CHRISTMAN
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Addendum No.[1]

Project Name: Mt. Hope School – New Build

Project No.: 221125-140

Architect: C2AE

Date: 7/25/2023

Bid Package No.: 2

Bid Due Date: 08/03/2023

This Addendum is issued to inform the bidders of modifications in the scope of work being bid for this project.

A. Documents included in this Addendum and dated [7/25/2023]:

- C2AE Addendum 1:
  - Specification section(s):200533 - Heat Tracing, 200593 - Testing, Adjusting, and Balancing, 211316 - Dry-Pipe Sprinkler Systems, 221116 - Domestic Water Piping, 221119 - Domestic Water Piping Specialties, 221319 - Sanitary Waste Piping Specialties, 224200 - Commercial Plumbing Fixtures, 224700 - Drinking Fountains and Electric Water Coolers, 230900 - Instrumentation and Control for HVAC, 233113 - Metal Ducts, 235216 - Condensing Boilers, 237200 - Air-To-Air Energy Recovery Equipment, 237413 - Packaged Unitary Rooftop Units, 238126 - Split-System Air-Conditioners, 238239 - Cabinet Unit Heaters, 323113 - Chain Link Fences and Gates
  - Drawing(s):
    - S-100A, S101A, S101B, S-201, S-503, A-101B, A-102, A-102A, A-102B, A-121A, A-121B, A131, A-502, A-506, A-601, M-111A, M-112A, M-112B, M-301, M-401, M-502, M-601, M-603, P-110A, P-110B, P-111A, P-111B, P-301, P-501, P-502, P-601

B. Bids are due [8/03/2023].

- **Include in your bid the increase or decrease for all materials, labor, supervision, overhead and profit required to properly and completely execute the work described in this Addendum.**
- **Acknowledge receipt of this Addendum on the Bid Proposal Form.**

The applicable provisions of the Contract Documents shall govern all work included herein unless specifically noted otherwise.

END OF ADDENDUM NO. [1]

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Lansing, MI 48933
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Addendum 1

Project No.:	22-0116	Date:	July 21, 2023
Project:	Mt. Hope Lansing School District SB-1785 Ingham County, MI	A/E Firm: Project Manager:	C2AE Steve Jurczuk
Owner:	Lansing School District 519 West Kalamazoo Street Lansing, MI 48933		

The following changes, revisions, modifications, etc. shall be incorporated into the contract documents, specifications, and plans.

BID FORM

A1.1 The Bidder shall acknowledge receipt of Addenda # 1 by indicating so in the spaces provided on Bid Form

SPECIFICATIONS

A1.2 Refer to Section 105113 – Metal Lockers (not reissued):
Delete paragraphs 2.5.D and 3.1.D to delete fixed benches.

A1.3 Refer to Section 107500 – Flagpoles (not reissued):
Delete paragraph 3.2.A.

A1.4 Refer to Section 126600 – Telescoping Stands (not reissued):
Revise subparagraph 2.2.B.3.b as follows:

"b. ~~Single-Phase Voltage: 115 V ac, 60 hertz.~~ *Three-Phase Voltage: 208V ac, 60 hertz."*

A1.5 Refer to Section 126600 – Telescoping Stands (not reissued):
Revise paragraph 2.3.C as follows:

"C. Deck: ~~Manufacturer's standard laminated panel.~~ *Manufacturer's standard panel with poly laminated surface."*

A1.6 Refer to Section 126600 – Telescoping Stands (not reissued):
Revise subparagraph 2.4.B.2 as follows:

"2. End panels covering exposed ends of stands in the stored position. *Provide end curtains covering exposed ends of stands in deployed position."*

A1.7 Refer to Section 126600 – Telescoping Stands (not reissued):
Delete the following subparagraphs 2.2.B.4.b, 2.2.B.4.c, 2.3.E.5, 2.3.E.6 and 2.4.B.1.

A1.8 Refer to Section 200533 – Heat Tracing (reissued):
Delete previously issued section and replace in its entirety.

A1.9 Refer to Section 200593 – Testing, Adjusting, and Balancing (reissued):
Delete previously issued section and replace in its entirety.

A1.10 Refer to Section 211316 – Dry Pipe Sprinkler Systems (reissued):
Delete previously issued section and replace in its entirety.

A1.11 Refer to Section 221116 – Domestic Water Piping (reissued):
Delete previously issued section and replace in its entirety.

A1.12 Refer to Section 221119 – Domestic Water Piping Specialties (reissued):
Delete previously issued section and replace in its entirety.

A1.13 Refer to Section 221319 – Sanitary Waste Piping Specialties (reissued):
Delete previously issued section and replace in its entirety.

A1.14 Refer to Section 221323 – Sanitary Waste Interceptors (not reissued):
Delete section. Duplicate information is covered in 221319.

A1.15 Refer to Section 224200 – Commercial Plumbing Fixtures (reissued):
Delete previously issued section and replace in its entirety.

A1.16 Refer to Section 224700 – Drinking Fountains and Electric Water Coolers (reissued):
Delete previously issued section and replace in its entirety.

A1.17 Refer to Section 230900 – Instrumentation and Control for HVAC (reissued):
Delete previously issued section and replace in its entirety.

A1.18 Refer to Section 233113 – Metal Ducts (reissued):
Delete previously issued section and replace in its entirety.

A1.19 Refer to Section 235216 – Condensing Boilers (reissued):
Delete previously issued section and replace in its entirety.

A1.20 Refer to Section 237200 – Air to Air Energy Recovery Equipment (reissued):
Delete previously issued section and replace in its entirety.

A1.21 Refer to Section 237413 – Packaged Unitary Rooftop Units (reissued):
Delete previously issued section and replace in its entirety.

A1.22 Refer to Section 238126 – Split-System Air-Conditioners (reissued):
Delete previously issued section and replace in its entirety.

A1.23 Refer to Section 238239 – Cabinet Unit Heaters (reissued):
Delete previously issued section and replace in its entirety.

A1.24 Refer to Section 323113 – Chain Link Fences and Gates (reissued):
Reissue section in its entirety to delete Horizontal-slide, motor operated gates.

DRAWINGS

A1.25 Refer to Sheet G-001 (not reissued):

- Add alternate 4 Glass Break Sensors
- Provide wired glass break sensors for exterior windows and integrate into intrusion detection system. Sensors are to be detect both impact and shattering frequencies with a range of 30' (e.g Honeywell FG730 or similar by NAPCO or approved equivalent). Locate in each room according to manufacturer guidelines. Provide conduit to conceal cables within open ceiling spaces. Configure system to notify central station of glass breakages. Provide for all Classrooms, Resource Rooms 114/406, Offices 102/103/105, Project Rooms 205/205/210, and Media Center 110. Mandatory alternate is to be based on wired sensors (i.e. not requiring battery replacement); wireless solutions can be proposed as a voluntary alternate.

A1.26 Refer to Sheet L-500 (not reissued):
Revise concrete maintenance strips in details 8/L-500 and 9/L-500 to be exposed aggregate.

A1.27 Refer to Sheet S-100A (reissued):
Clarify footing extents at bearing wall openings. Revise ramp landing elevation. Show schematic layout for equipment pads.

A1.28 Refer to Sheet S-101A (reissued):
Clarify roof deck conditions with added detail references.

A1.29 Refer to Sheet S-101B (reissued):
Clarify roof deck conditions with added detail references.

A1.30 Refer to Sheet S-201 (reissued):
Revise top girt elevation for screenwalls. Flip orientation of channel bracing.

A1.31 Refer to Sheet S-503 (reissued):
Add detail for beam bearing at high CMU walls.

A1.32 Refer to Sheet A-101B (reissued):
Masonry wall added behind washer and dryer to contain dryer vent.

A1.33 Refer to Sheets A-102, A-102A, and A-102B (reissued):
Revise roof drain location at canopy roof, and revise taper insulation to match.

A1.34 Refer to Sheets A-121A, A-121B, and A-131 (reissued):
Add washer and dryer to equipment schedules, and tag on plans.

A1.35 Refer to Sheets A-201, A-202, and A-211 (not reissued):
Reference ACM panels A thru E. Each will be a custom color for a total of five distinct ACM panel colors.

A1.36 Refer to Sheet A-502 (reissued):
Clarification on control joint detail 9/A-502.

A1.37 Refer to Sheet A-506 (reissued):
Revise door details to adjust spray foam insulation vs. air barrier linework.

A1.38 Refer to Sheet A-601 (reissued):
Revise door 308.1 to be 7'-10"H. with 2" head (8'-0" M.O.). Revise W2 height and width. Adjust SF8 security film to fit entire window extent.

A1.39 Refer to Sheet P-110A (reissued):
1. Add plumbing general note 19.
2. Revise storm drain sizes, square footage coverage, and building lead flow information as shown.
3. Add trap primer piping to beneath boiler room area as shown.

A1.40 Refer to Sheet P-110B (reissued):
1. Add plumbing general note 19.
2. Revise storm drain sizes, square footage coverage, and building lead flow as shown.
3. Add floor drain locations and tag with keynote P05 (previously graphically not showing up).

A1.41 Refer to Sheet P-111A (reissued):
1. Add plumbing general note 19.
2. Revise storm drain sizes, square footage coverage, and overflow discharge information as shown.
3. Add storm and storm overflow piping from new canopy roof drains.
4. Clarified cleanouts as floor cleanouts in locations shown.

A1.42 Refer to Sheet P-111B (reissued):
1. Add plumbing general note 19.
2. Revise storm drain sizes, square footage coverage, and overflow discharge information as shown.
3. Continue storm piping from new canopy roof drain. Revise connections to riser near room 111.
4. Clarified cleanouts as floor cleanouts in locations shown.
5. Clarified pipe sizes and routing outside room 212.

A1.43 Refer to Sheet P-301 (reissued):
1. Add plumbing general note 19.
2. Revise storm drain square footage coverage on plan 4.
3. Clarified cleanout as floor cleanout on plan 1.

A1.44 Refer to Sheet P-501 (reissued):
1. Revise Grease Interceptor detail.
2. Revise Water Service Piping Diagram.

A1.45 Refer to Sheet P-502 (reissued):
Revise sheet title.

A1.46 Refer to Sheet P-601 (reissued):
Revise floor drain / trap primer verbiage in plumbing fixture schedule.

A1.47 Refer to Sheet M-111A (reissued):
1. Decrease length of duct within room 102 to coordinate with new overflow roof conductor pipe.
2. Add VFD's to room 307.

A1.48 Refer to Sheet M-112A (reissued):
1. Revise sizes and square footage coverage of roof drains.
2. Add new roof drains at canopy.

A1.49 Refer to Sheet M-112B (reissued):
1. Revise sizes and square footage coverage of roof drains.
2. Add new roof drains at canopy (Same as previous item)

A1.50 Refer to Sheet M-301 (reissued):
Plan 1/M-301:
1. Call out equipment housekeeping pads.
2. Revise reference sheet for Manual Bypass.
3. Add TP-2 and ¾" DCW branch piping to cabinet.
4. Add isolation valves.
5. Clarify DCW & DHW branch sizes.

A1.51 Refer to Sheet M-401 (reissued):
Diagram 3: Revise Housekeeping pad note.

A1.52 Refer to Sheet M-502 (reissued):
1. Revise cooling coil and energy recovery section condensate drain trap piping detail note.
2. Revise rooftop equipment curb and duct drop detail as shown.

A1.53 Refer to Sheet M-601 (reissued):
1. Add air to air heat exchange schedule note.
2. Revise VFD schedule as shown.

A1.54 Refer to Sheet M-603 (reissued):
Revise HVAC Circ Pump Schedule "control" column to indicate control of HWHP-5 is "Auto" in lieu of VFD.

SECTION 200533 - HEAT TRACING – ADDENDUM 1

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: Five 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. 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 200593 - TESTING, ADJUSTING, AND BALANCING – ADDENDUM 1

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 211316 - DRY-PIPE SPRINKLER SYSTEMS – ADDENDUM 1

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 221116 - DOMESTIC WATER PIPING – ADDENDUM 1

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. Sanitary and vent piping.
   3. Storm drainage 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.

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 – ADDENDUM 1

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. Nameplates and signs are specified in 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 221319 - SANITARY WASTE PIPING SPECIALTIES – ADDENDUM 1

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. Trench Drains
4. Air-admittance valves.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Grease interceptors.
8. 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.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
   1. Grease interceptors.
   2. Solids Interceptors

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 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.

1.7 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 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 (appears round on plans, provide square)
13. Top Loading Classification: Medium-Duty. Drains located in Corridors and other occupied spaces shall be heavy duty loading.
14. Funnel: In locations indicated on plans.
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 TRENCH DRAINS

A. Trench Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Oatey

b. US Trench Drain

c. Luxe

2. Material: 304 SS
3. Flange: Anchor.
4. Clamping Device: Required.
5. Outlet: Bottom
6. Grate Material: 304 Stainless steel .
7. Grate Finish: Satin Stainless
8. Top Loading Classification: Medium Duty.
9. Trap Pattern: Standard P-trap.

2.5 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.

2.6 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.

2.7 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.

2.8 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

2.9 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.

A. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

B. Install fixture air-admittance valves on fixture drain piping.

C. Install stack air-admittance valves at top of stack vent and vent stack piping.

D. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Assemble open drain fittings and install with top of hub 1 inch above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. 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.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install vent caps on each vent pipe passing through roof.

K. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

M. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

N. 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.

O. 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.

P. Install wood-blocking reinforcement for wall-mounting-type specialties.

Q. 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 224200 - COMMERCIAL PLUMBING FIXTURES – ADDENDUM 1

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 224700 - ELECTRIC WATER COOLERS – ADDENDUM 1

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: Electric 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 – ADDENDUM 1

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 CO2.
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. Basis of Design: Veris TW Series
   a. Where manual overrides are required, the sensor housing shall feature an optional sliding mechanism for adjusting the space temperature setpoint.
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 (CO2 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; low profile surface mounted raceway may be used in finished areas on masonry walls with architect/engineer approval. All surface raceway in finished areas must be color matched to the existing finish.
   6. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. All conduit to be concealed.
   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 at substantial completion 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

C. A follow up on-site training shall occur 6 months after owner occupancy of the building and shall consist of a minimum of (8) hours of re-training the above items.

3.5 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.

3.6 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.

3.7 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.

3.8 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

3.9 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

3.10 AN ELECTRONIC COPY OF ALL DATABASES, CONFIGURATION FILES, OR ANY TYPE OF FILES CREATED SPECIFICALLY FOR EACH SYSTEM.

3.11 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.

3.12 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 233113 - METAL DUCTS – ADDENDUM 1

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.

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. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed ducts shall have a No. 4 finish and No. 2D for concealed ducts.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. 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.

G. 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. See Duct System Application Schedule on plans.

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 235216 - CONDENSING BOILERS – ADDENDUM 1

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. Second session to be completed within 12 months of date of Substantial Completion.
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 – ADDENDUM 1

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: 24 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. Can be split into two sessions of training with the second session to be completed within 12 months of date of Substantial Completion.

END OF SECTION 237200

SECTION 237413 – PACKAGED UNITARY ROOFTOP UNITS – ADDENDUM 1

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: 24 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. Can be split into two sessions of training with the second session to be completed within 12 months of date of Substantial Completion.

END OF SECTION 237413

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS – ADDENDUM 1

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: 18 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 238239 - CABINET UNIT HEATERS – ADDENDUM 1

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 temperature sensors 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 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.~~ (ADM1)

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.~~ (ADM1)
      d. Gates and hardware.
      ~~e. Gate operators, including operating instructions and motor characteristics.~~ (ADM1)

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.~~ (ADM1)

~~1.4 CLOSEOUT SUBMITTALS~~(ADM1)

~~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.~~ (ADM1)

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. (ADM1)
   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.~~ (ADM1)
   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~~ (ADM1)

~~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**~~ **(ADM1)**

~~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.~~ (ADM1)

C. Lubricate hardware and other moving parts.

~~3.8 DEMONSTRATION~~ (ADM1)

~~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

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

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

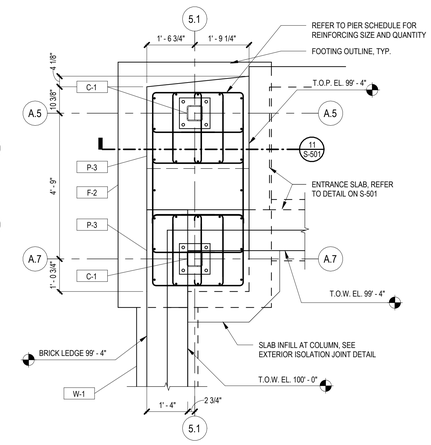
MARK	DIMENSIONS			REINFORCING		COMMENTS
	WIDTH	LENGTH	THICKNESS	W (SHORT BARS)	L (LONG BARS)	
F-1	5' - 0"	5' - 0"	1' - 6"	(6) #5 BARS TOP & BOTT.	(6) #5 BARS TOP & BOTT.	
F-2	5' - 0"	8' - 0"	1' - 6"	(7) #5 BARS TOP & BOTT.	(5) #5 BARS TOP & BOTT.	

FOUNDATION PLAN NOTES

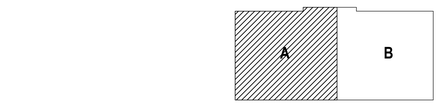
1. C.J. AND CONST. JOINT LOCATIONS ARE SHOWN FOR VISUAL REPRESENTATION ONLY. FIELD LOCATE AT SPACING NOT TO EXCEED 30 *SLAB THICKNESS.
2. PIPE PENETRATIONS THRU FOUNDATION, PER DETAIL.
3. REFER TO DETAIL FOR PIPE BOLLARD FOOTING DETAIL.
4. ALL FOOTINGS SHALL BEAR ON UNDISTURBED SOIL OR PROPERLY COMPACTED 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
NOT TO SCALE



KEY PLAN
NOT TO SCALE

01.0 - FOUNDATION PLAN - AREA A
1/8" = 1'-0"

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FOUNDATION PLAN - AREA A

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21JULY2023

PROJ. #: 220116
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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	HSS5X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3

FRAMING PLAN - AREA A LOW ROOF LEVEL
1/8" = 1'-0"

KEY PLAN
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FRAMING PLAN - AREA A LOW ROOF

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REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21JUL2023

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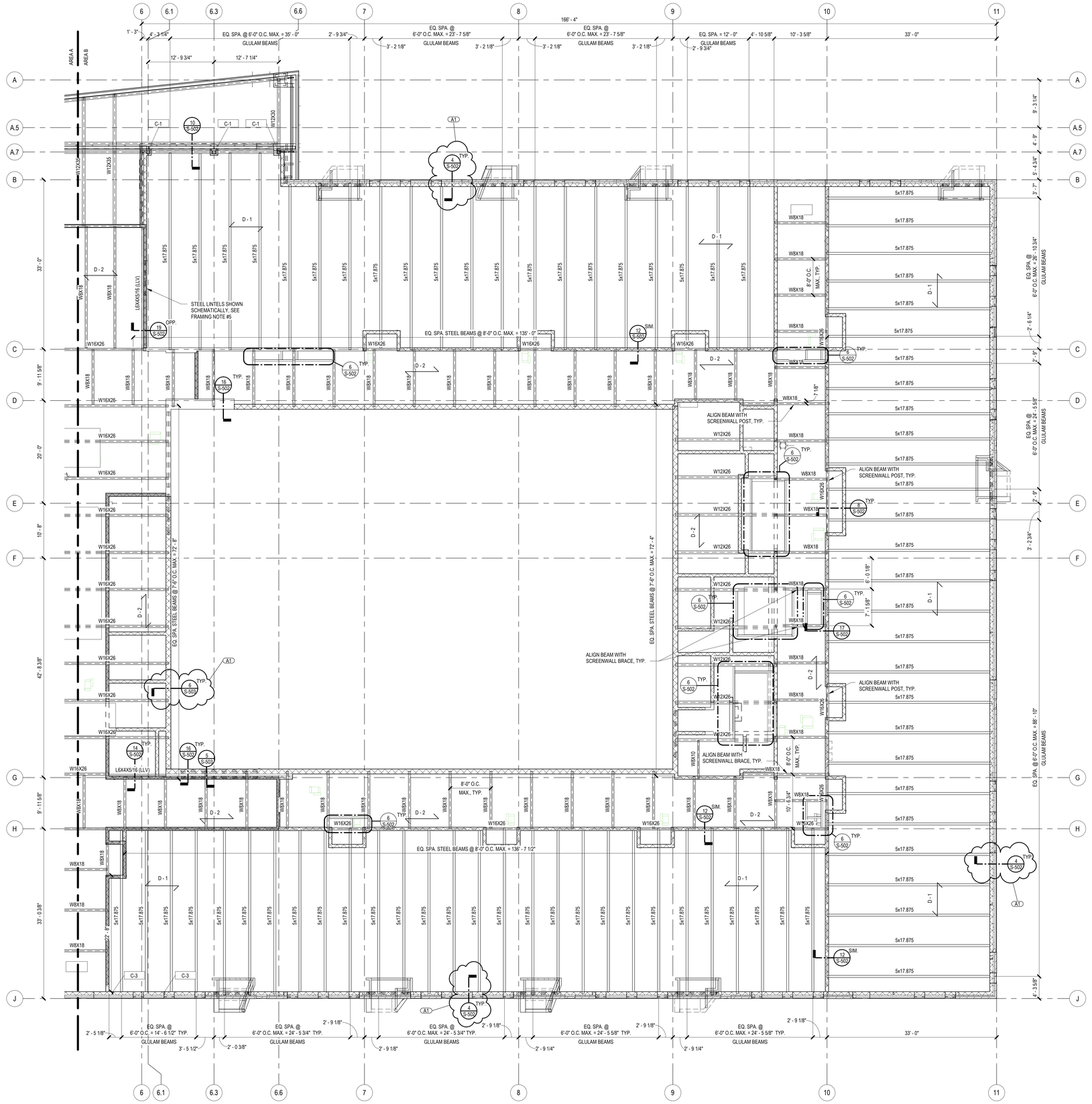

FRAMING PLAN - AREA B LOW ROOF LEVEL
1/8" = 1'-0"

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
   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
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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	HSS5X3X3/8	7" X 7" X 1/2"	4	1/2"Ø	12"	BP-3

KEY PLAN
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FRAMING PLAN - AREA B LOW ROOF

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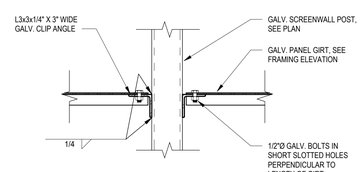
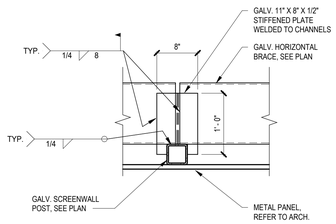
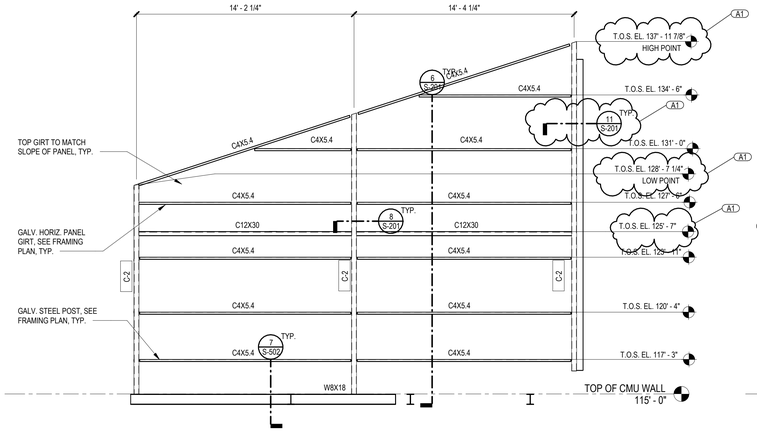


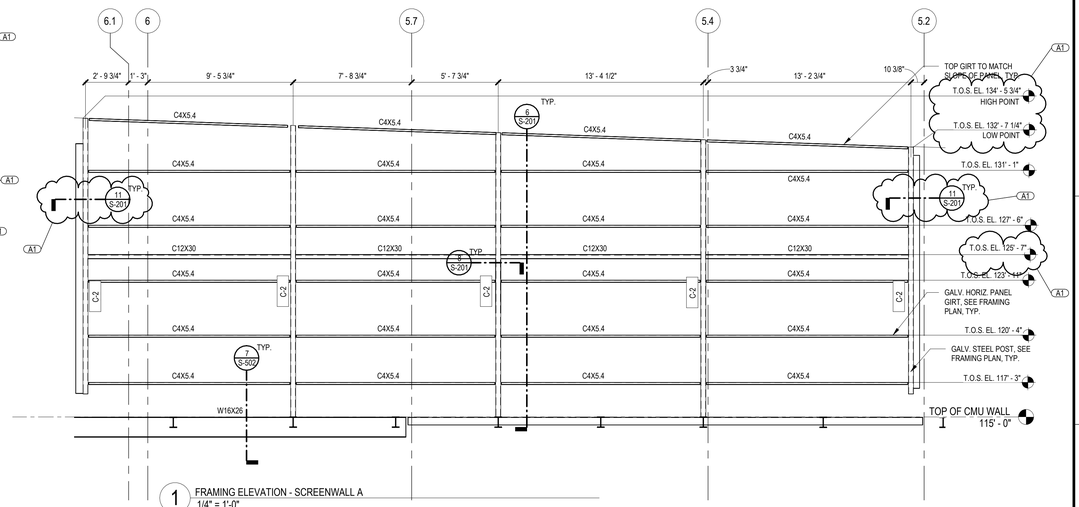
7 PANEL GIRT CONNECTION AT SCREENWALL POST
1 1/2" = 1'-0"



