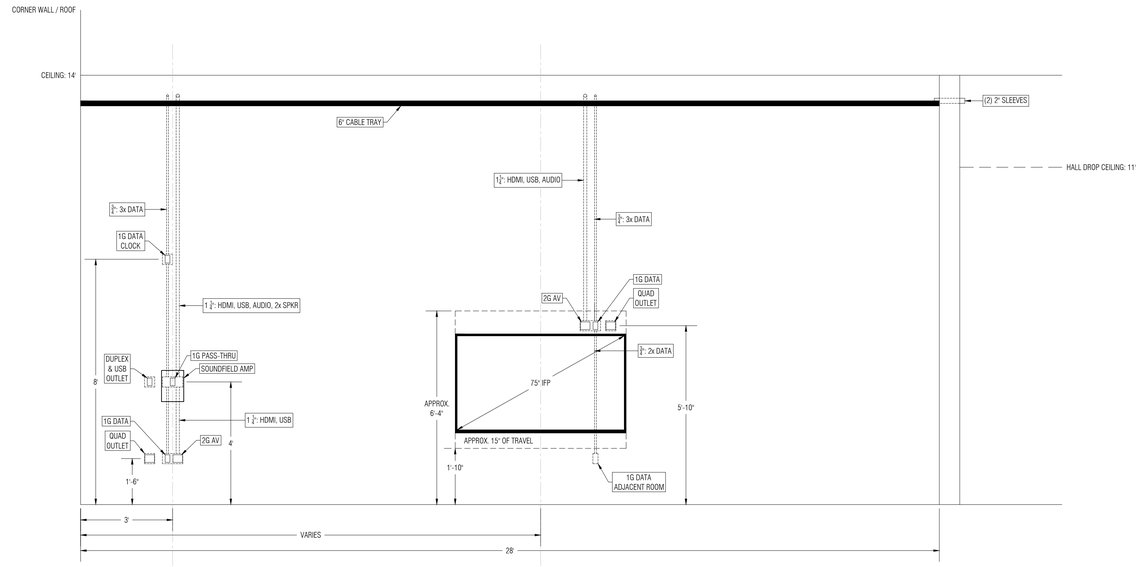
Mt. Hope

N

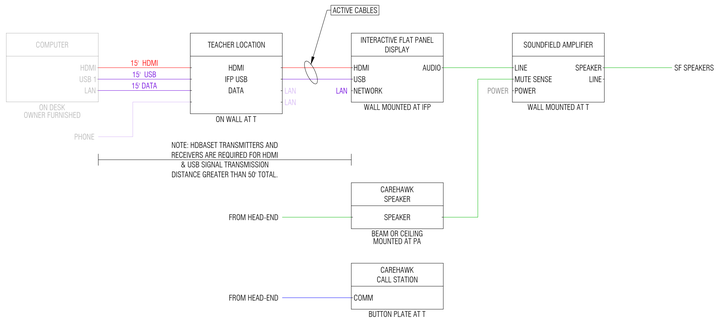
T7.1



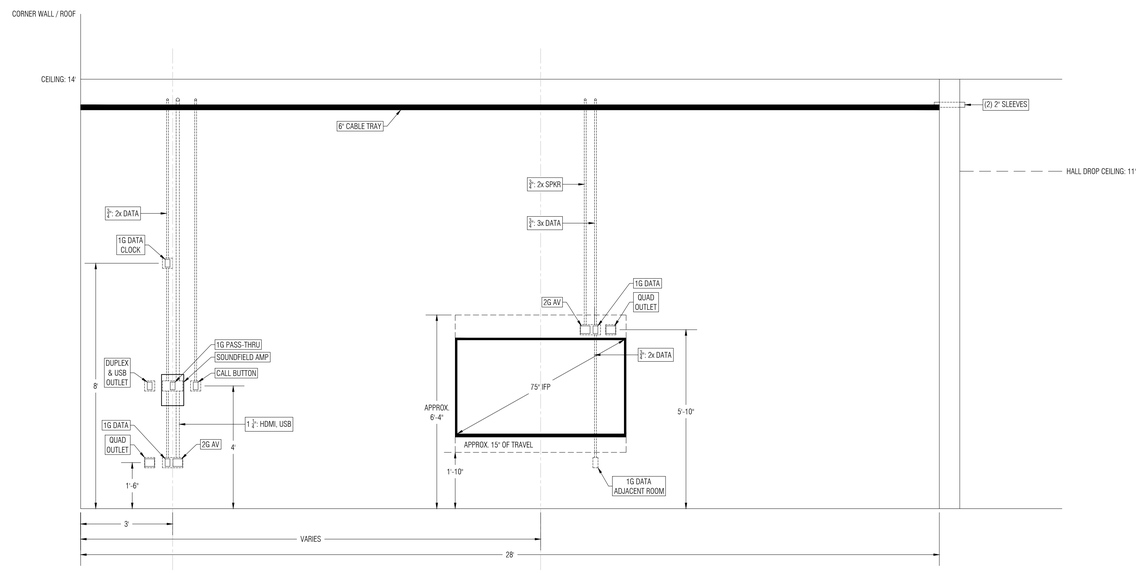
Typical Classroom Audiovisual System Schematic
SCALE: NONE



Typical Classroom Interactive Flat Panel & Teacher Station Elevation
SCALE: 1/2" = 1'