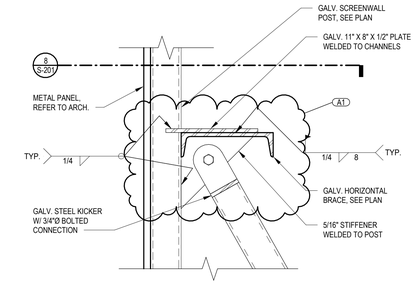
8 BRACE CONNECTION TO SCREENWALL POST
1" = 1'-0"



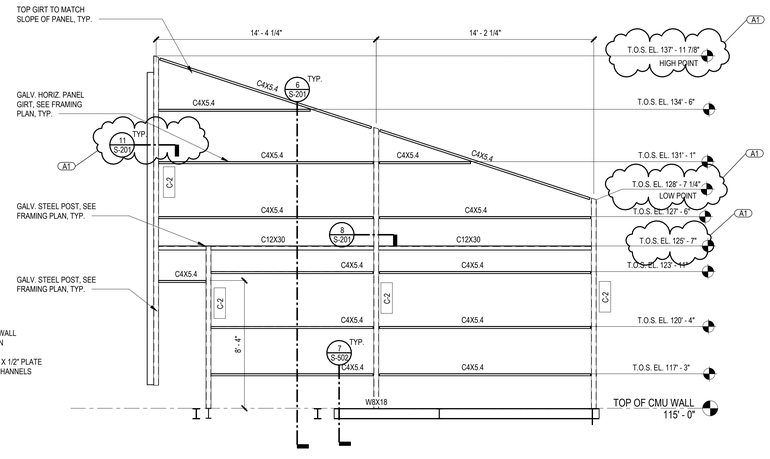
3 FRAMING ELEVATION - SCREENWALL D
1/4" = 1'-0"



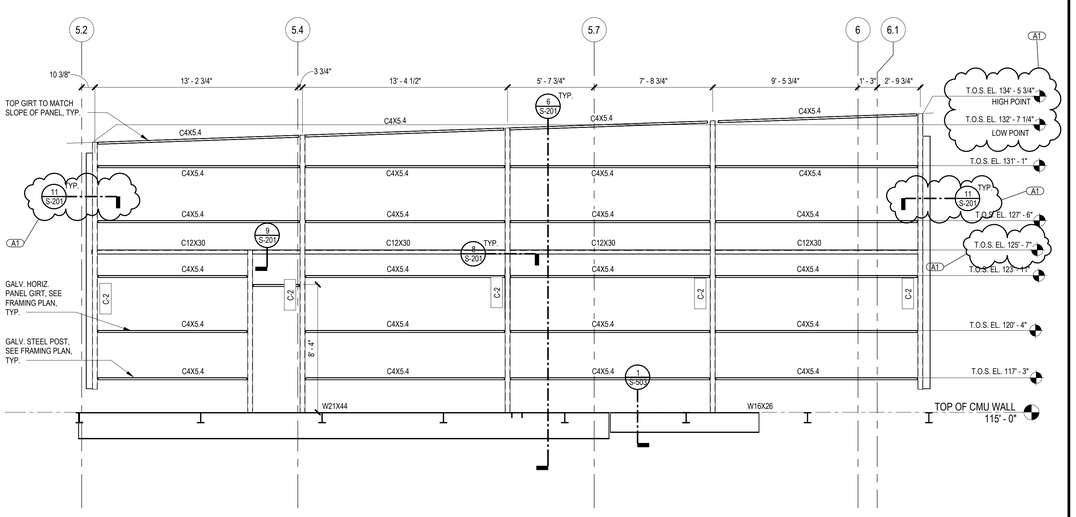
1 FRAMING ELEVATION - SCREENWALL A
1/4" = 1'-0"



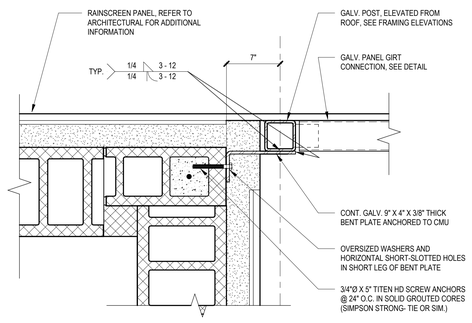
10 BRACE CONNECTION TO SCREENWALL POST
1 1/2" = 1'-0"



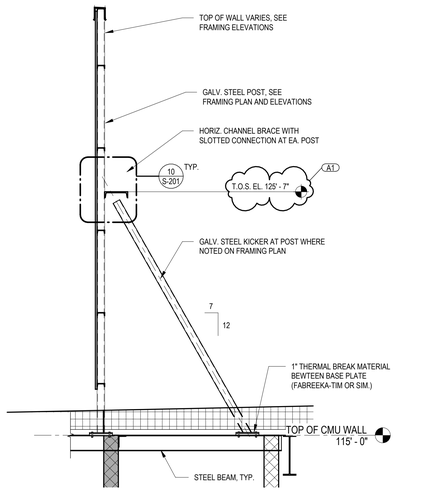
5 FRAMING ELEVATION - SCREENWALL E
1/4" = 1'-0"



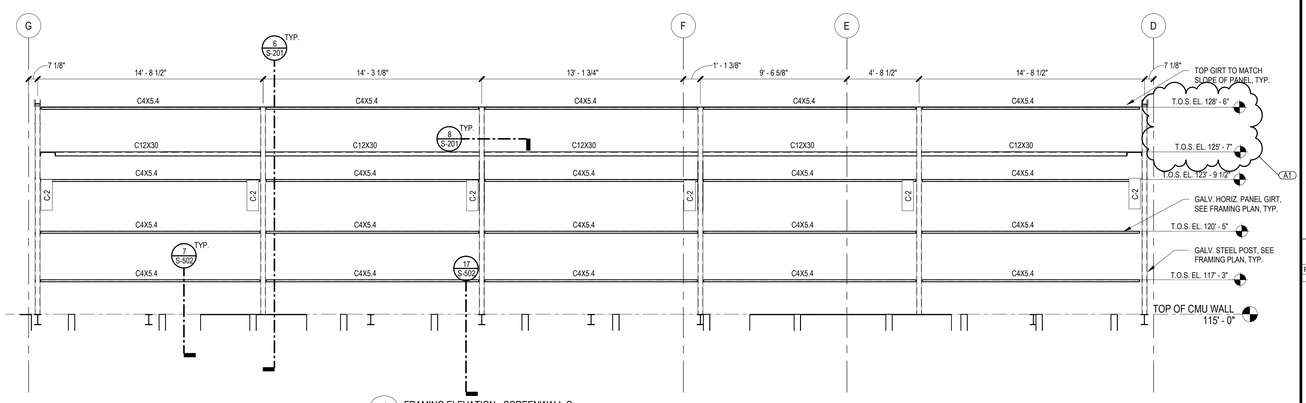
2 FRAMING ELEVATION - SCREENWALL B
1/4" = 1'-0"



11 TYP. SCREENWALL CLIP ATTACHMENT
1 1/2" = 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

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REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21JULY2023

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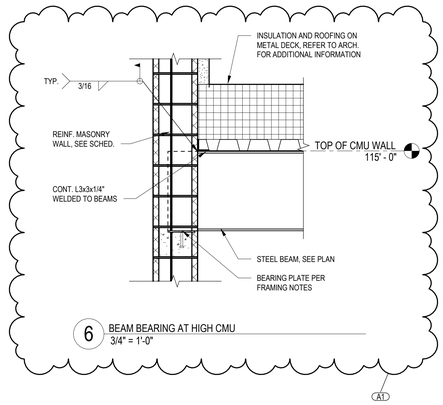
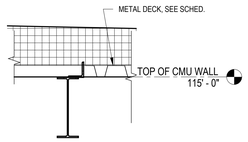
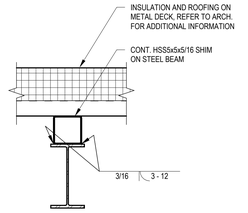


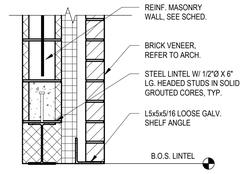
6 BEAM BEARING AT HIGH CMU
3/4" = 1'-0"



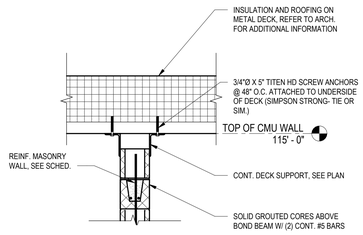
1 ROOF FRAMING DETAIL
3/4" = 1'-0"



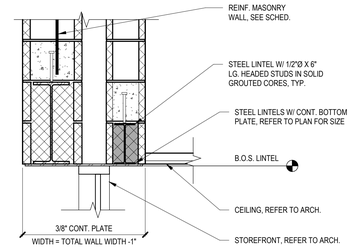
2 BUILT-UP CANOPY BEAM
1" = 1'-0"



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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FRAMING DETAILS

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21JUL2023

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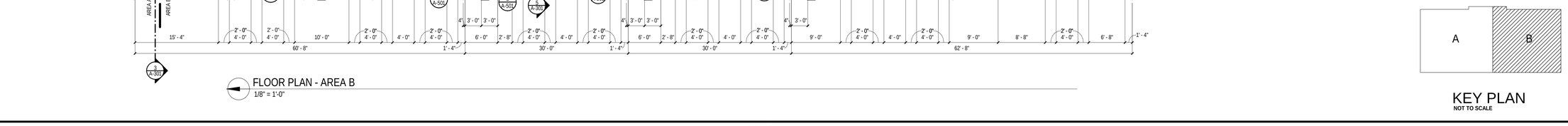
PARTITION TYPE GENERAL NOTES

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.

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.
3. DETAILS OF CONSTRUCTION NOT FULLY SHOWN SHALL BE OF THE SAME NATURE AS SHOWN FOR SIMILAR CONDITIONS. ANY UNCLEAR CONDITIONS SHALL BE VERIFIED WITH OWNER'S REPRESENTATIVE PRIOR TO CONSTRUCTION OF THAT AREA.
4. DRAWINGS ARE NOT TO BE SCALED. ANY UNCLEAR DIMENSIONS OR DIMENSIONAL DISCREPANCIES SHALL BE VERIFIED WITH OWNER'S REPRESENTATIVE.
5. ALL EXISTING CONDITIONS AND ALL RELATED DIMENSIONS INDICATED IN THE CONTRACT DOCUMENTS SHALL BE FIELD VERIFIED PRIOR TO FABRICATION, ERECTION, AND/OR CONSTRUCTION. ANY CONDITIONS THAT DIFFER FROM THAT INDICATED IN THE CONTRACT DOCUMENTS SHALL BE SUBMITTED TO THE OWNER'S REPRESENTATIVE FOR REVIEW PRIOR TO FABRICATION, ERECTION, AND/OR CONSTRUCTION.
6. CONSTRUCTION MANAGER (CM) / GENERAL CONTRACTOR (GC) TO REVIEW ENTIRE SET OF CONSTRUCTION DOCUMENTS AND SHALL COORDINATE WORK BETWEEN ALL TRADES. IF CONFLICTS ARISE DUE TO COORDINATION OF TRADES, CM / GC IS TO VERIFY CONFLICT WITH OWNER'S REPRESENTATIVE PRIOR TO CONSTRUCTION / INSTALLATION OF CONFLICTING ITEMS.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PREPARATIONS OF THE FLOORS, WALLS, AND CEILINGS FOR NEW FINISHES.
8. MAINTAIN FIRE RATING AT ALL ASSEMBLIES WHERE OPENINGS PENETRATIONS, EMBEDMENT, RECESSED EQUIPMENT, ACCESSORIES, ETC. DISRUPT THE CONTINUITY OF THE RATING
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 - AREA B
1/8" = 1'-0"



KEY PLAN
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FLOOR PLAN - AREA B

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21AUG2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-101B

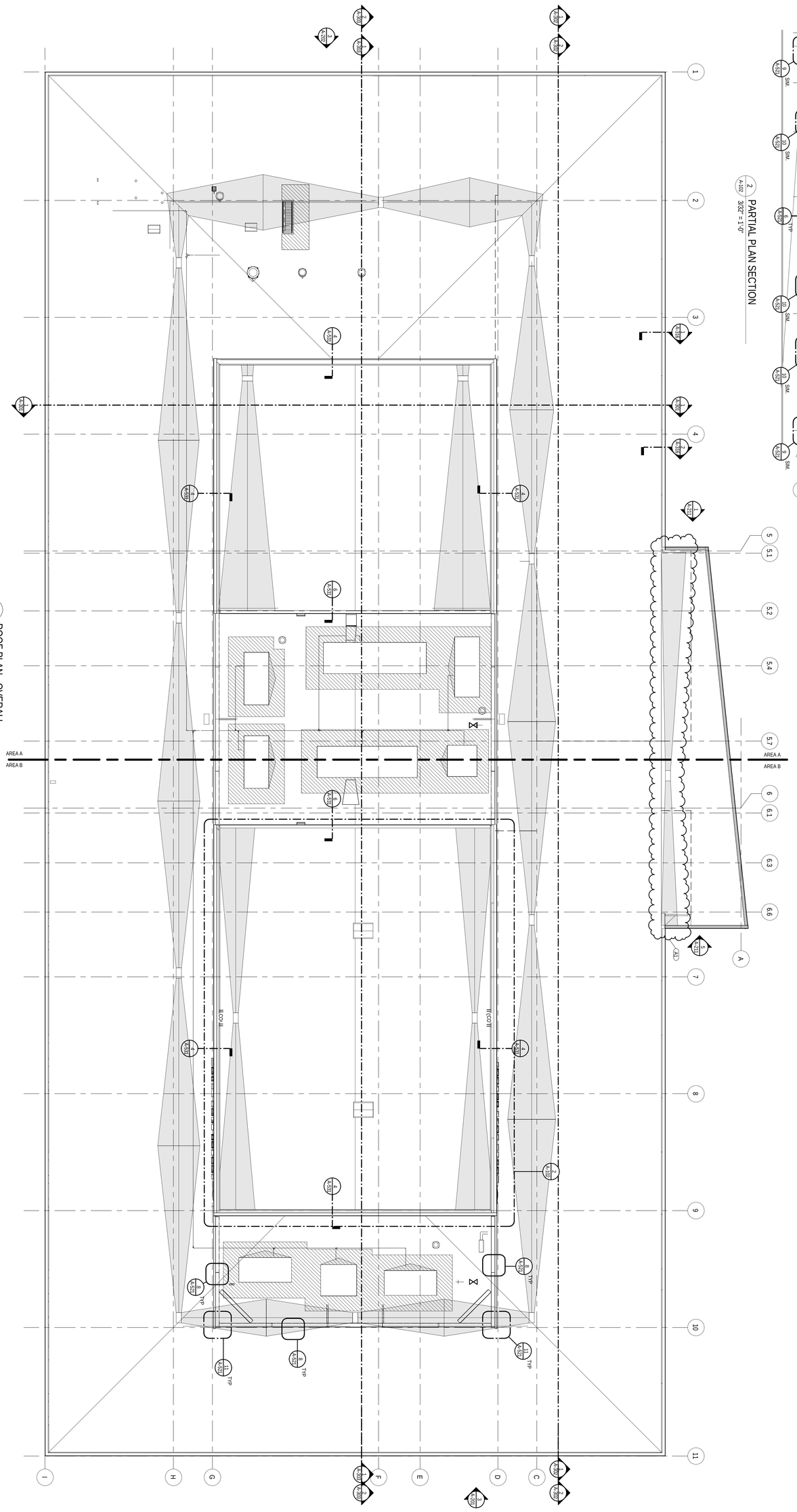
100% CONSTRUCTION DOCUMENTS
Addendum 1

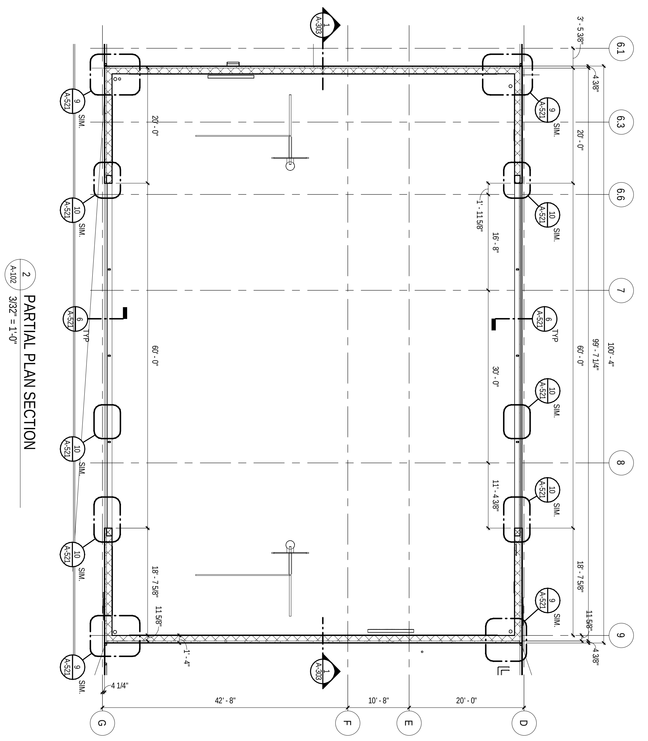
DESIGNED BY: Designer

CHECKED BY: Checker APPROVED BY: Approver

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID
WHITE BLACK

WE RECYCLE





ROOF PLAN

LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

REVISIONS		
REV	DESCRIPTION	DATE
A	ADDENDUM 1	7/24/2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET: A-102

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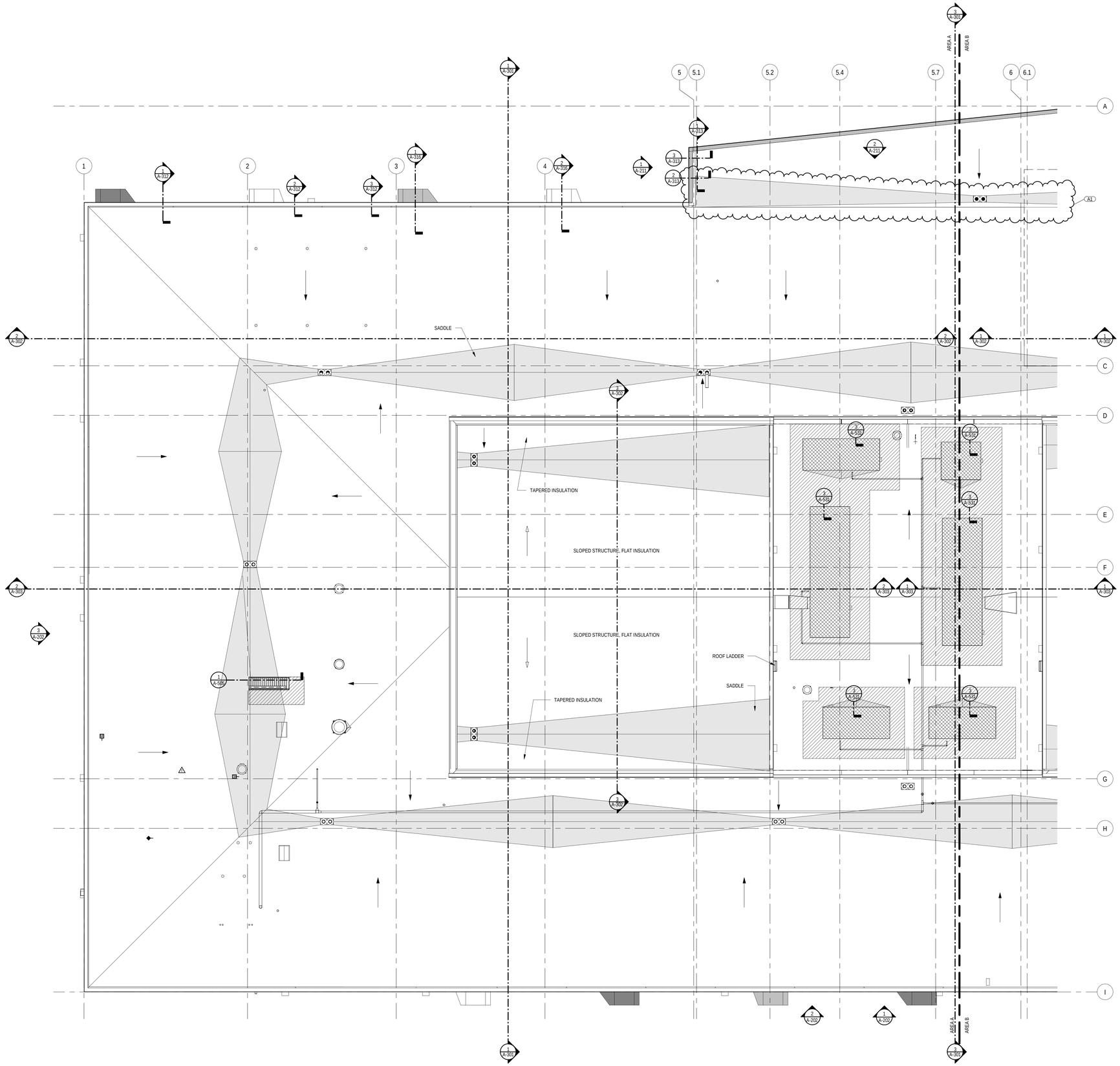
Addendum 1

100% CONSTRUCTION DOCUMENTS

WE RECYCLE

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK

WHITE

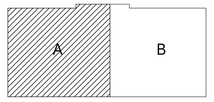


ROOF LEGEND

- 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.

ROOF PLAN - AREA A
1/8" = 1'-0"



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ROOF PLAN - AREA A

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21AUG2023

PROJ. #: 220116

DATE: 23-JUN-2023

SHEET

A-102A

100% CONSTRUCTION DOCUMENTS

Addendum 1

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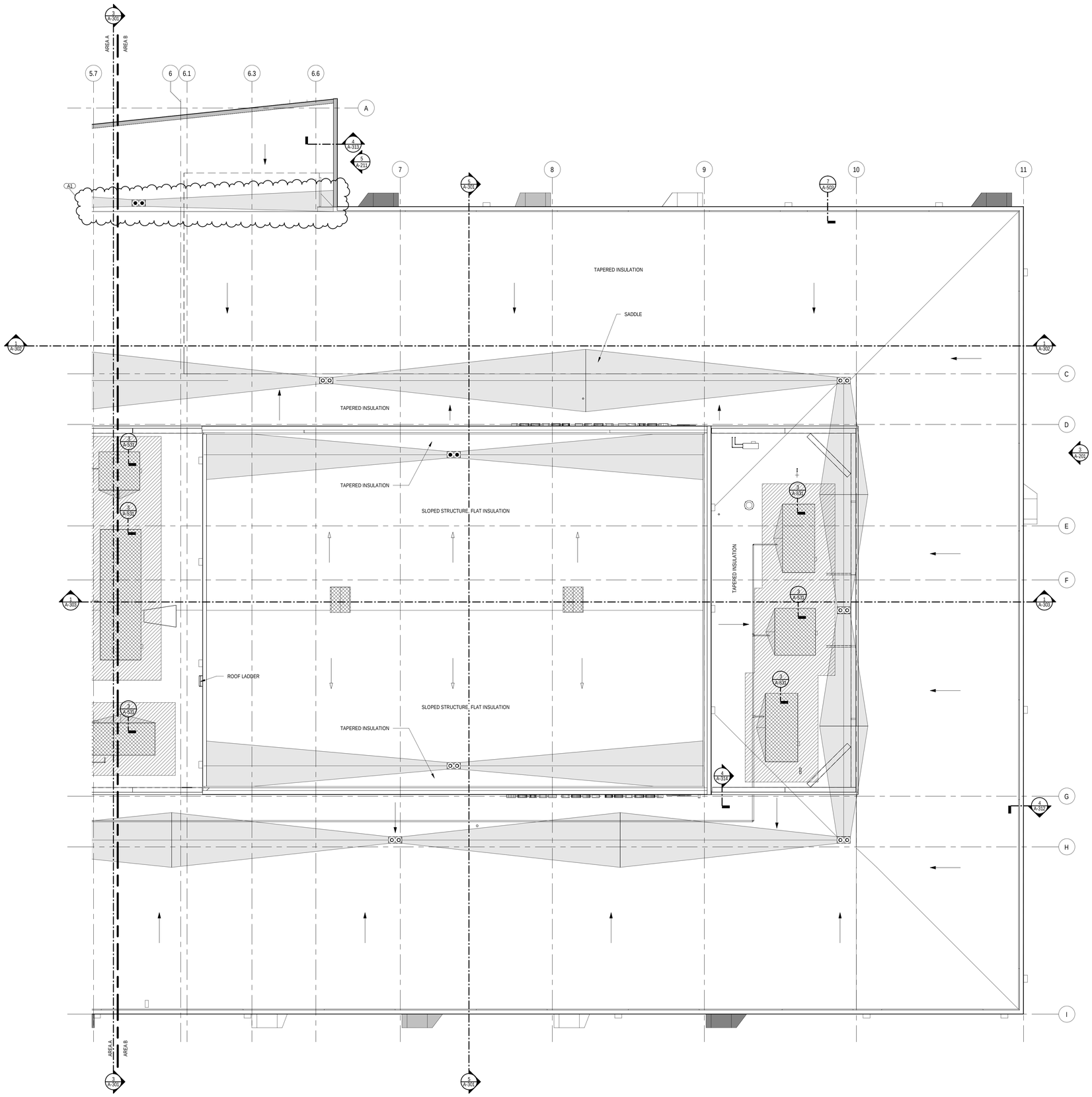
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



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
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- SD = SCUPPER DRAIN
- CONDENSING UNIT

NOTE:
FINAL TAPERED INSULATION DESIGN IS THE RESPONSIBILITY OF ROOFER.