Alternate Typical Classroom Audiovisual System Schematic - Public Address Speaker & Call Button
SCALE: NONE



Alternate Typical Classroom Interactive Flat Panel & Teacher Station Elevation - Public Address Call button
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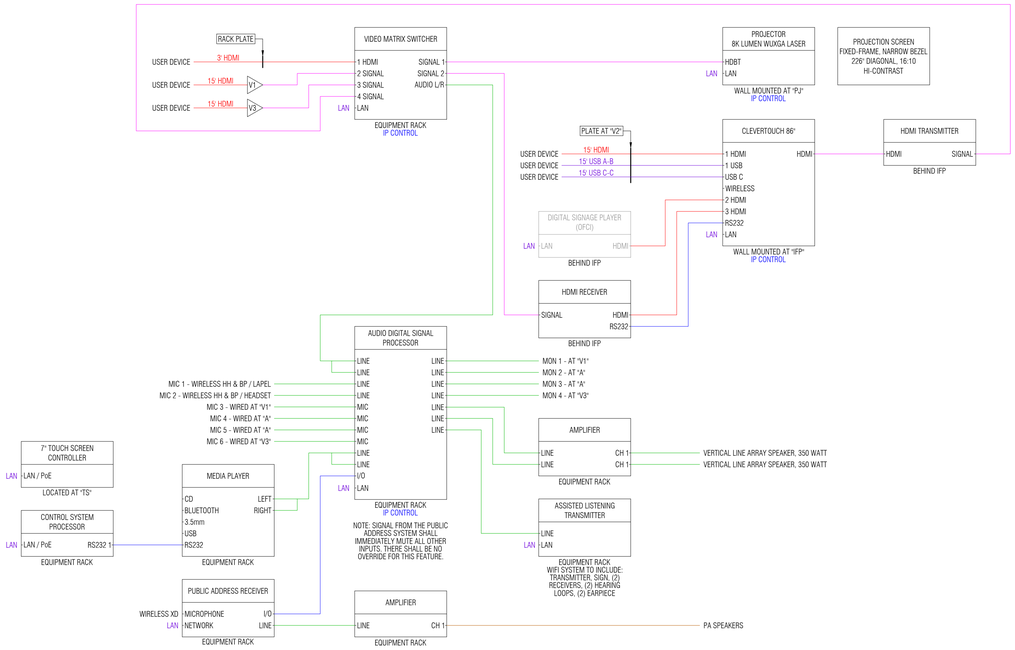
Scale: As Noted