KEY PLAN
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ROOF PLAN - AREA B

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	25JULY2023

PROJ. #: 220116
DATE: 23-JUN-2022
SHEET
A-102B

100% CONSTRUCTION DOCUMENTS
Addendum 1

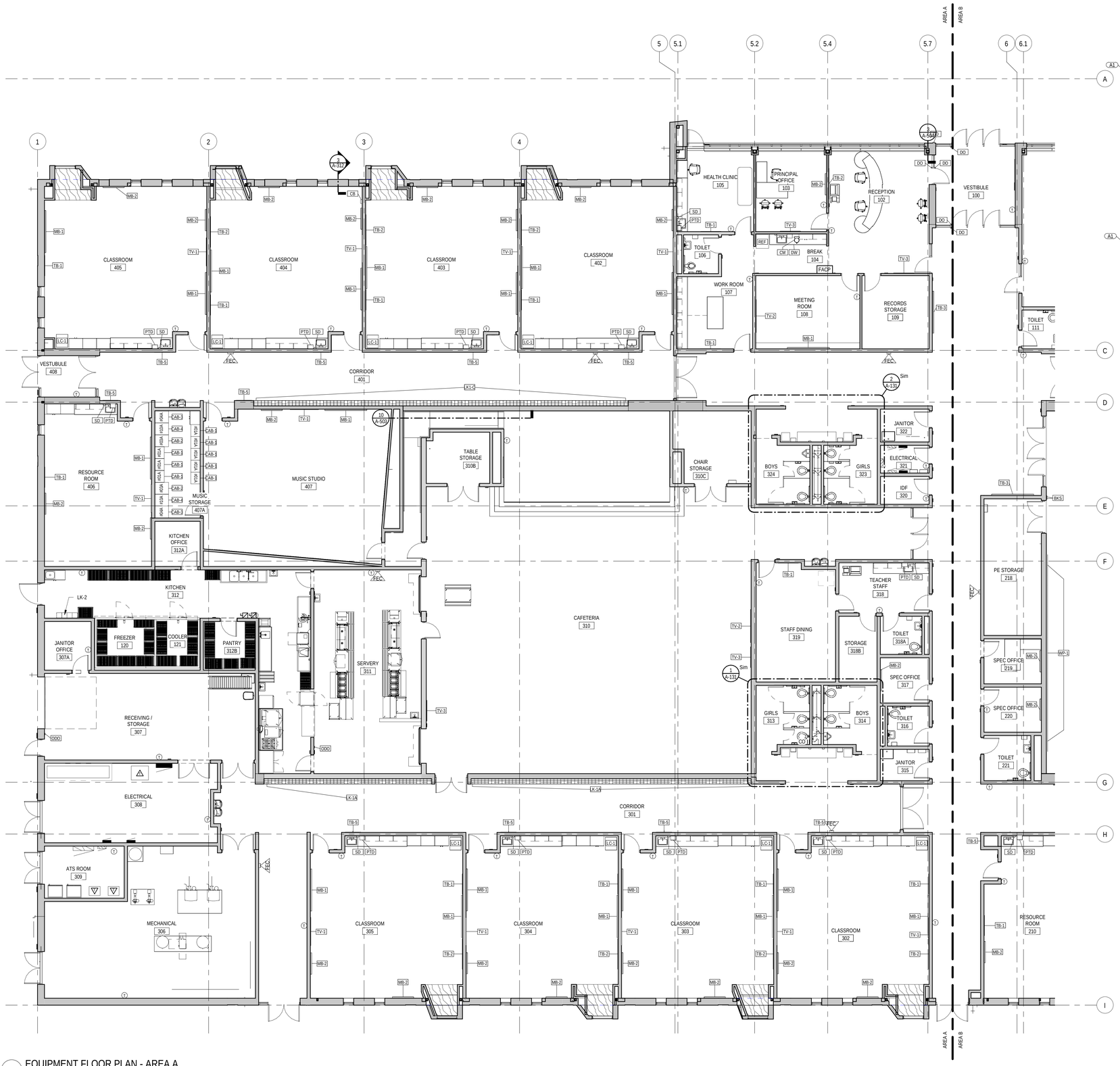
EQUIPMENT SCHEDULE

	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	--
DRY	DRYER	--	--	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 5'-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	--
WSH	WASHER	--	--	CONTRACTOR	CONTRACTOR	--

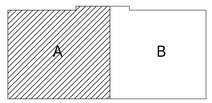
ACCESSORY SCHEDULE

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



EQUIPMENT FLOOR PLAN - AREA A
1/8" = 1'-0"



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EQUIPMENT PLAN - AREA A

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	23JUL2023

PROJ.#: 220116
DATE: 23-JUN-2023
SHEET
A-121A

100% CONSTRUCTION DOCUMENTS
Addendum 1

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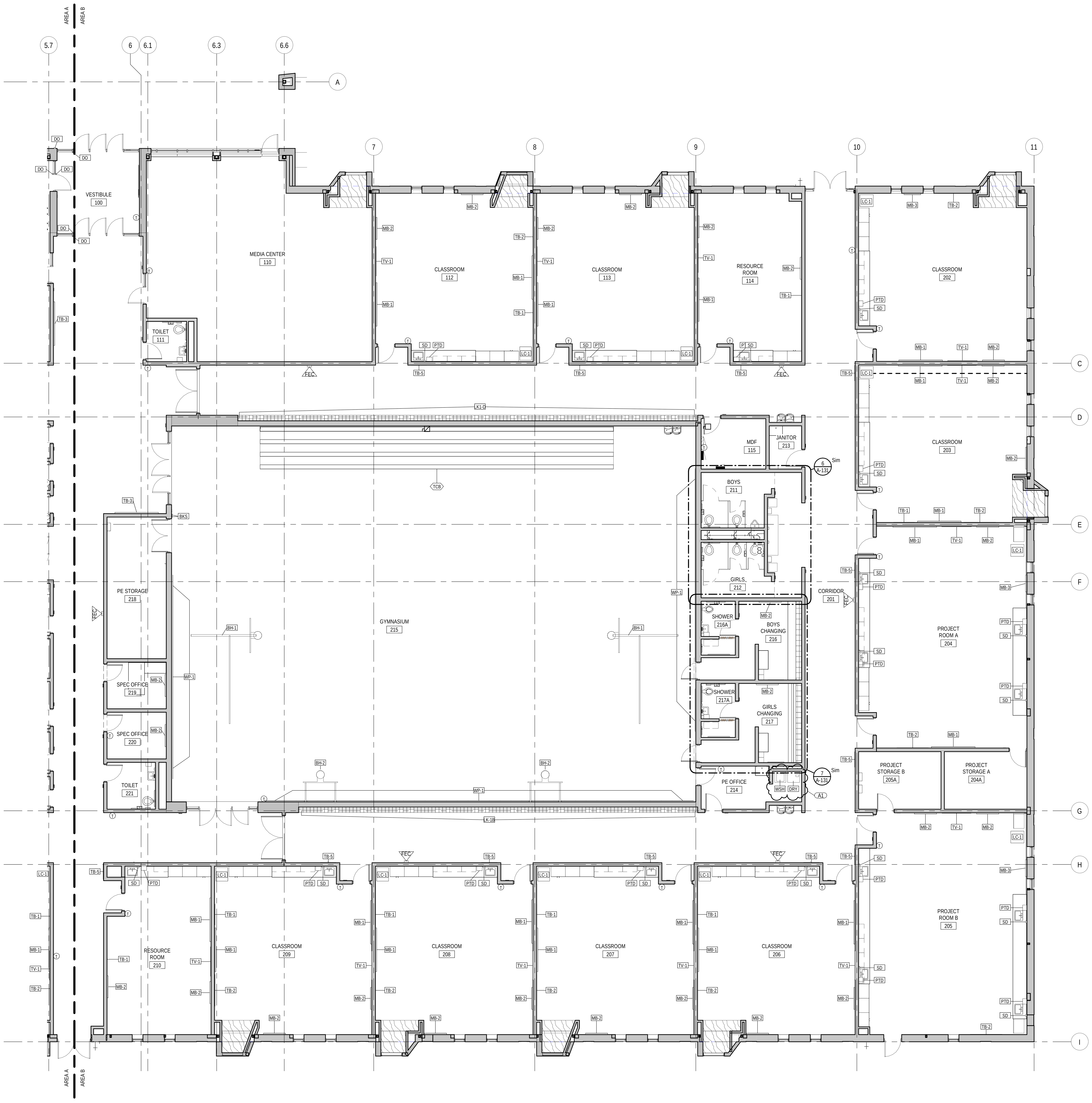
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



EQUIPMENT FLOOR PLAN - AREA B
1/8" = 1'-0"

EQUIPMENT SCHEDULE

	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	--
DRY	DRYER	--	--	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	--
WSH	WASHER	--	--	CONTRACTOR	CONTRACTOR	

A1

A1

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
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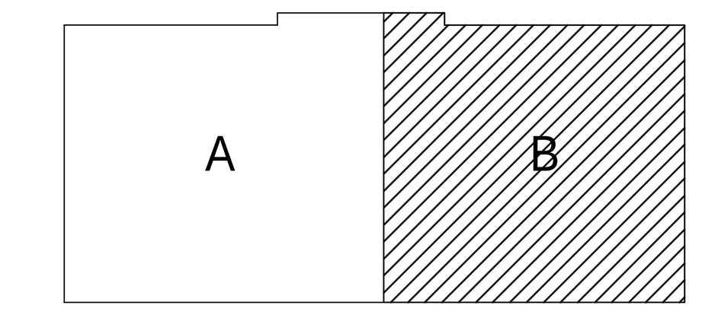
MB-2	MAGNETIC WHITE BOARD, 4' X 4'	--	--	CONTRACTOR	CONTRACTOR
MB-3	MAGNETIC WHITE BOARD, 3' X 3'	--	--	CONTRACTOR	CONTRACTOR
MR-1	36" x 72" MIRROR	--	--	CONTRACTOR	CONTRACTOR
MR-2	24" X 36" MIRROR	--	--	CONTRACTOR	CONTRACTOR
PTD	PAPER TOWEL DISPENSER	--	--	OWNER	CONTRACTOR
SCR	SHOWER CURTAIN & ROD	--	--	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
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EQUIPMENT PLAN - AREA B

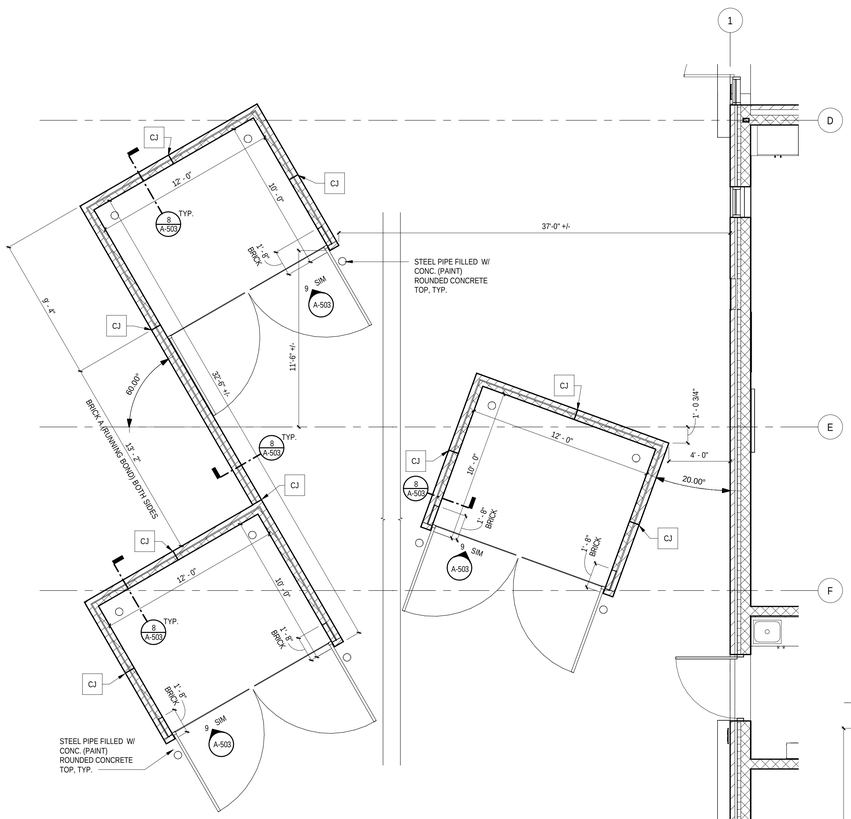
REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21JUL2023

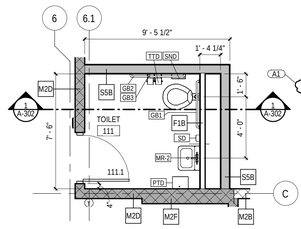
PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-121B

100% CONSTRUCTION DOCUMENTS

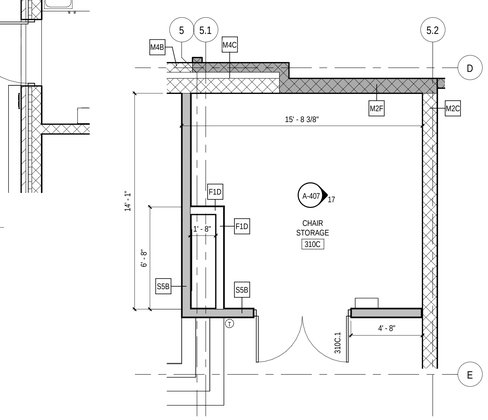
Addendum 1



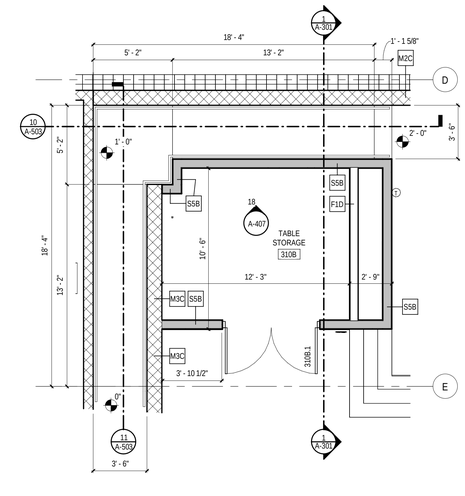
DUMPSTER ENCLOSURE PLAN DETAIL
1/4" = 1'-0"



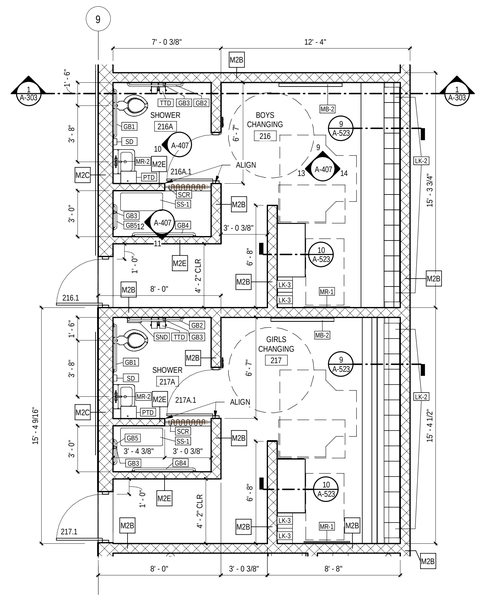
AREA B - TOILET ROOM
8 A-101A — 1/4" = 1'-0"



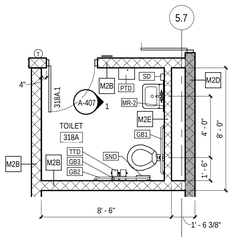
AREA A - PLATFORM STORAGE
11 A-101A — 1/4" = 1'-0"



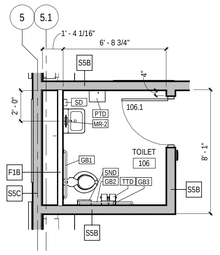
AREA A - PLATFORM STORAGE & RAMP
9 A-101A — 1/4" = 1'-0"



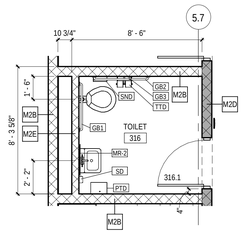
AREA B - LOCKER ROOMS
7 A-101B — 1/4" = 1'-0"



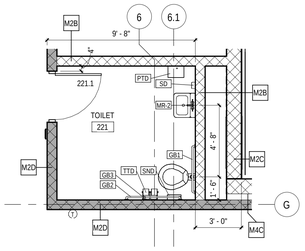
AREA A - SINGLE TOILET 318A
4 A-101A — 1/4" = 1'-0"



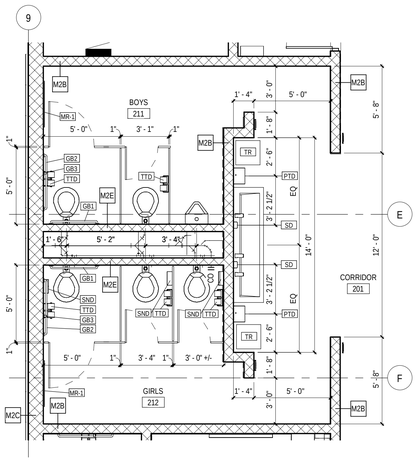
AREA A - TOILET ROOM
3 A-101A — 1/4" = 1'-0"



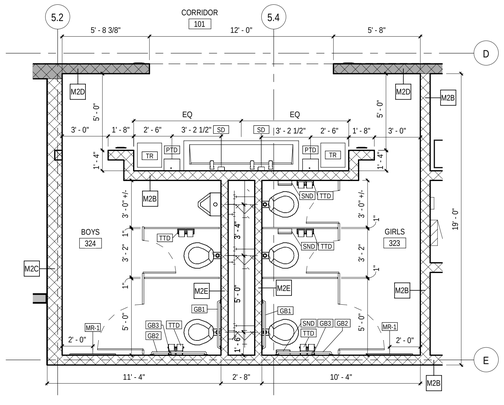
AREA A - SINGLE TOILET 316
5 A-101A — 1/4" = 1'-0"



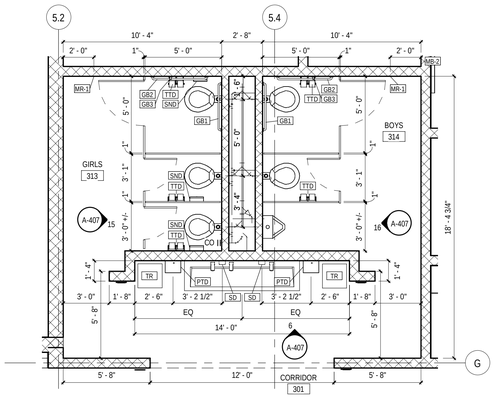
AREA B - TOILET ROOM 221
12 A-101A — 1/4" = 1'-0"



AREA B - GROUP TOILET ROOMS
6 A-101B — 1/4" = 1'-0"



AREA A - ENTRY GROUP TOILET ROOMS
2 A-101A — 1/4" = 1'-0"



AREA A - GROUP TOILET ROOMS
1 A-101A — 1/4" = 1'-0"

EQUIPMENT SCHEDULE

	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	--
DRY	DRYER	--	--	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	--
WSH	WASHER	--	--	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

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

ENLARGED FLOOR PLANS

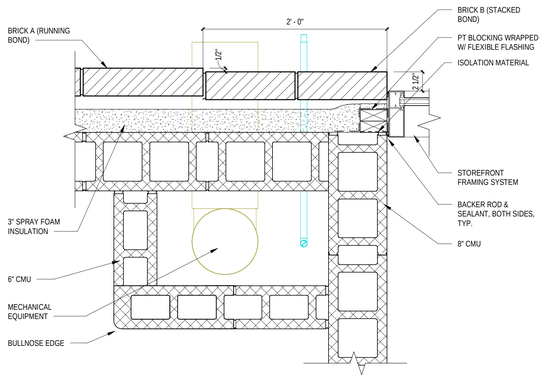
REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	31AUG2023

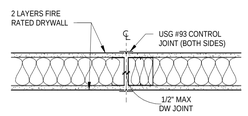
PROJ.#: 220116
DATE: 23-JUN-2023
SHEET
A-131
Addendum 1

100% CONSTRUCTION DOCUMENTS

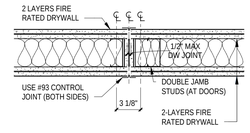
7/21/2023 11:23:43 AM
Autodesk Docs://220116_LSD - Mt HOPE/220116_Arch
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



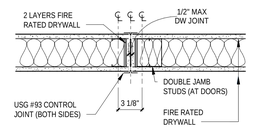
13 A-101B — ACCENT BRICK AT DOOR PLAN DETAIL
1 1/2" = 1'-0"



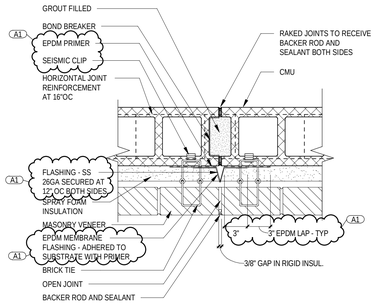
12 — TYPICAL CONTROL JOINT @ NON-RATED WALLS
1 1/2" = 1'-0"



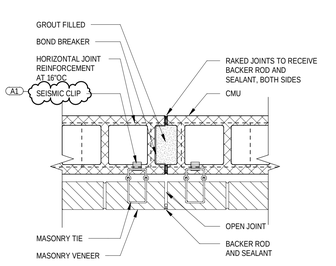
11 — TYPICAL CONTROL JOINT @ 2-HR
1 1/2" = 1'-0"



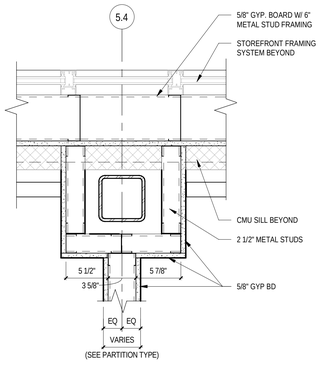
10 — TYPICAL CONTROL JOINT @ 1-HR (INCLUDE SMOKE)
1 1/2" = 1'-0"



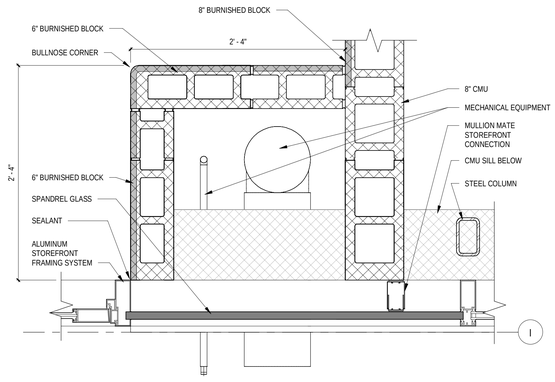
9 A-101A — MASONRY CONTROL JOINT AT CMU, INSULATION, BRICK
1 1/2" = 1'-0"



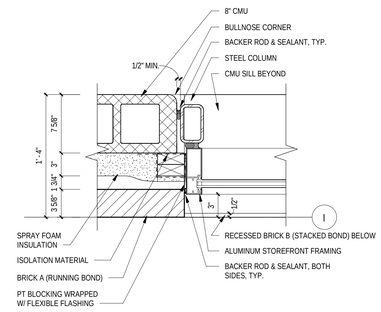
8 A-101A — MASONRY CONTROL JOINT AT CMU, AIR SPACE, BRICK
1 1/2" = 1'-0"



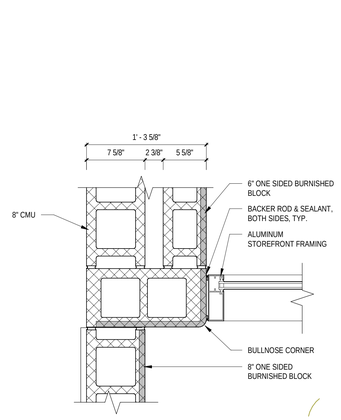
7 A-101A — TYPICAL COLUMN ENCLOSURE DETAIL - ABOVE
1 1/2" = 1'-0"



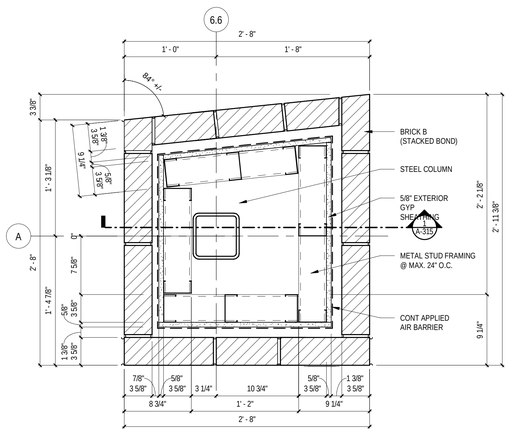
6 A-101A — PLAN AREA B - SPANDREL GLASS & PIPE ENCLOSURE DETAIL
1 1/2" = 1'-0"



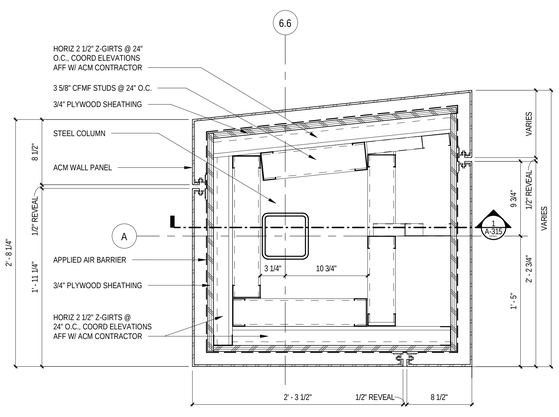
5 A-101A — TYPICAL COLUMN WINDOW DETAIL
1 1/2" = 1'-0"



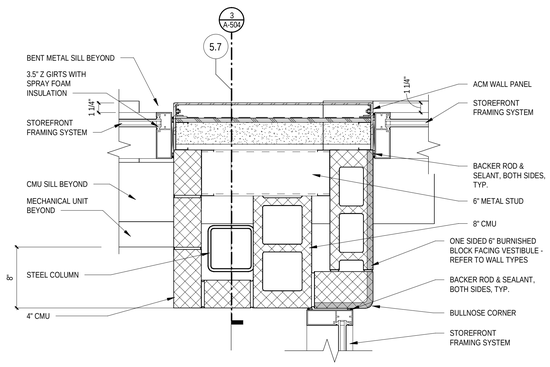
4 A-101A — PLAN BURNISHED BLOCK DETAIL AT ENTRY
1 1/2" = 1'-0"



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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PLAN DETAILS

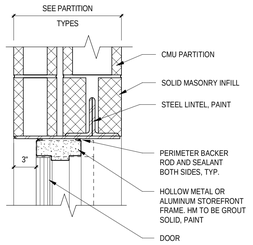
REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21AUG2023

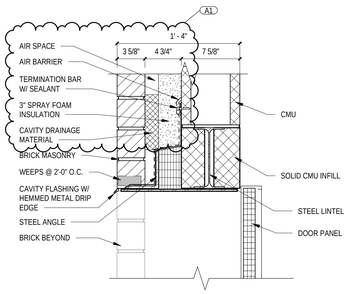
PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-502

100% CONSTRUCTION DOCUMENTS

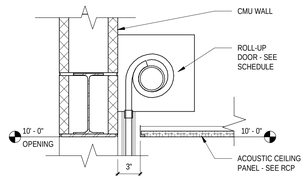
Addendum 1



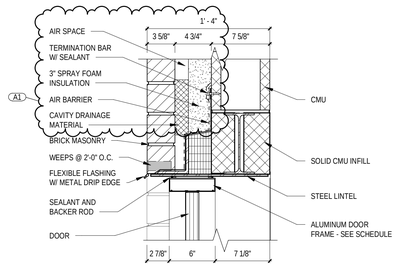
H6 HM INTERIOR DOOR AT CMU WALL HEAD 2
1 1/2" = 1'-0"



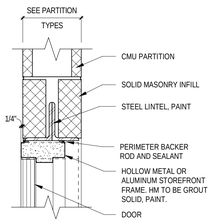
H5 SECTIONAL OVERHEAD DOOR HEAD
1 1/2" = 1'-0"



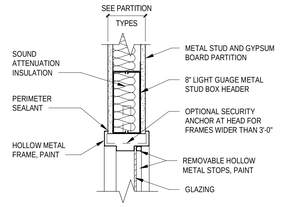
H4 ROLL UP DOOR AT CMU HEAD
1 1/2" = 1'-0"



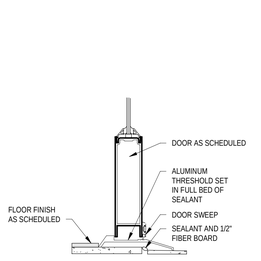
H3 EXTERIOR DOOR AT CMU WITH BRICK HEAD
1 1/2" = 1'-0"



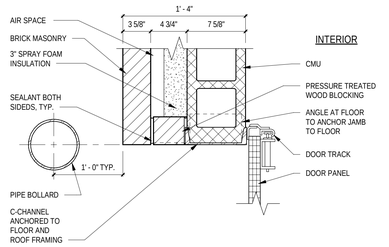
H2 HM INTERIOR DOOR AT CMU WALL HEAD
1 1/2" = 1'-0"



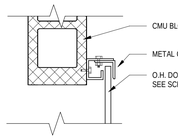
H1 HM BORROWED LITE AT METAL STUDS HEAD
1 1/2" = 1'-0"



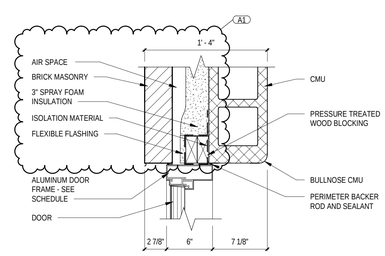
S1 ALUMINUM DOOR THRESHOLD DETAIL
3" = 1'-0"



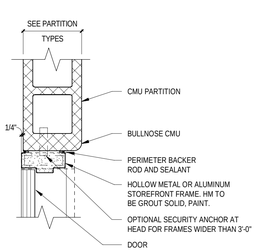
J5 SECTIONAL OVERHEAD DOOR JAMB
1 1/2" = 1'-0"



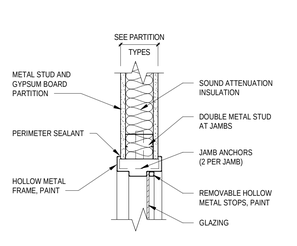
J4 ROLL UP DOOR AT CMU JAMB
1 1/2" = 1'-0"



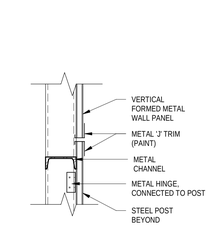
J3 EXTERIOR DOOR AT CMU WITH BRICK JAMB
1 1/2" = 1'-0"



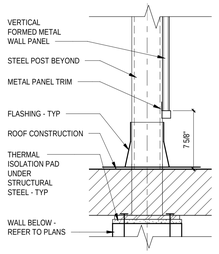
J2 HM INTERIOR DOOR AT CMU WALL JAMB
1 1/2" = 1'-0"



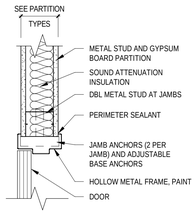
J1 HM BORROWED LITE AT METAL STUDS JAMB
1 1/2" = 1'-0"



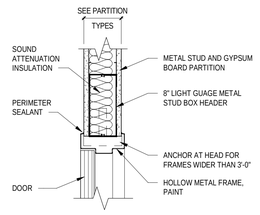
8 A-314 TYP SWING GATE HEAD
1 1/2" = 1'-0"



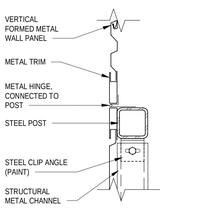
7 A-314 TYP SWING GATE BOTTOM
1 1/2" = 1'-0"



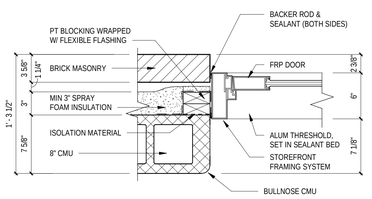
6 HM INTERIOR DOOR AT METAL STUDS JAMB
1 1/2" = 1'-0"



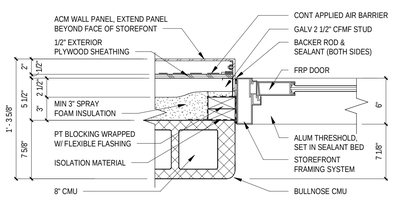
5 HM INTERIOR DOOR AT METAL STUDS HEAD
1 1/2" = 1'-0"



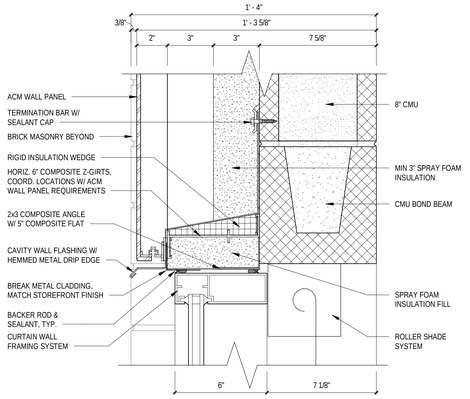
9 A-314 TYP SWING GATE JAMB
1 1/2" = 1'-0"



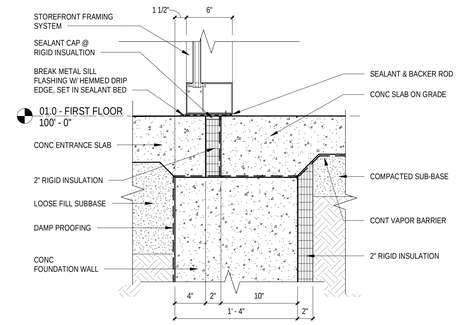
4 A-501 TYP. STOREFRONT DOOR JAMB @ BRICK / CMU
1 1/2" = 1'-0"



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"

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

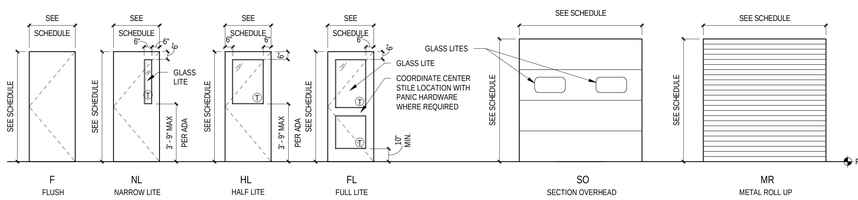
DOOR & WINDOW DETAILS

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21AUG2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-506

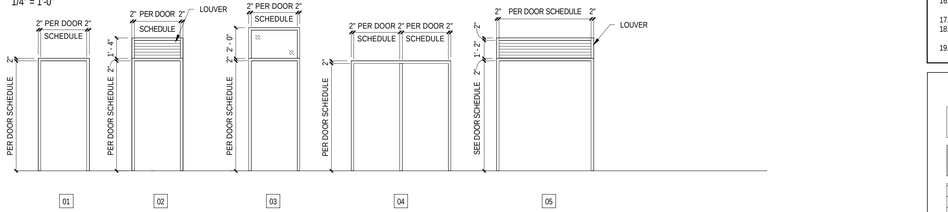
100% CONSTRUCTION DOCUMENTS
Addendum 1

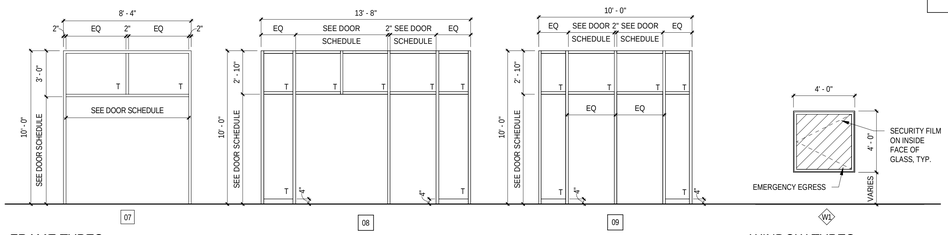


F FLUSH | NL NARROW LITE | HL HALF LITE | FL FULL LITE | SO SECTION OVERHEAD | MR METAL ROLL UP

DOOR TYPES

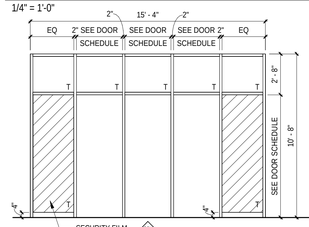
1/4" = 1'-0"

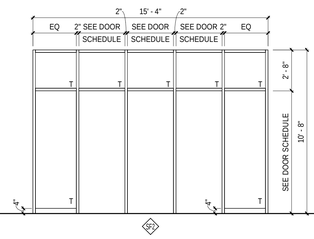




FRAME TYPES

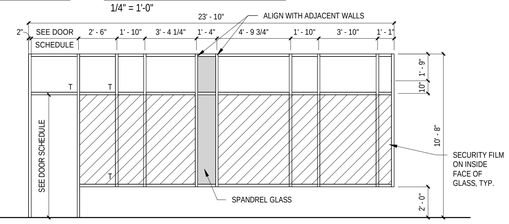
1/4" = 1'-0"

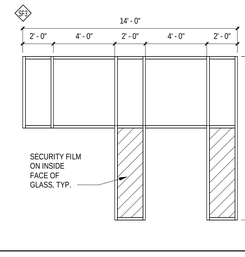


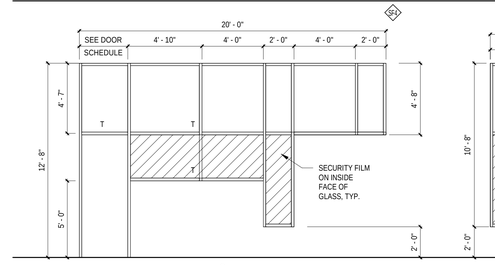


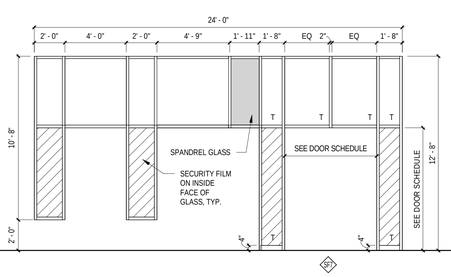
WINDOW TYPES

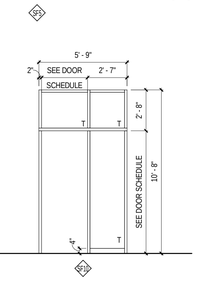
1/4" = 1'-0"

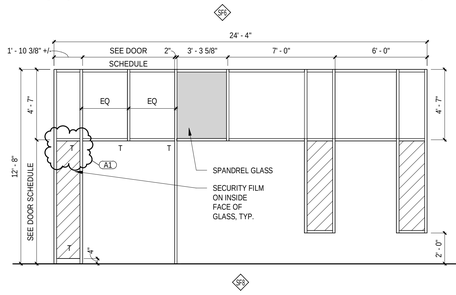


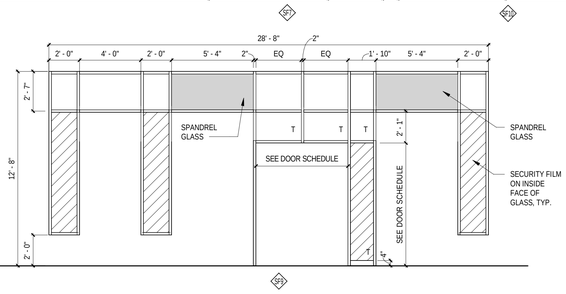












CURTAIN WALL/STOREFRONT ELEVATIONS

1/4" = 1'-0"

DOOR & FRAME GENERAL NOTES

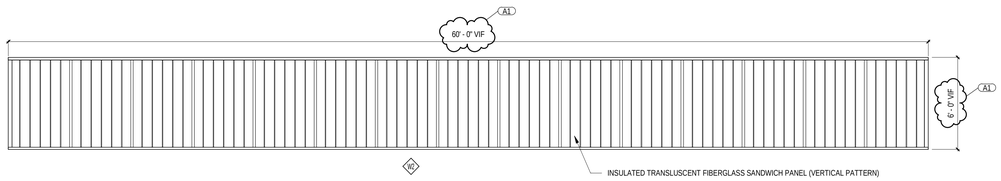
1. PROVIDE THRESHOLD SET IN A BED OF SEALANT AT ALL EXTERIOR DOORS. DO NOT BLOCK WEEP HOLES.
2. ALL EXTERIOR HOLLOW METAL DOORS & FRAMES SHALL BE GALVANIZED, U.N.O.
3. ALL DOOR AND WINDOW FRAMES SHALL HAVE SEALANT & BACKER ROD AT ENTIRE PERIMETER (BOTH SIDES,) U.N.O.
4. REFER TO SPECIFICATIONS FOR HARDWARE 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 NO.	ROOM NO.	ROOM NAME	DOOR SIZE WD.	DOOR SIZE HGT	DOOR MATL	DOOR TYPE	FRAME MATL	FRAME TYPE	FRAME DETAIL HEAD	FRAME DETAIL JAMB	FRAME DETAIL 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' - 10"	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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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

SCHEDULES & DIAGRAMS

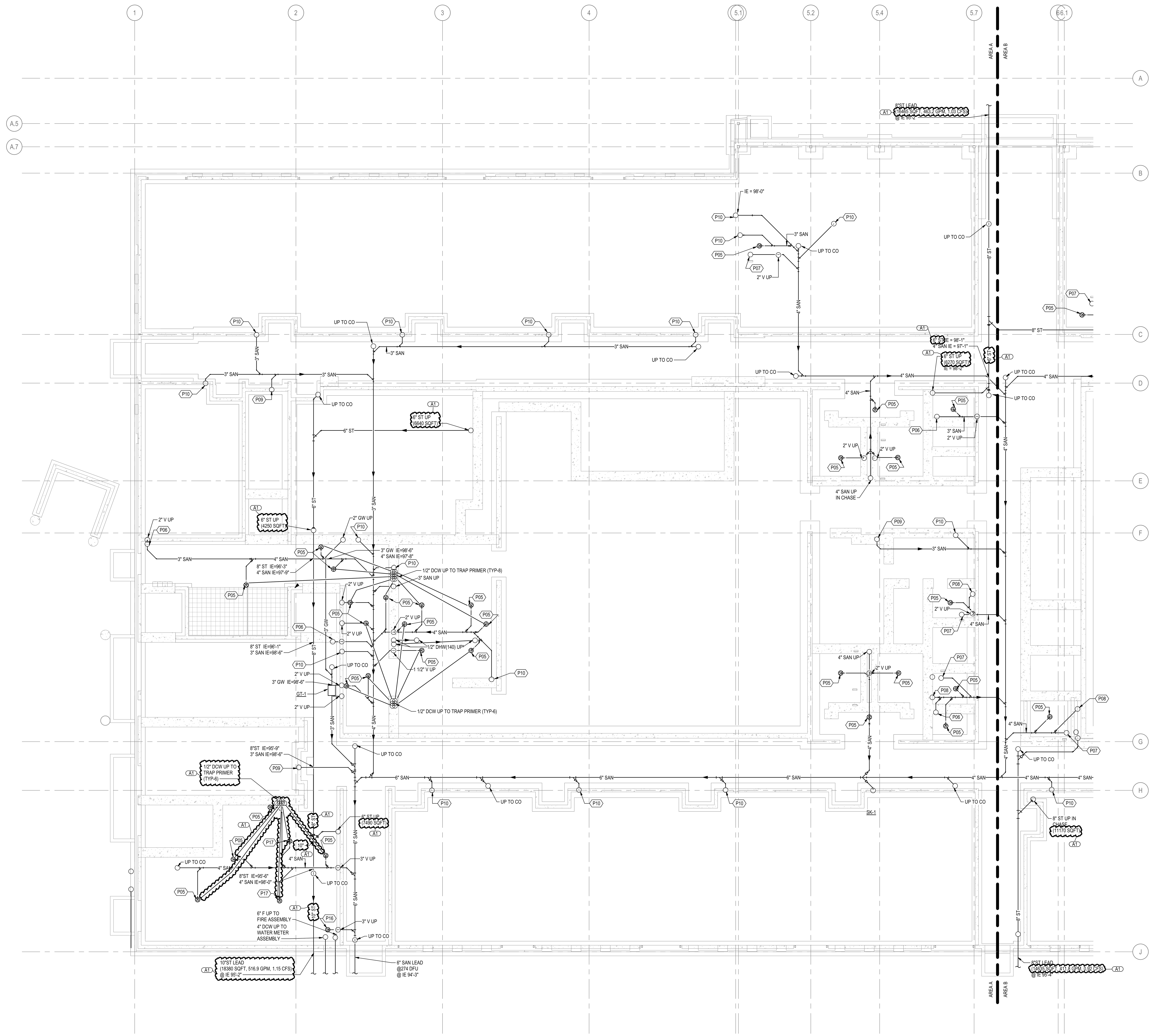
REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	31AUG2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
A-601

100% CONSTRUCTION DOCUMENTS
Addendum 1

7/21/2023 2:59:32 PM
Autodesk Docs://220116_LSD - Mt HOPE/220116_Arch
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



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.