Bid Package SB-1785
Mt. Hope

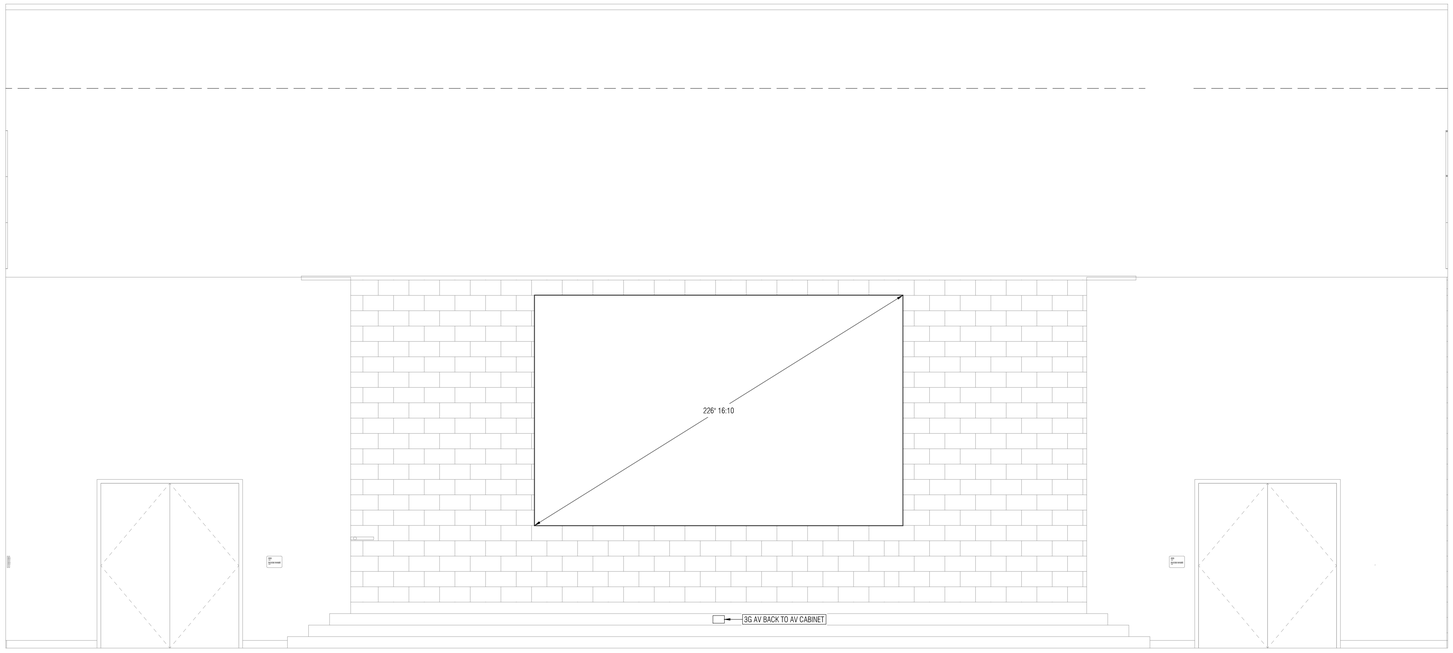
Details

Typical Classroom
Schematic, Elevations, Details

T9.1



Cafeteria Audiovisual System Schematic
SCALE: NONE



Cafeteria Stage & Projection Screen Elevation
SCALE: 3/8" = 1'

Barton Malow

Barton Malow Builders
26500 American Drive
Southfield, MI 48034

248.436.5000
www.bartonmalow.com

Owner:

Lansing School District
Lansing, Michigan

Project Number: TBD
Project Manager: Paul Twigg
Drawn By: Bill Dawson
Checked By: Paul Twigg

Issued For	Date
BID	06/23/2023

Key Plan:

Native Page Size: 42" X 30"