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- P06 ROUTE 3" SAN UP TO SERVICE SINK/MOP BASIN.
- P07 ROUTE 4" SAN UP TO FLOOR MOUNTED WATER CLOSET.
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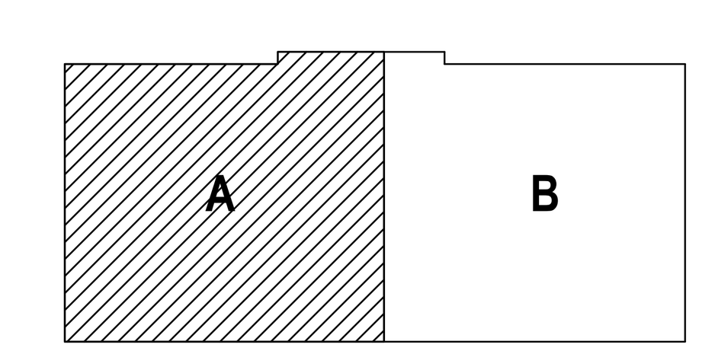

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UNDERGROUND PLUMBING PLAN - AREA A

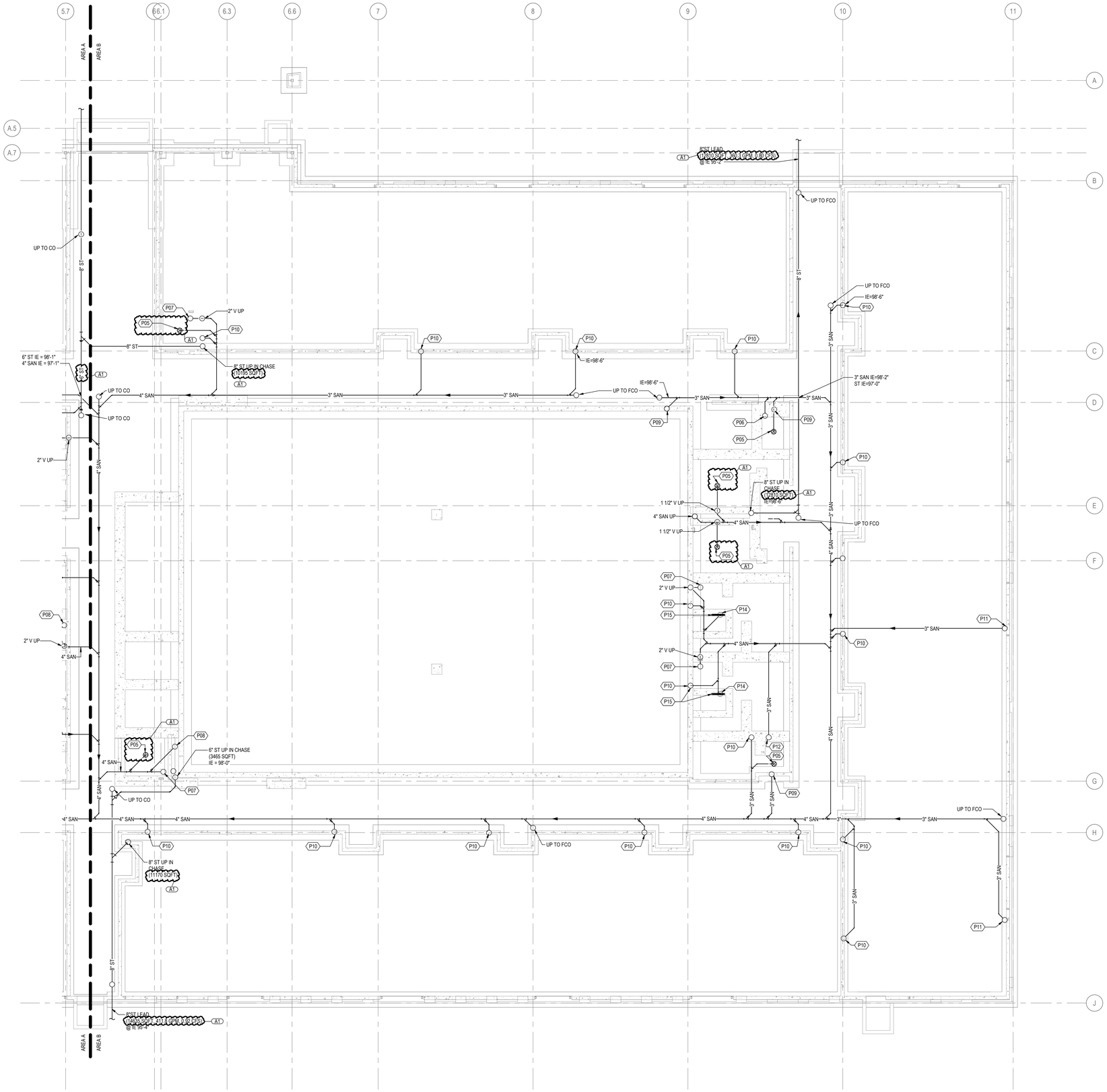
REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-110A

100% CONSTRUCTION DOCUMENTS

Addendum I



UNDERGROUND PLUMBING PLAN - AREA B
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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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UNDERGROUND PLUMBING PLAN - AREA B

REVISIONS

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Addendum 1

7/21/2023 1:07:12 PM
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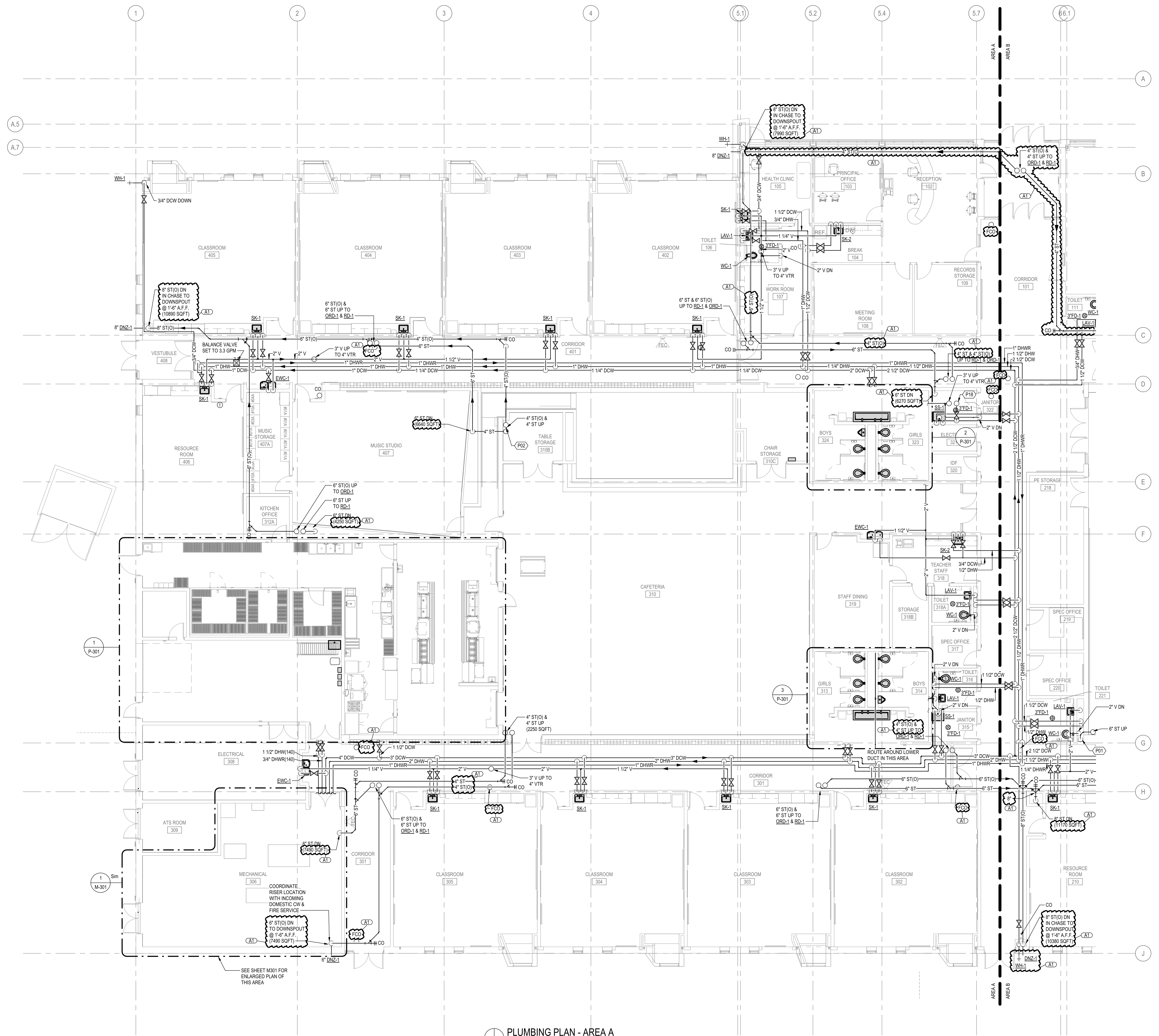
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



PLUMBING PLAN - AREA A
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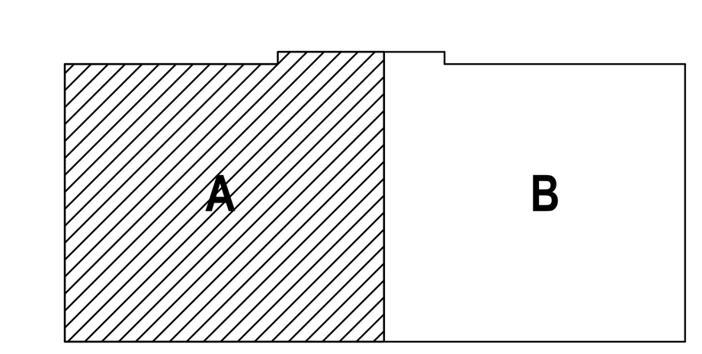
PLUMBING KEYNOTES

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.



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PLUMBING PLAN - AREA A

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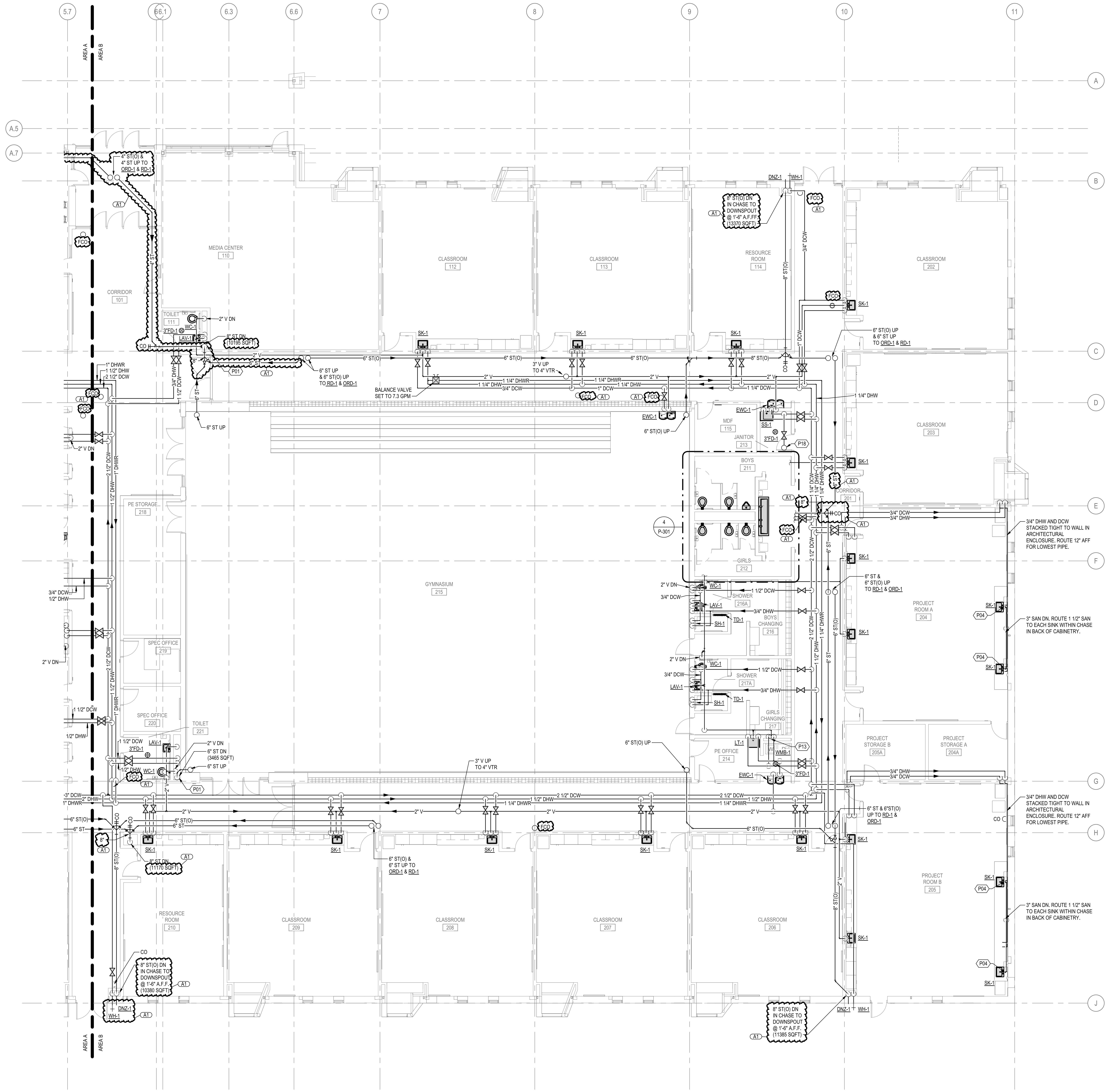
Addendum 1



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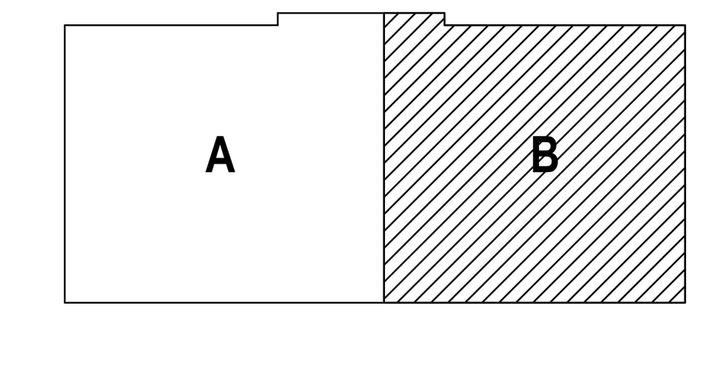
PLUMBING KEYNOTES

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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PLUMBING PLAN - AREA B

REVISIONS

REV	DESCRIPTION	DATE
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PROJ. #: 220116

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Addendum 1

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.

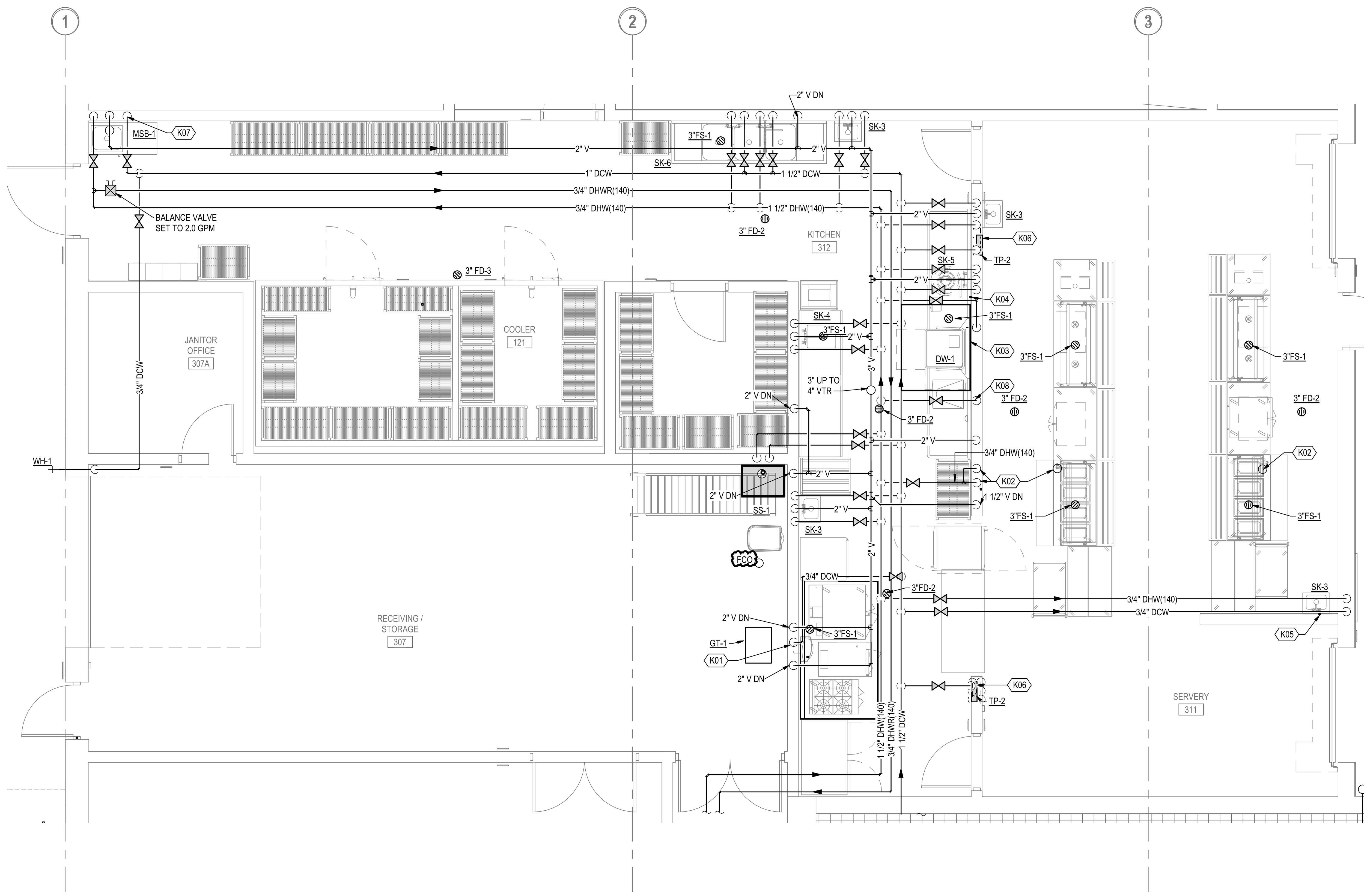
K04 PROVIDE 3/4" DCW DOWN IN WALL AND STUB OUT AND CONNECT TO DISPOSAL SYSTEM. PROVIDE 1/2" DCW CONNECTION OFF 3/4" BRANCH TO CONNECT TO WATER SOFTENER AND FILTRATION SYSTEM (EQUIPMENT BY FSE TRADES)

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**
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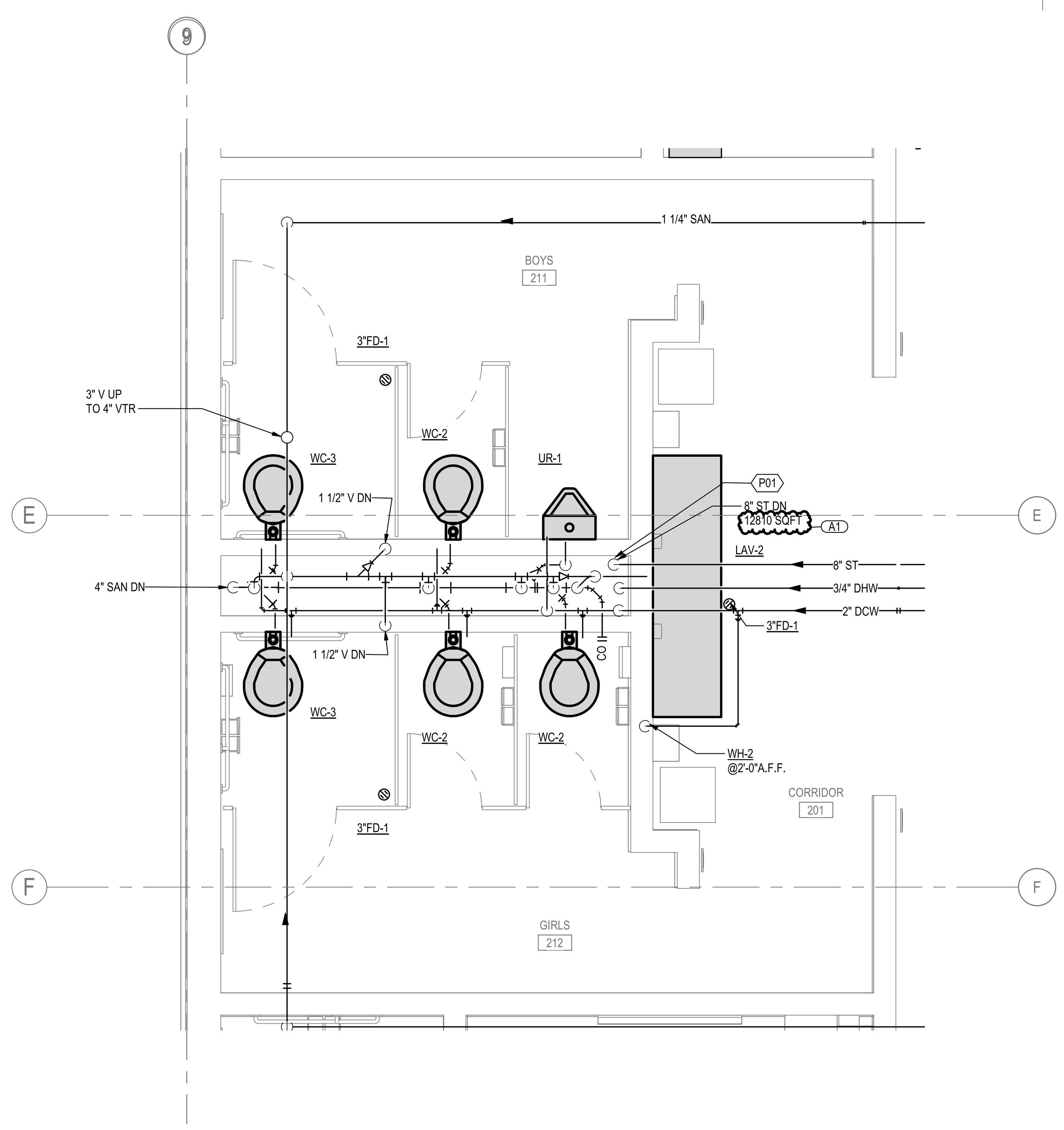
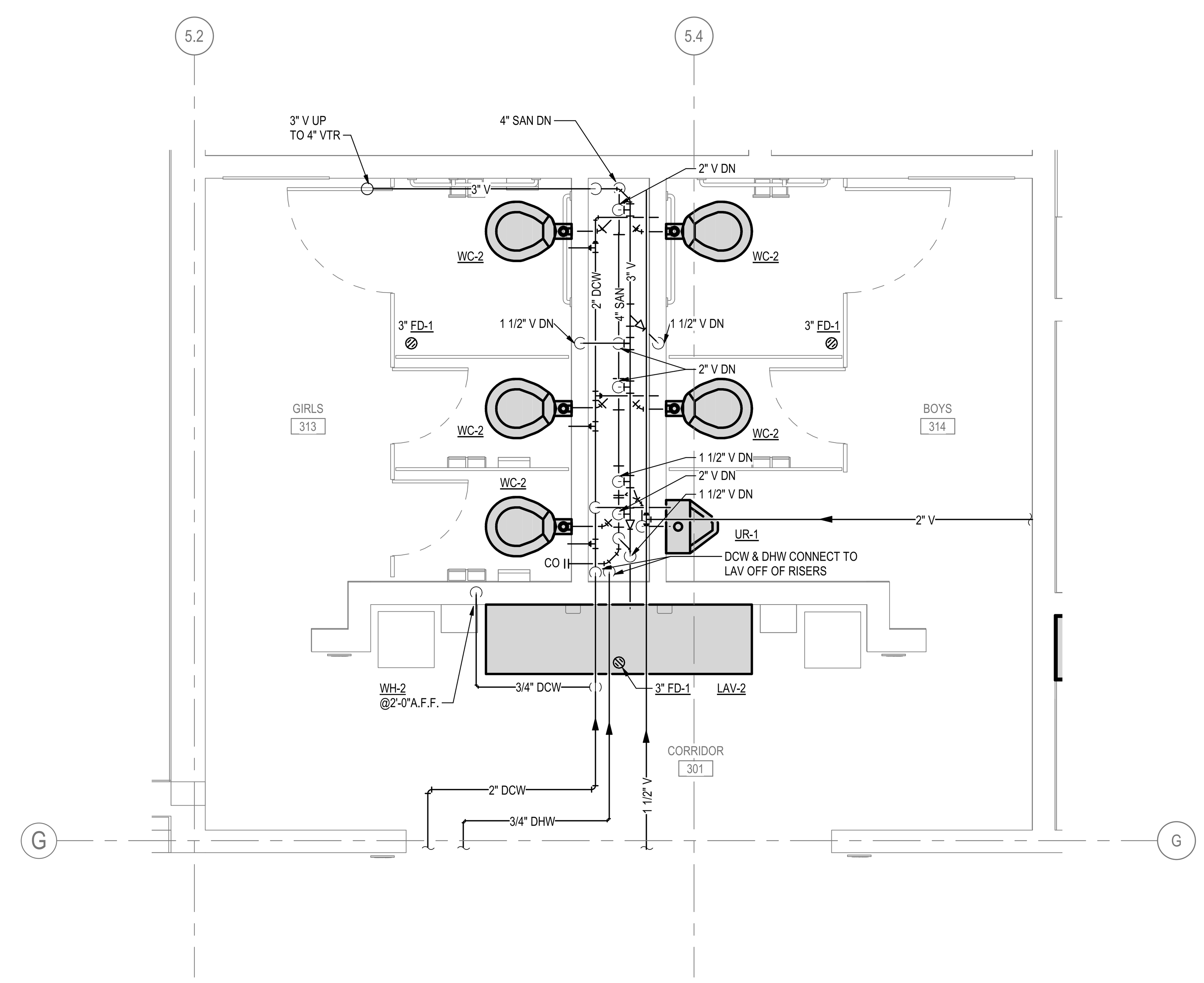


4 P-301 **ENLARGED TOILET ROOMS GIRLS 212 AND BOYS 211 PLUMBING PLAN**
3/8" = 1'-0"



3 P-301 **ENLARGED TOILET ROOMS GIRLS 313 AND BOYS 314 PLUMBING PLAN**
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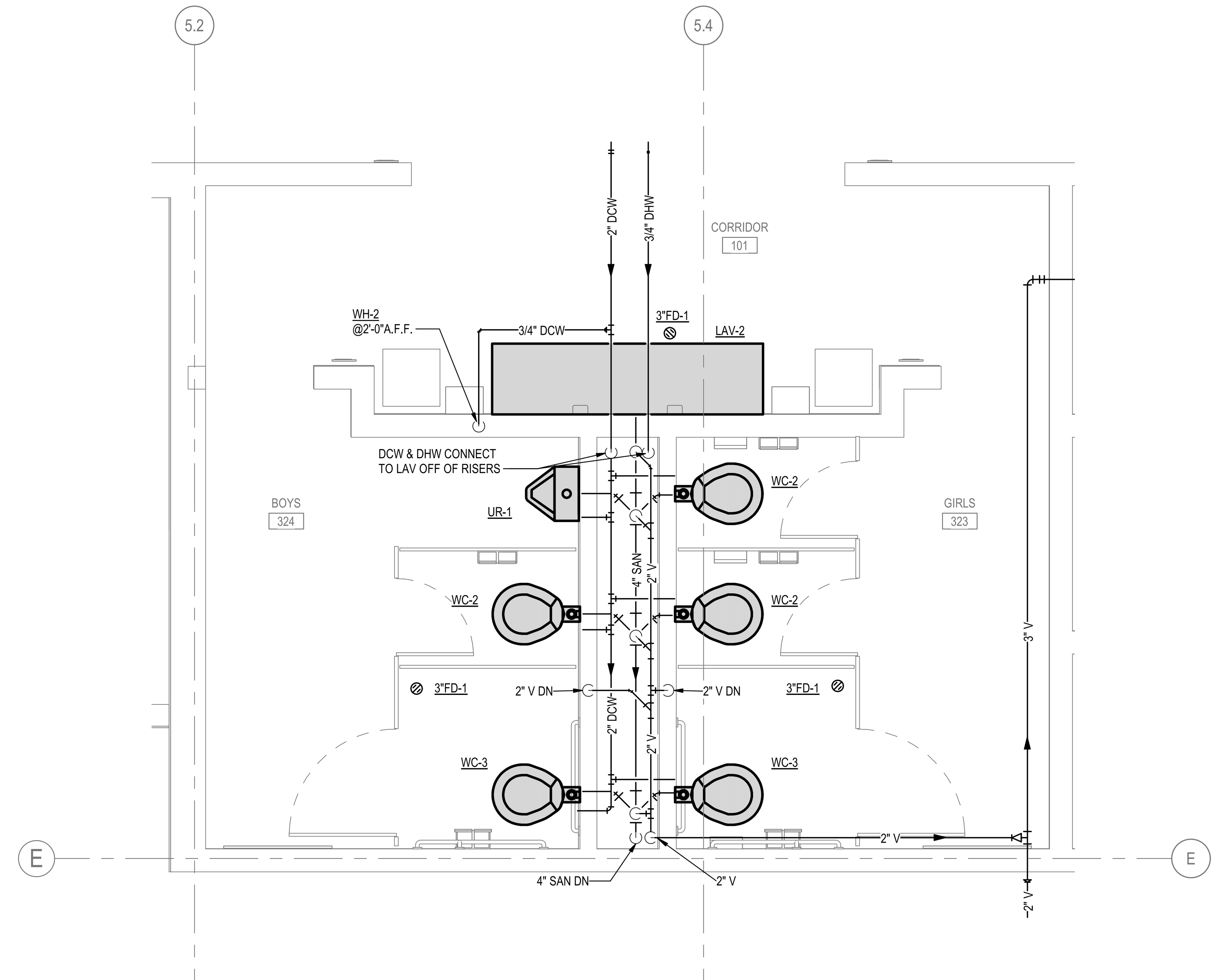

2 P-301 **ENLARGED TOILET ROOMS GIRLS 323 AND BOYS 324 PLUMBING PLAN**
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ENLARGED PLUMBING PLANS

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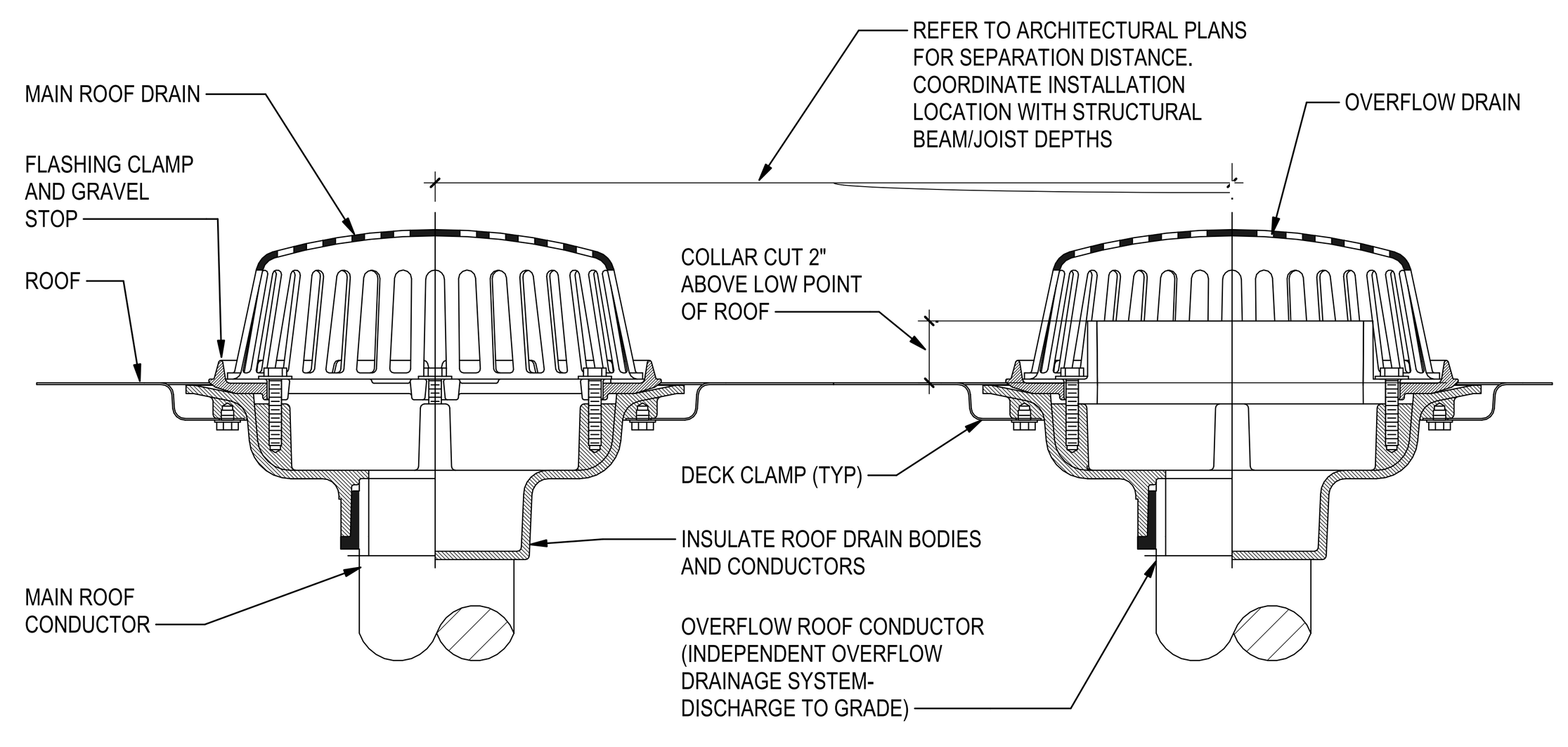
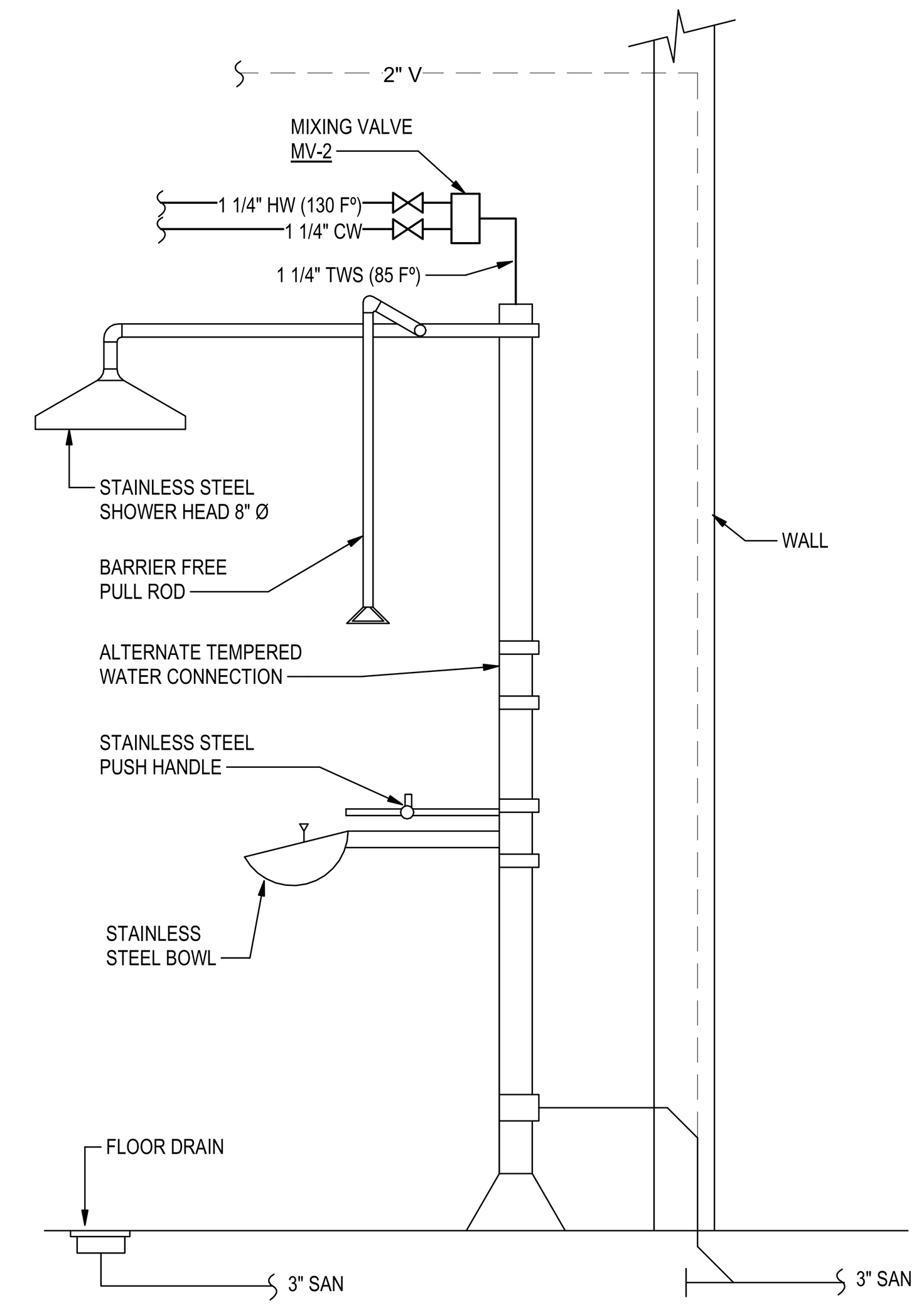
100% CONSTRUCTION DOCUMENTS

Addendum 1

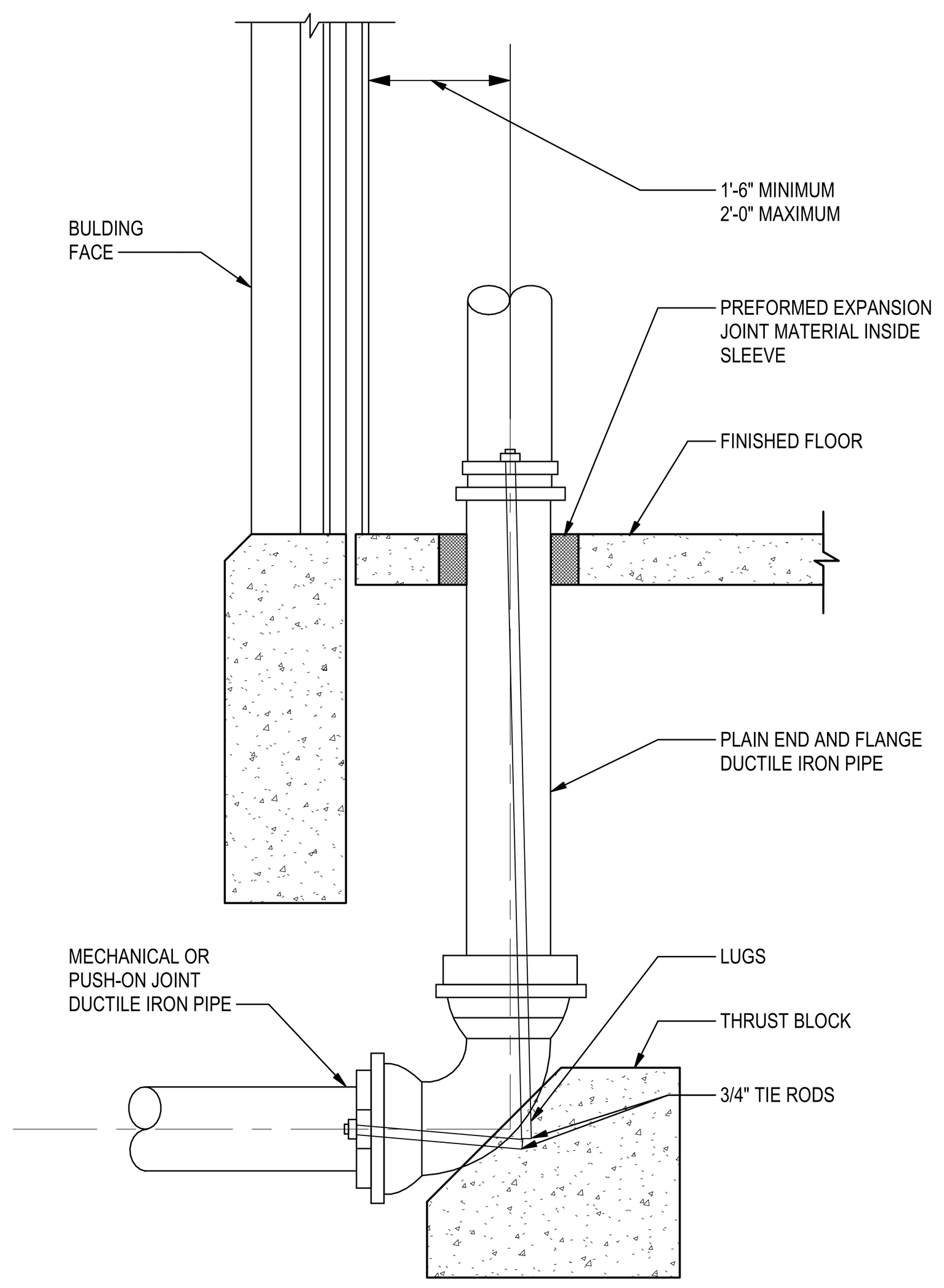


COMBINED ROOF DRAIN DETAIL
SCALE: NONE



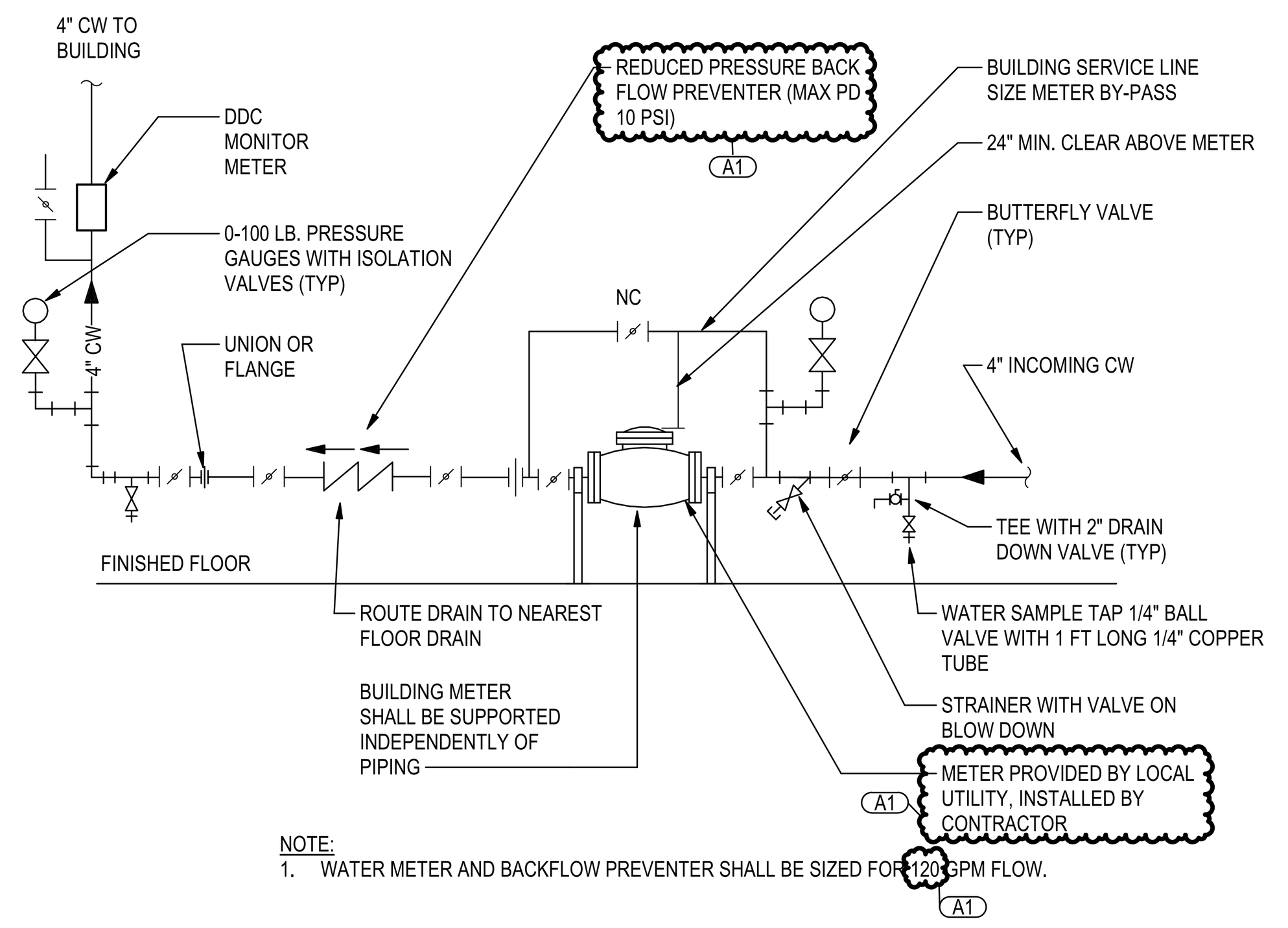
NOTES:
1. CONNECT TEMPERED WATER PIPING PER MANUFACTURER RECOMMENDATIONS.

EMERGENCY COMBINATION SHOWER/EYEWASH DETAIL
SCALE: NONE



NOTE:
1. LOCATE FLANGE AT 12" AFF . FLANGE TO BE PLUMB, LEVEL 3/4" TIE RODS.

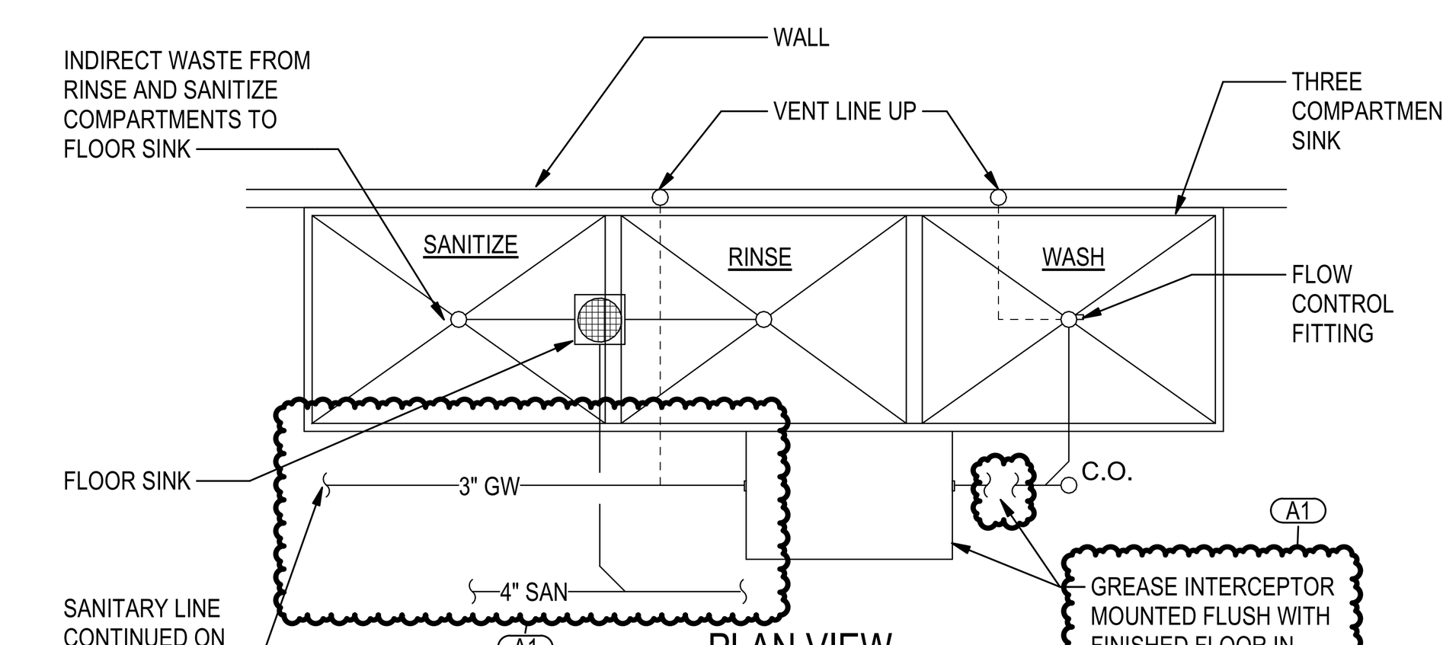
WATER SERVICE LINE SCHEMATIC



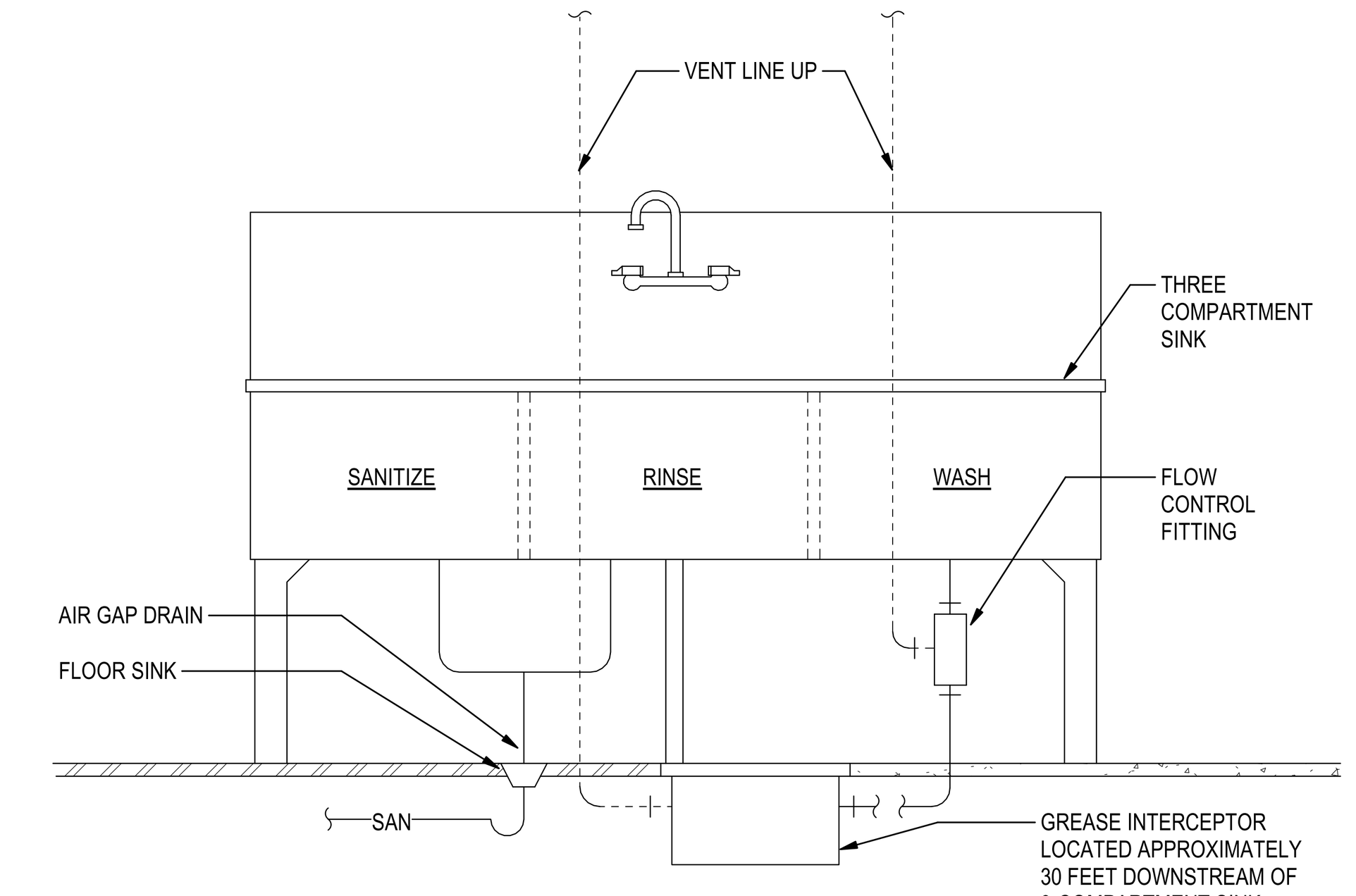
NOTE:
1. WATER METER AND BACKFLOW PREVENTER SHALL BE SIZED FOR 120 GPM FLOW.