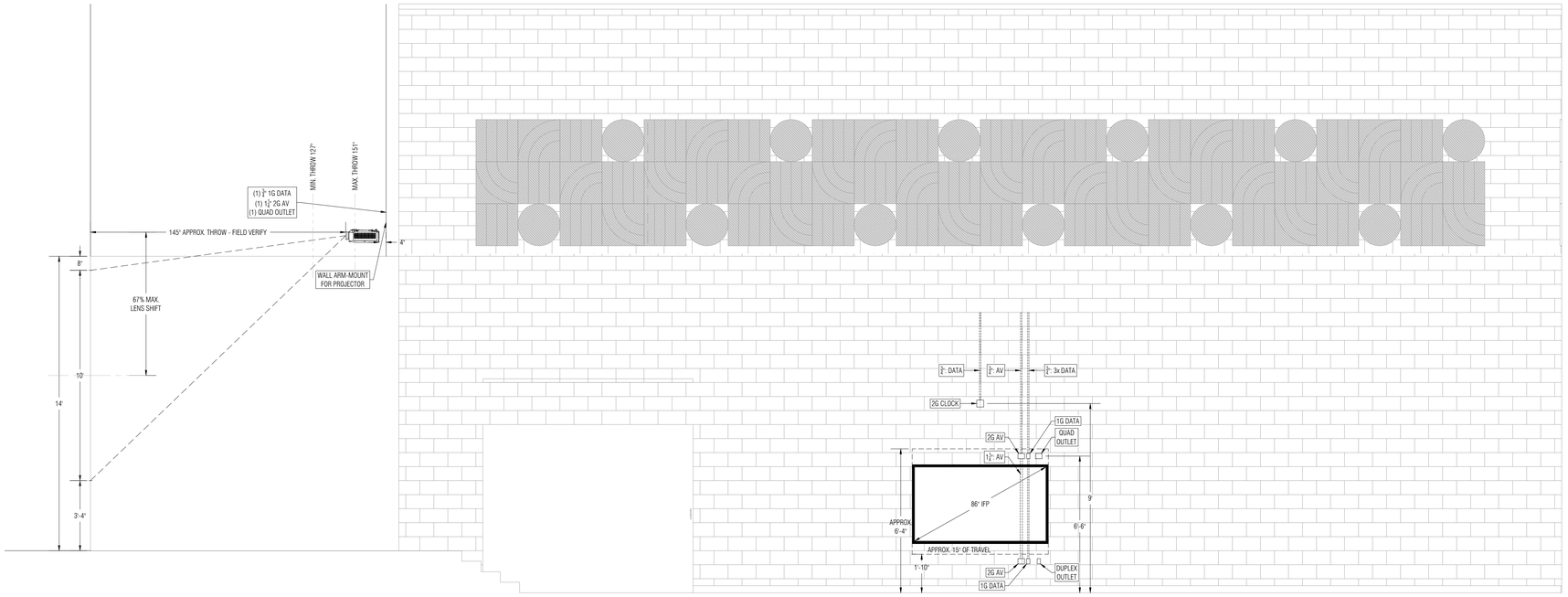
Scale: As Noted

Bid Package SB-1785
Mt. Hope

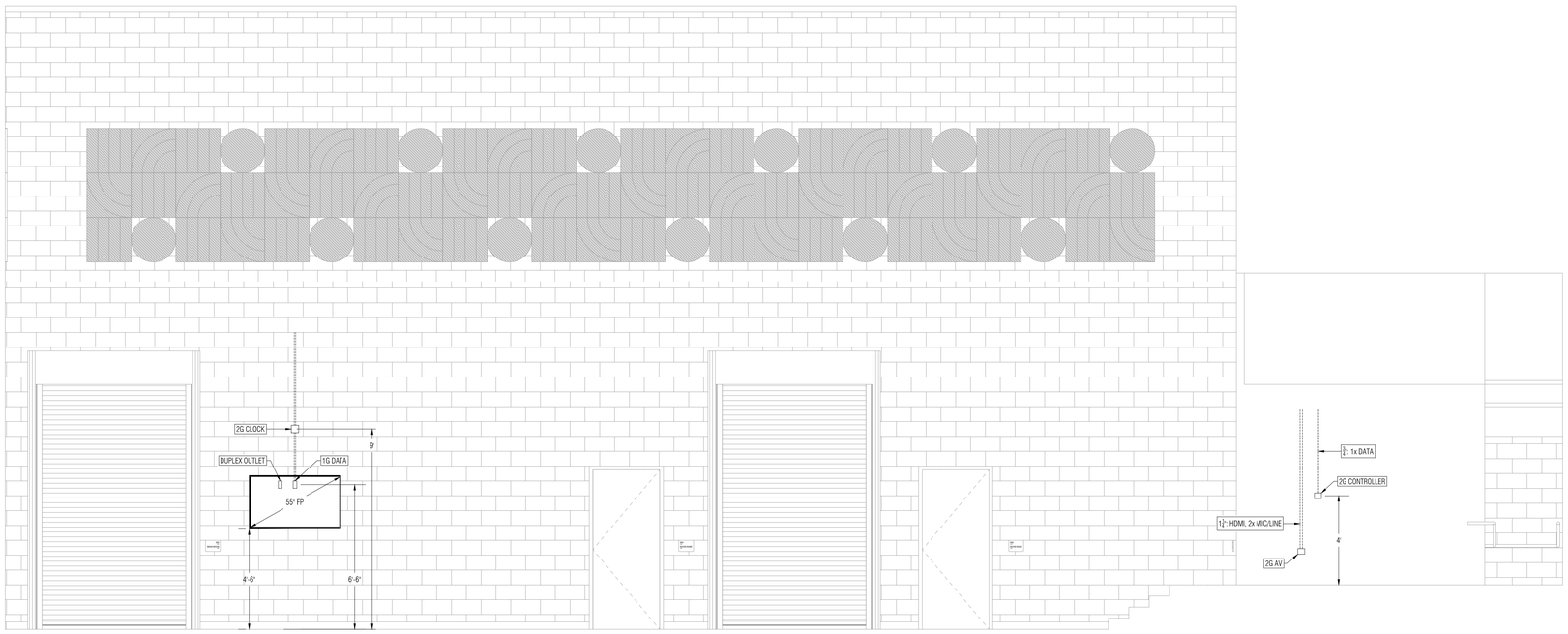
Details

Cafeteria
Audiovisual System Schematic
North Wall Elevation

T9.2



Cafeteria East Wall Elevation
SCALE: 3/8" = 1'



Cafeteria West Wall Elevation
SCALE: 3/8" = 1'

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Scale: As Noted

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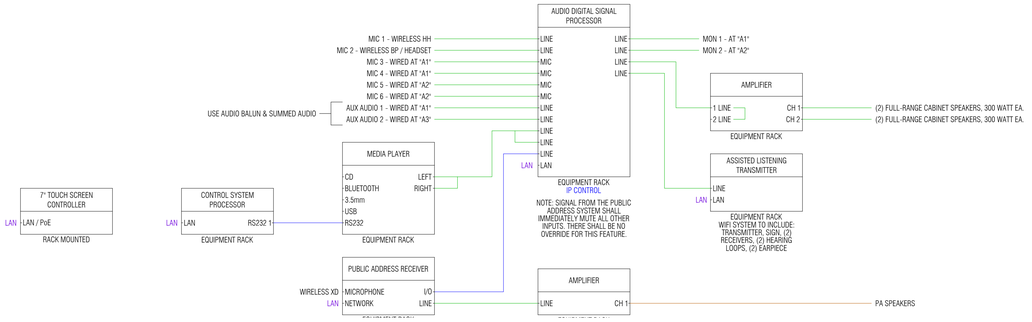
Mt. Hope