A1

WATER SERVICE PIPING DIAGRAM
SCALE: NONE

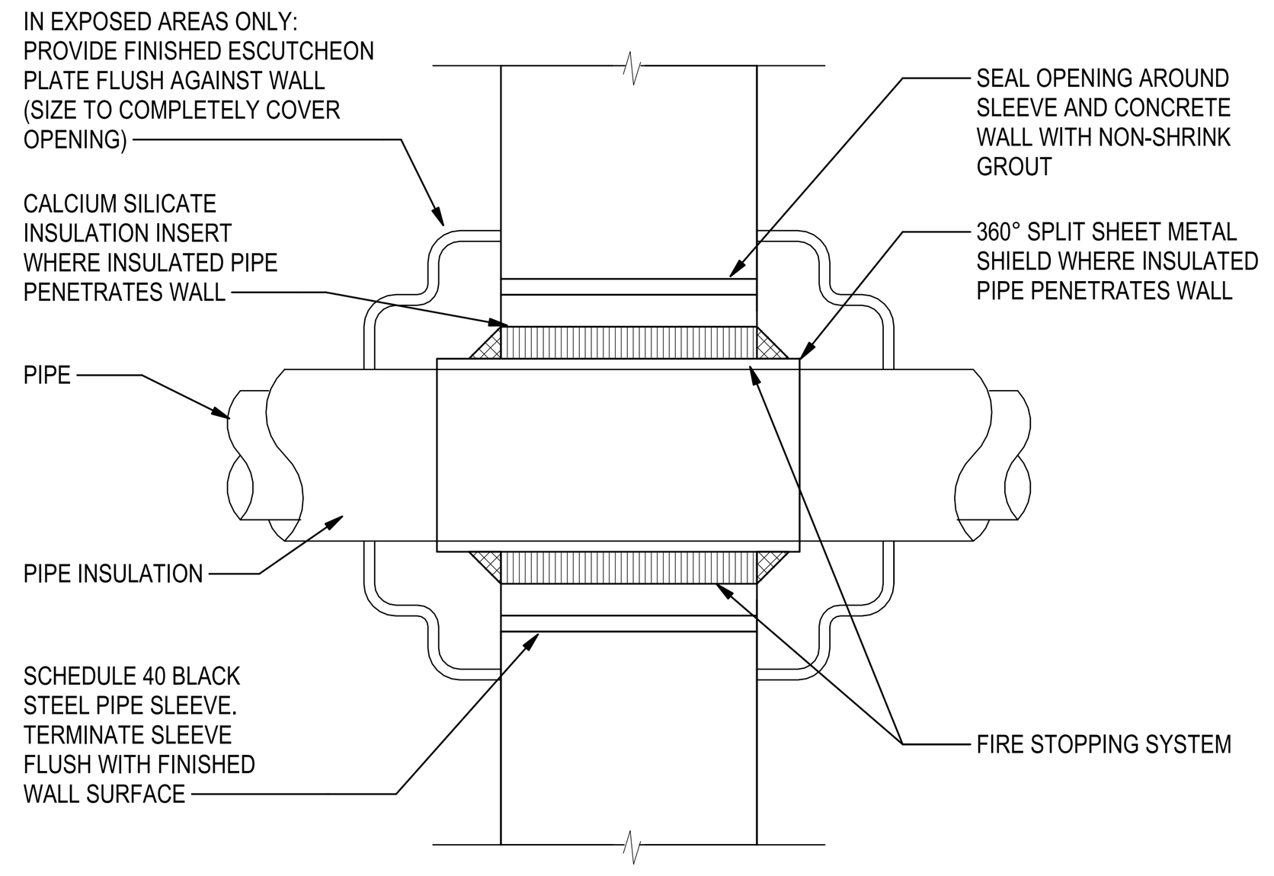


PLAN VIEW



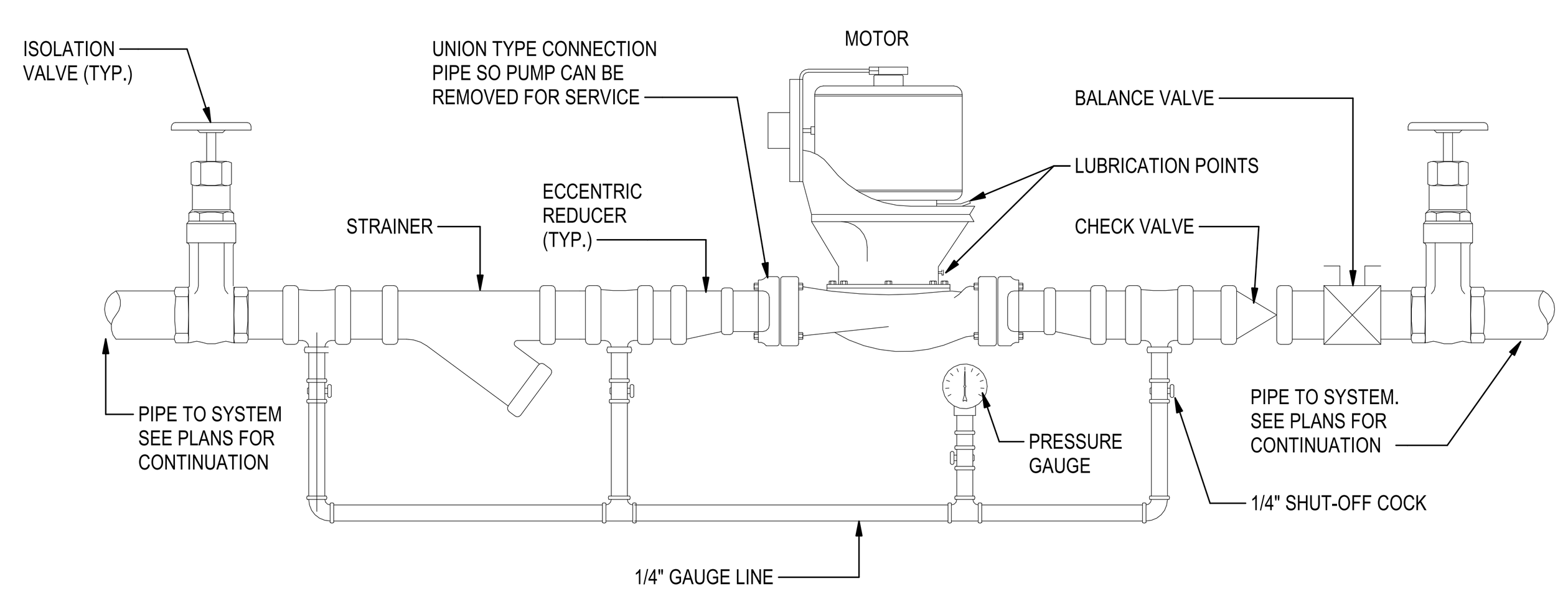
SECTION VIEW

GREASE INTERCEPTOR DETAIL
SCALE: NONE



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.

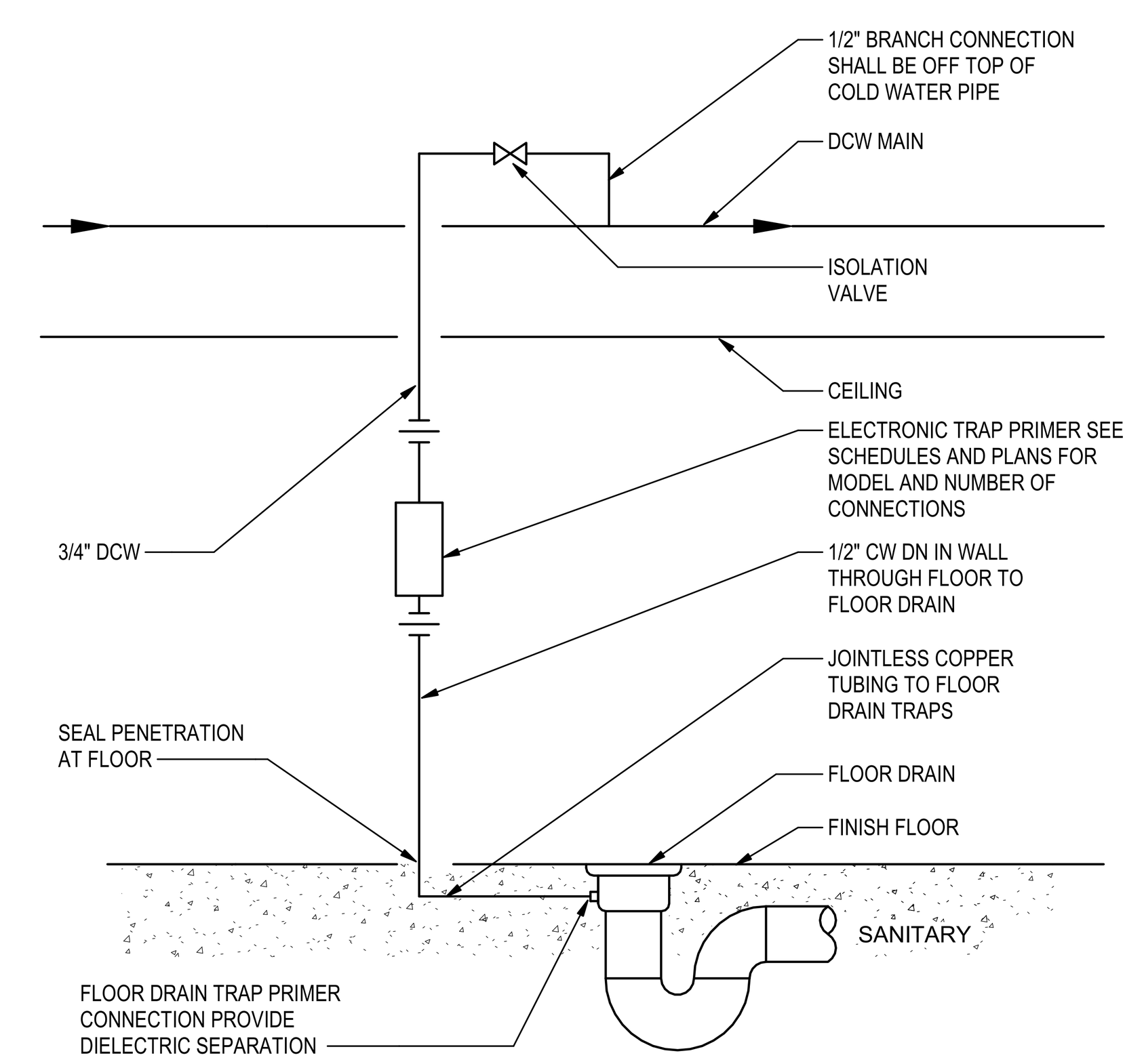
FIRE RATED AND NON-FIRE RATED POURED CONCRETE OR BLOCK WALL PIPE PENETRATION DETAIL
SCALE: NONE



INSTALLATION NOTES:

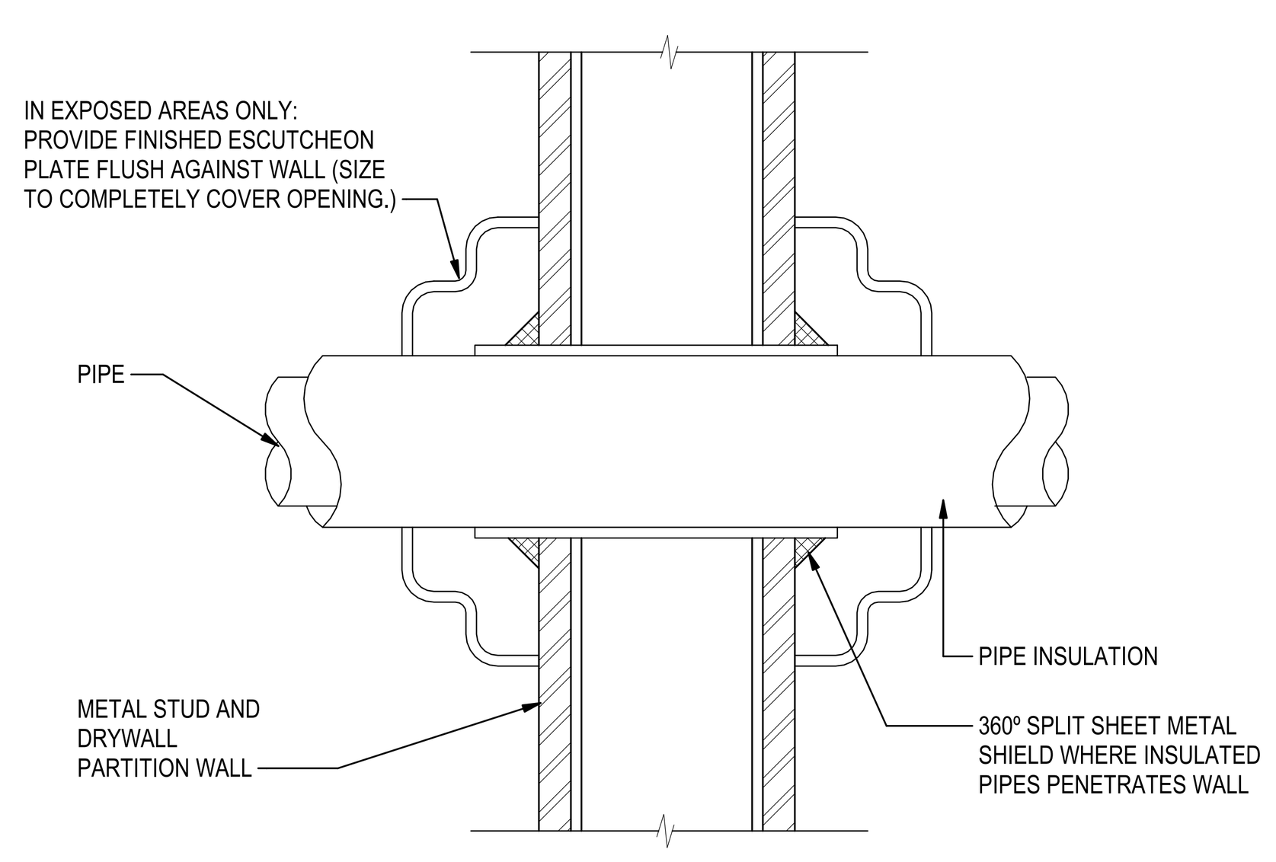
1. THE PUMP SHALL BE INSTALLED DEAD LEVEL, AND SHALL NOT TOUCH OR REST ON ANY PART OF THE BUILDING STRUCTURE.
2. THE ELECTRICAL CONNECTION TO THE PUMP SHALL BE MADE THROUGH THE USE OF FLEXIBLE CONDUIT (GREENFIELD) AT LEAST 18" LONG.
3. THE PUMP SUPPORTED INDEPENDENTLY OF PIPING AND SHALL BE INSTALLED 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



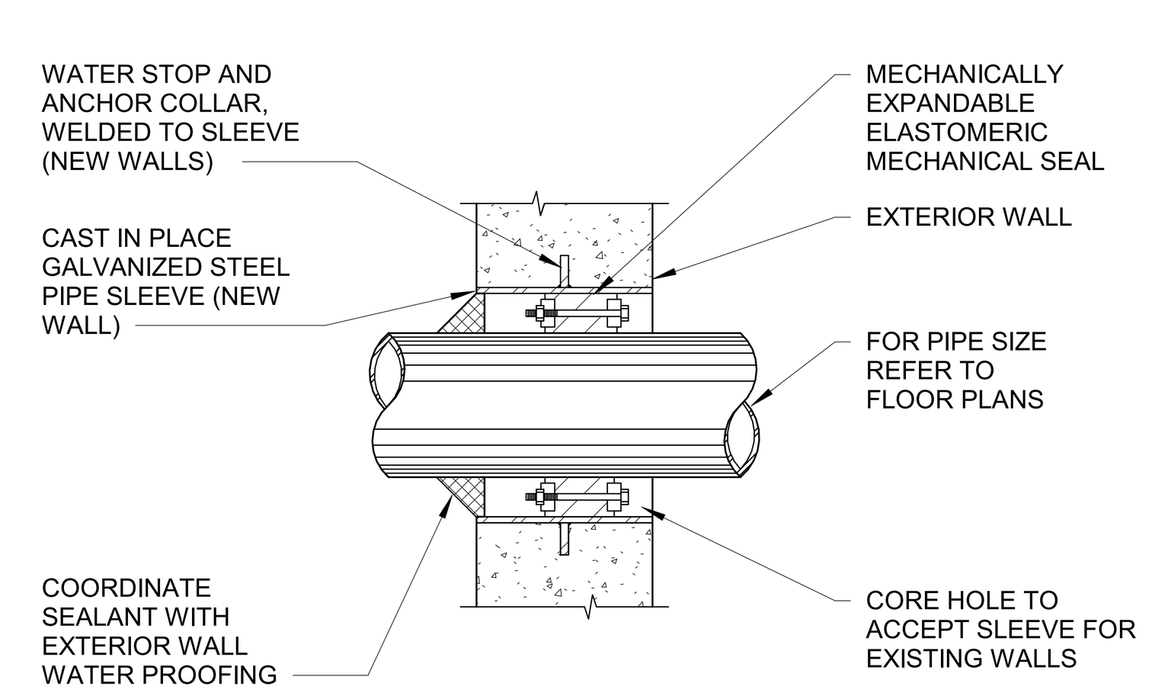
NOTES:
1. INSTALL TRAP PRIMER IN ACCESSIBLE LOCATION. COORDINATE ACCESS PANEL LOCATION WITH ARCHITECTURAL TRADES.
2. TUBING FROM TRAP PRIMER SHALL GRAVITY DRAIN TO FLOOR DRAIN TRAP PRIMER CONNECTION.

MULTIPLE TRAP PRIMER DETAIL
SCALE: NONE

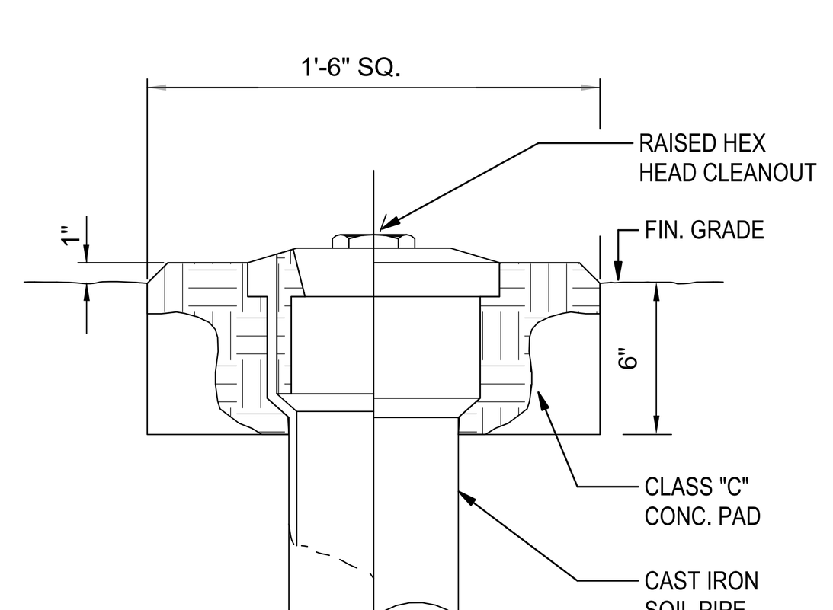


NOTES:
1. PIPE PENETRATION DETAIL SIMILAR FOR UNINSULATED PIPING.

NON-FIRE RATED STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL
SCALE: NONE

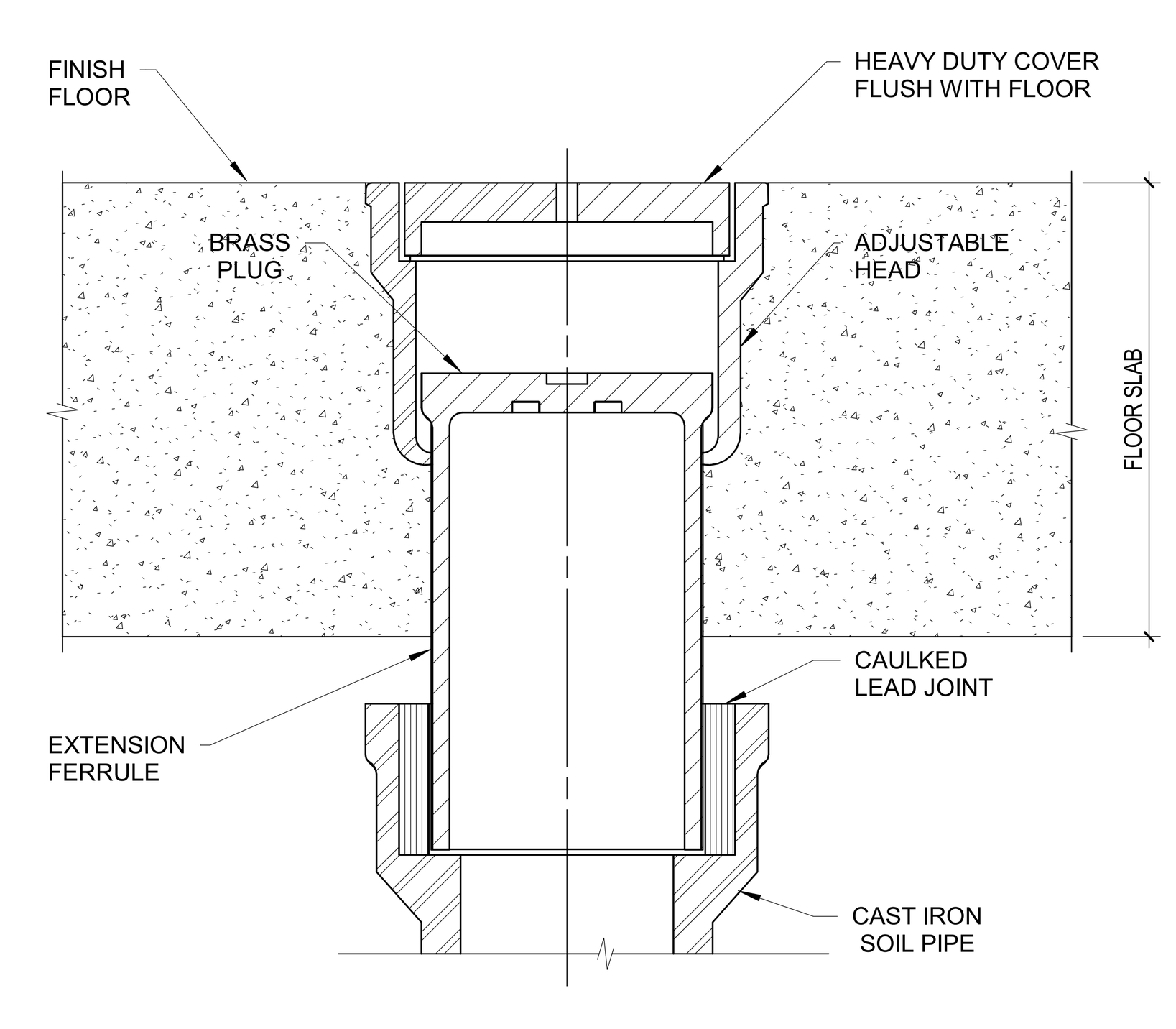


PIPE PENETRATION THROUGH EXTERIOR BELOW GRADE WALL DETAIL
SCALE: NONE

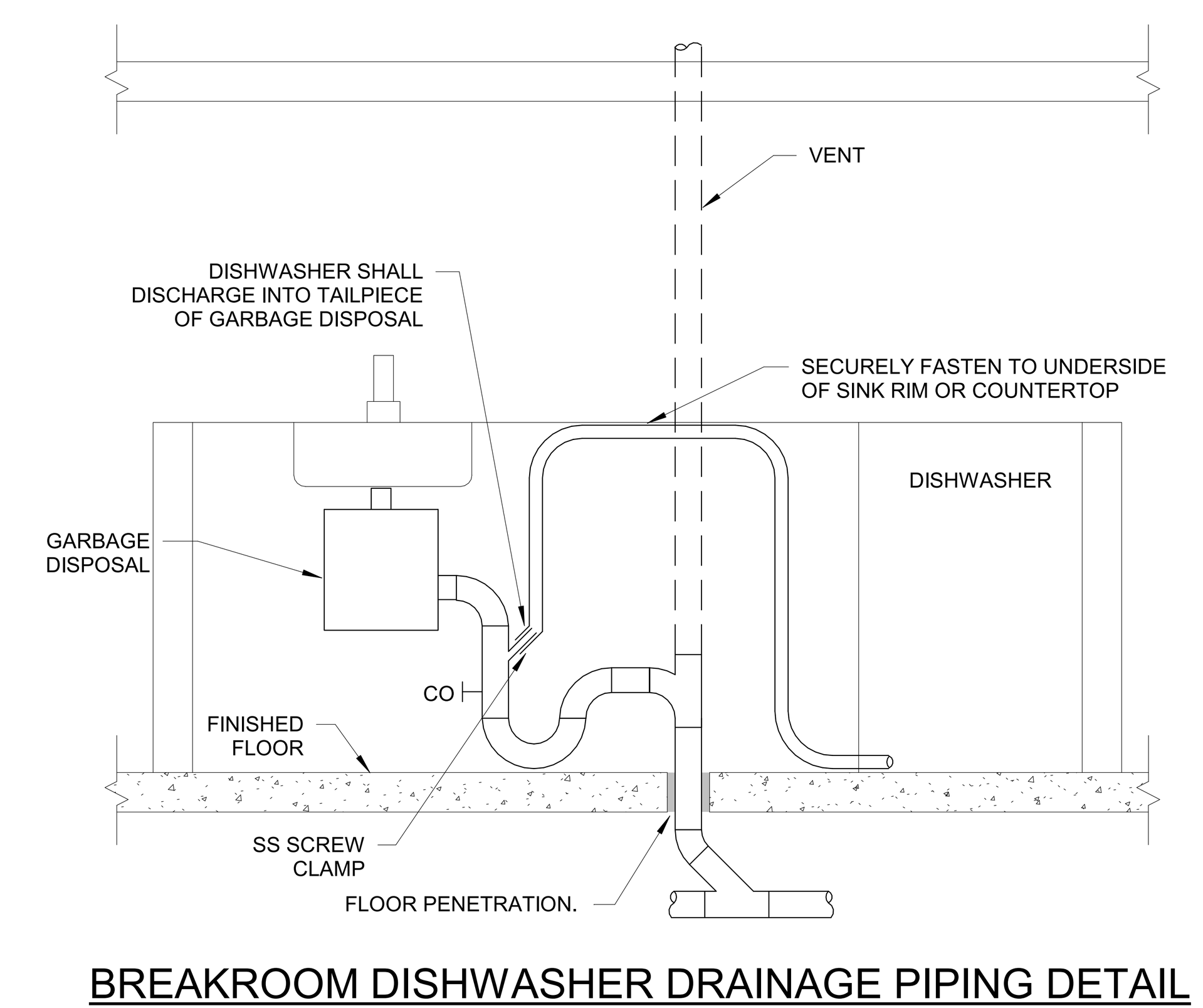


NOTE:
IN TRAFFIC AREAS PROVIDE FLUSH FINISH WITH 10" I.D. CAST IRON COVER AND FRAME.