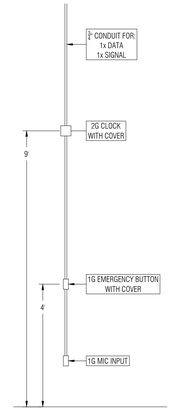
Details

Cafeteria
East Wall Elevation
West Wall Elevation

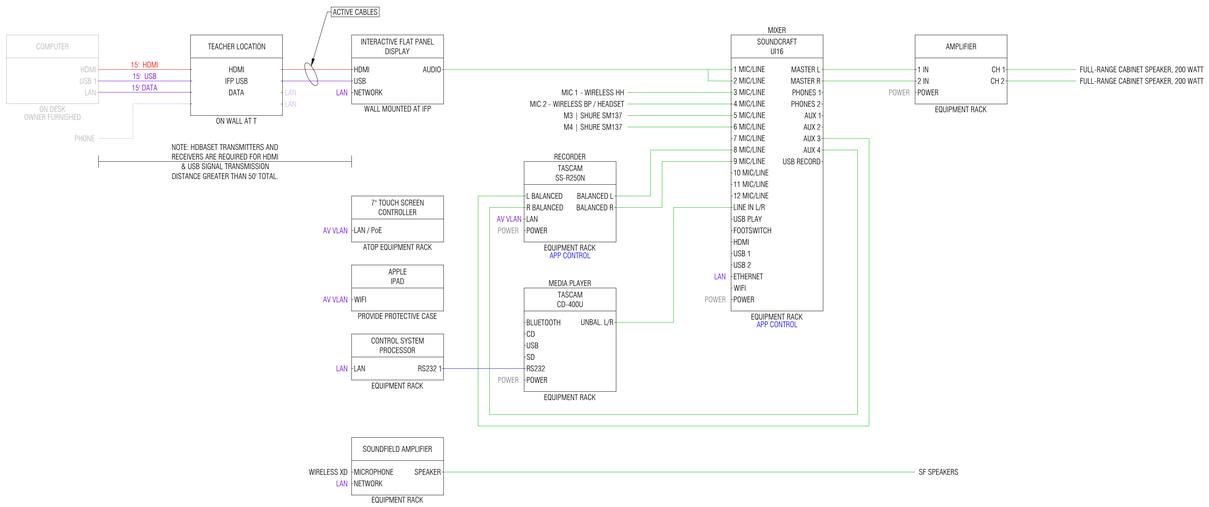
T9.3



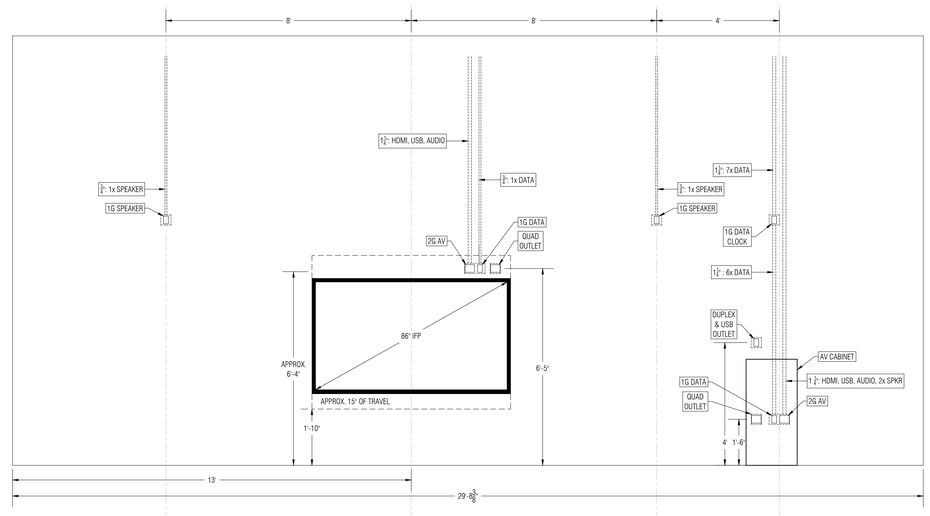
Gymnasium Audio System Schematic
SCALE: NONE



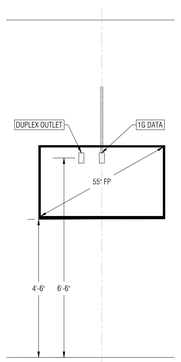
Gymnasium Emergency Button, Clock Elevation (typical of 2)
SCALE: 1/2" = 1'



Music Room Audiovisual System Schematic
SCALE: NONE



Music Room Front of Classroom Elevation
SCALE: 1/2" = 1'



Typical Digital Signage Display Elevation
SCALE: 1/2" = 1'

Sample Rack ID Plate
SCALE: 1/2"=1"

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Details

Gymnasium, Music Room
& Typical Digital Signage
Schematics, Elevations, Details

T9.4