EXTERIOR CLEAN OUT DETAIL
SCALE: NONE



CLEAN OUT DETAIL
SCALE: NONE



BREAKROOM DISHWASHER DRAINAGE PIPING DETAIL
SCALE: NONE

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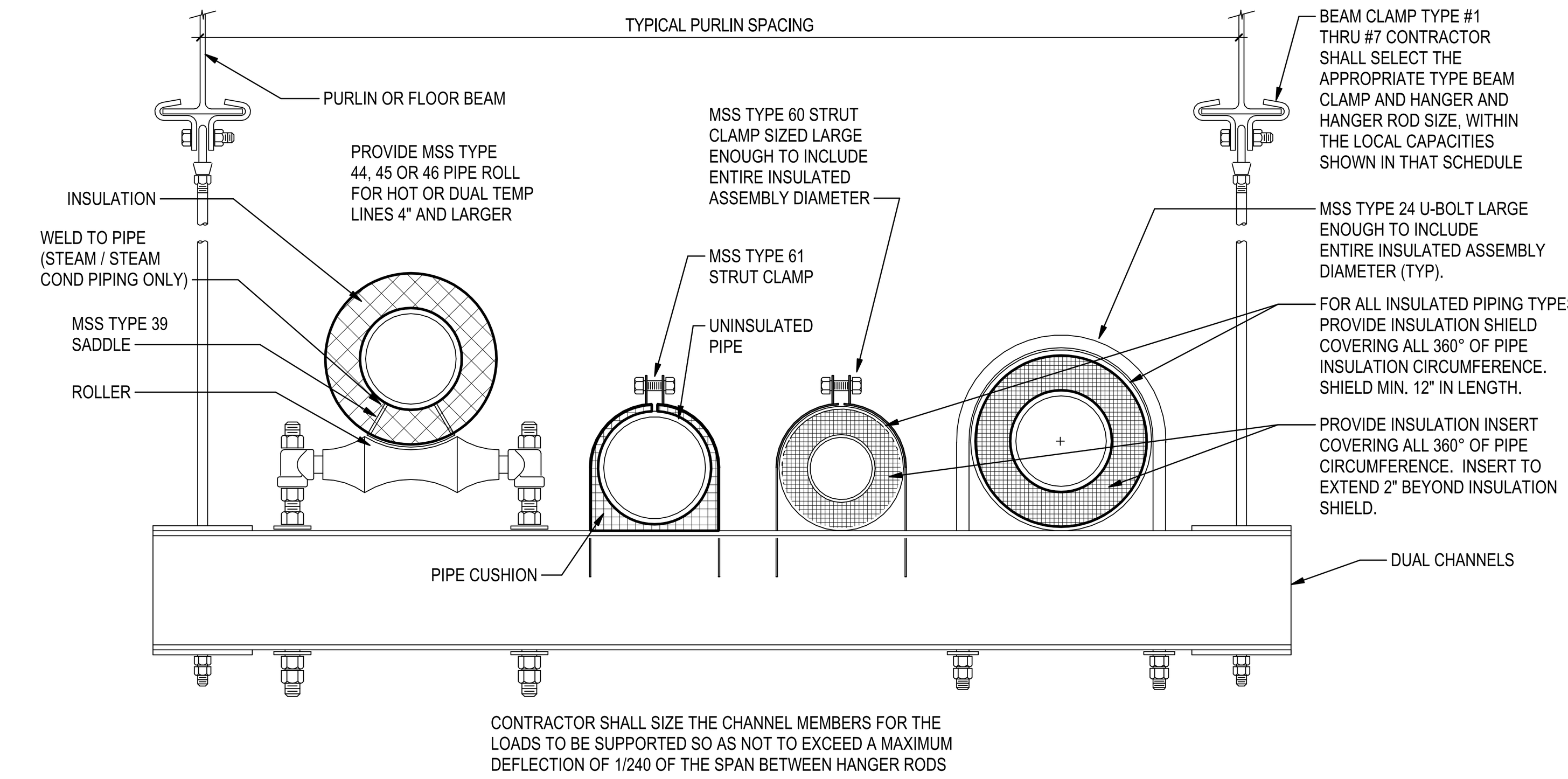
PLUMBING DETAILS

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM I	21-JUL-2023

PROJ #: 220116
DATE: 23-JUN-2023
SHEET
P-501

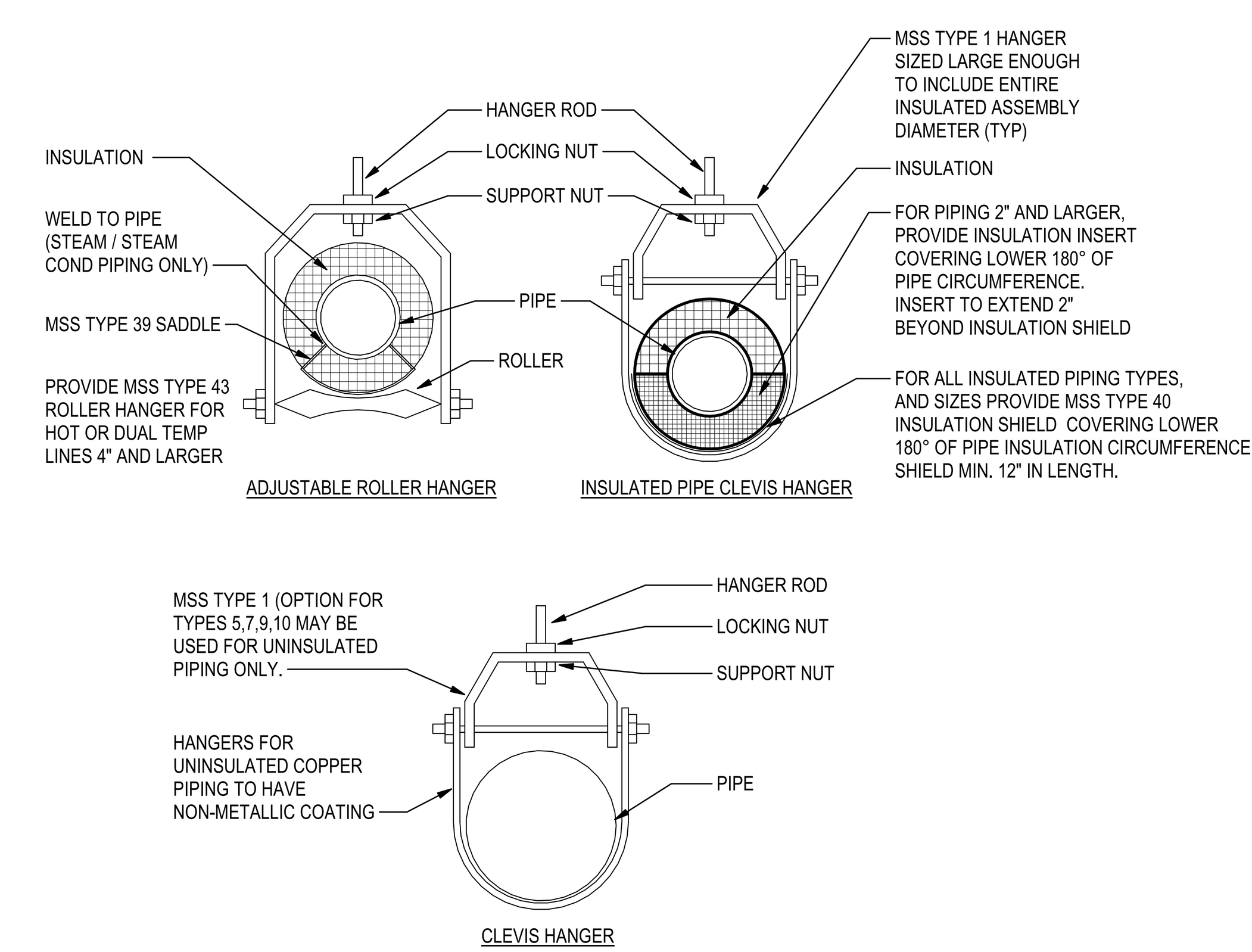
100% CONSTRUCTION DOCUMENTS
Addendum I



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.

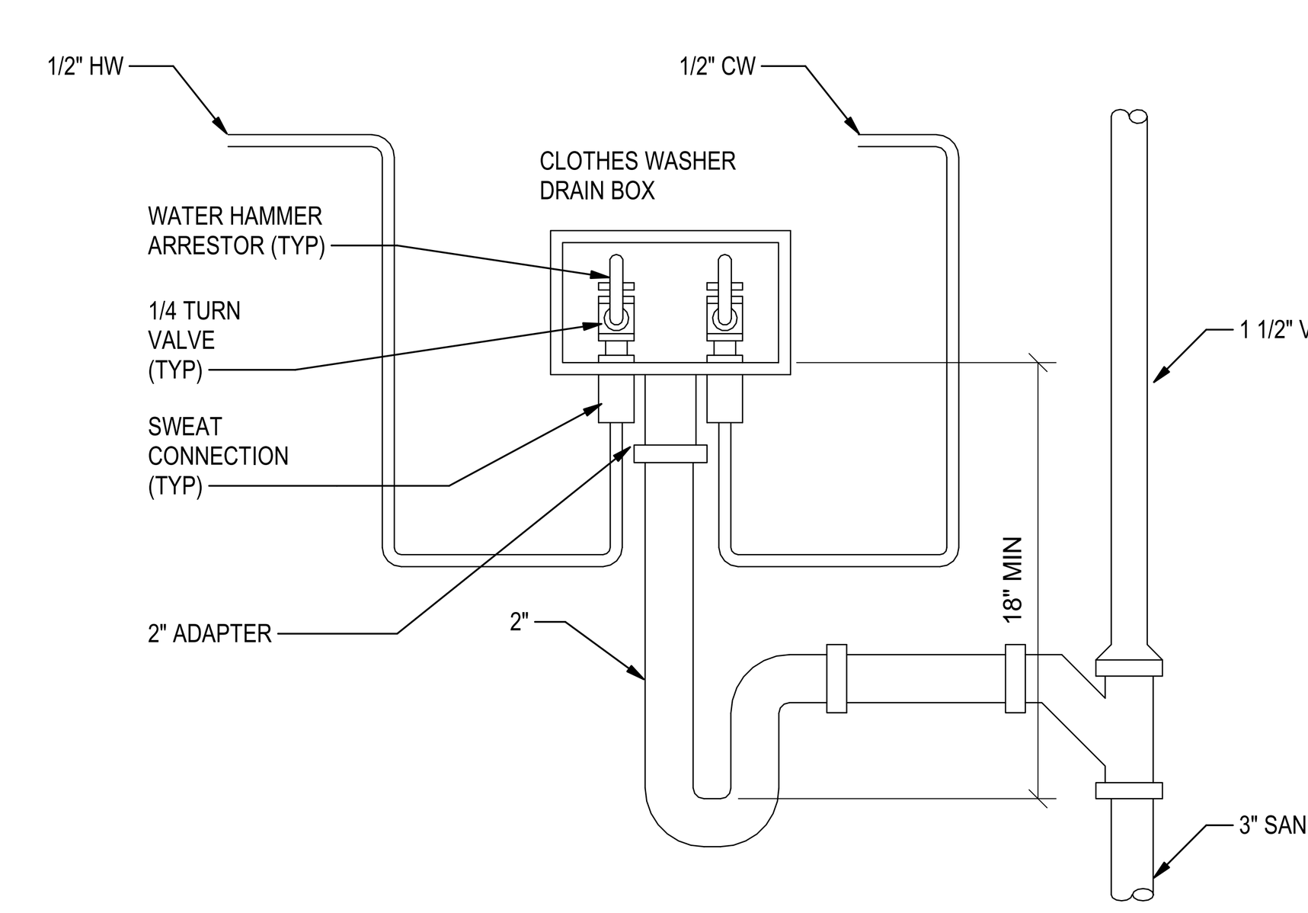
TRAPEZE SUPPORT DETAIL

SCALE: NONE



PIPE HANGER DETAIL

SCALE: NONE



WASHING MACHINE OUTLET BOX DETAIL W/ WATER HAMMER ARRESTORS

SCALE: NONE

NOTES:
1. PROVIDE ACCESS WALL PANEL AT TRAP.

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PLUMBING DETAILS (A1)

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-502

100% CONSTRUCTION DOCUMENTS
Addendum I

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. PROVIDE WITH TRAP PRIMER TYPE TP-1 A1
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 TYPE TP-2 A1
FD-3	FUNNEL FLOOR DRAIN	REFER TO FLOOR PLANS	-	REFER TO FLOOR PLANS	-	-	ZURN Z415F-AR FUNNEL FLOOR DRAIN WITH TYPE "F" STRAINER. CAST IRON BODY WITH ACID RESISTANT EPOXY COATING. PROVIDE 1/2" TRAP PRIMER CONNECTION FOR TRAP PRIMER TYPE TP-2 A1
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. PROVIDE 1/2" TRAP PRIMER CONNECTION FOR TRAP PRIMER TYPE TP-2 A1
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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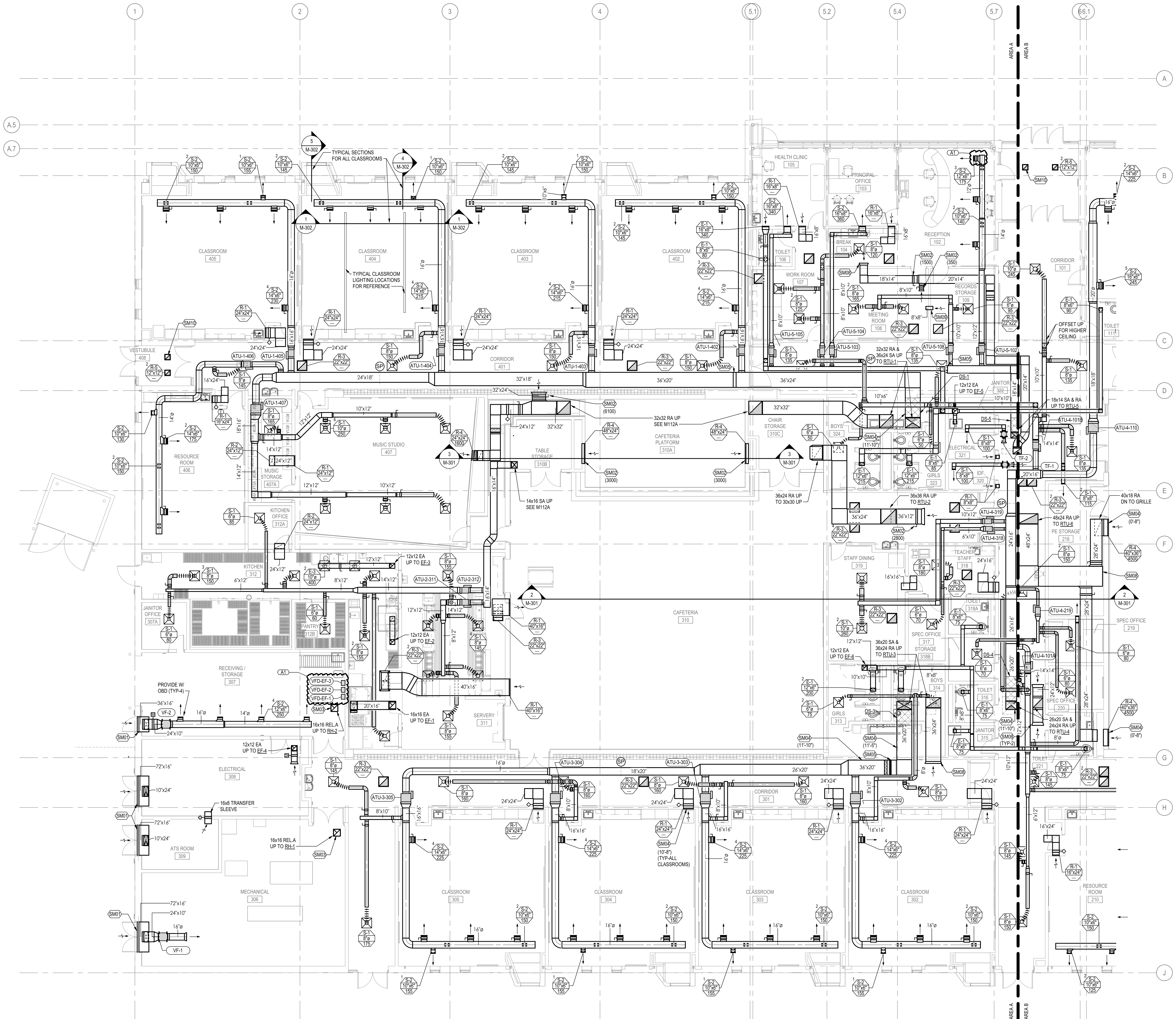
PLUMBING SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
P-601

100% CONSTRUCTION DOCUMENTS



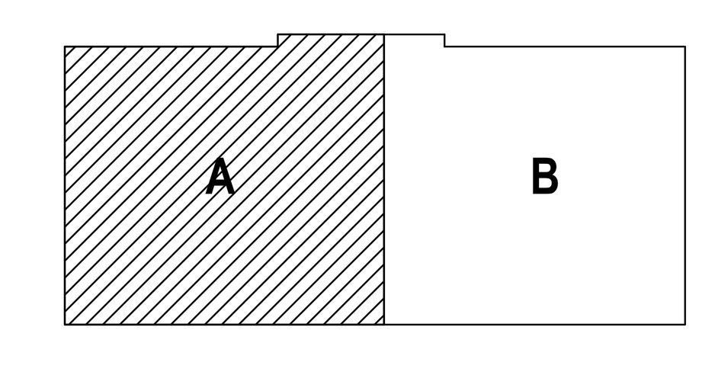
SHEET METAL PLAN - AREA A
1/8" = 1'-0"

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.

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
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-111A

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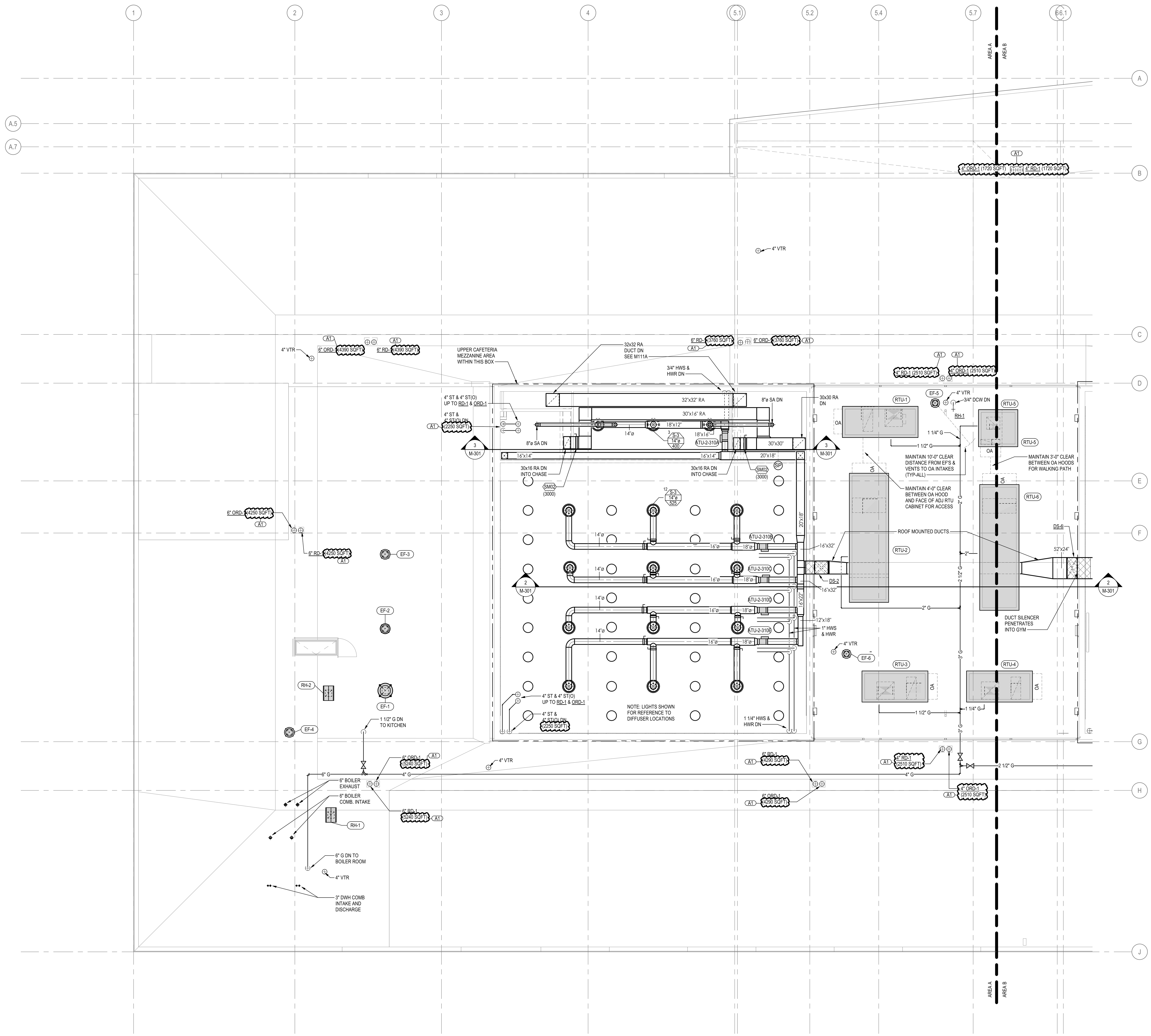
Addendum 1



MECHANICAL AND PLUMBING LOWER ROOF AND UPPER CAFE PLAN - AREA A
1/8" = 1'-0"

SHEET METAL GENERAL NOTES

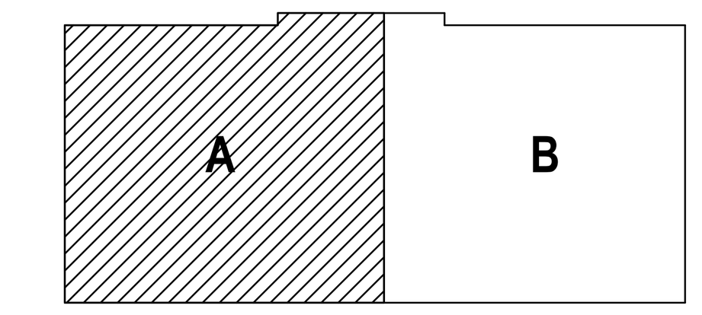
1. COORDINATE NEW DUCTWORK WITH SITE CONDITIONS EQUIPMENT MANUFACTURER AND ALL OTHER TRADES TO AVOID INTERFERENCES.
2. PROVIDE ACCESS AROUND ALL NEW EQUIPMENT PER MANUFACTURERS RECOMMENDATIONS.
3. VAV BOXES AND VALVES SHALL BE LOCATED NO MORE THAN 24 INCHES ABOVE SUSPENDED CEILINGS FOR ACCESS.
4. ALL 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.
19. SEE PLUMBING FIXTURE SCHEDULE ON P601 FOR BRANCH PIPING SIZES TO INDIVIDUAL PLUMBING FIXTURES.

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

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-112A

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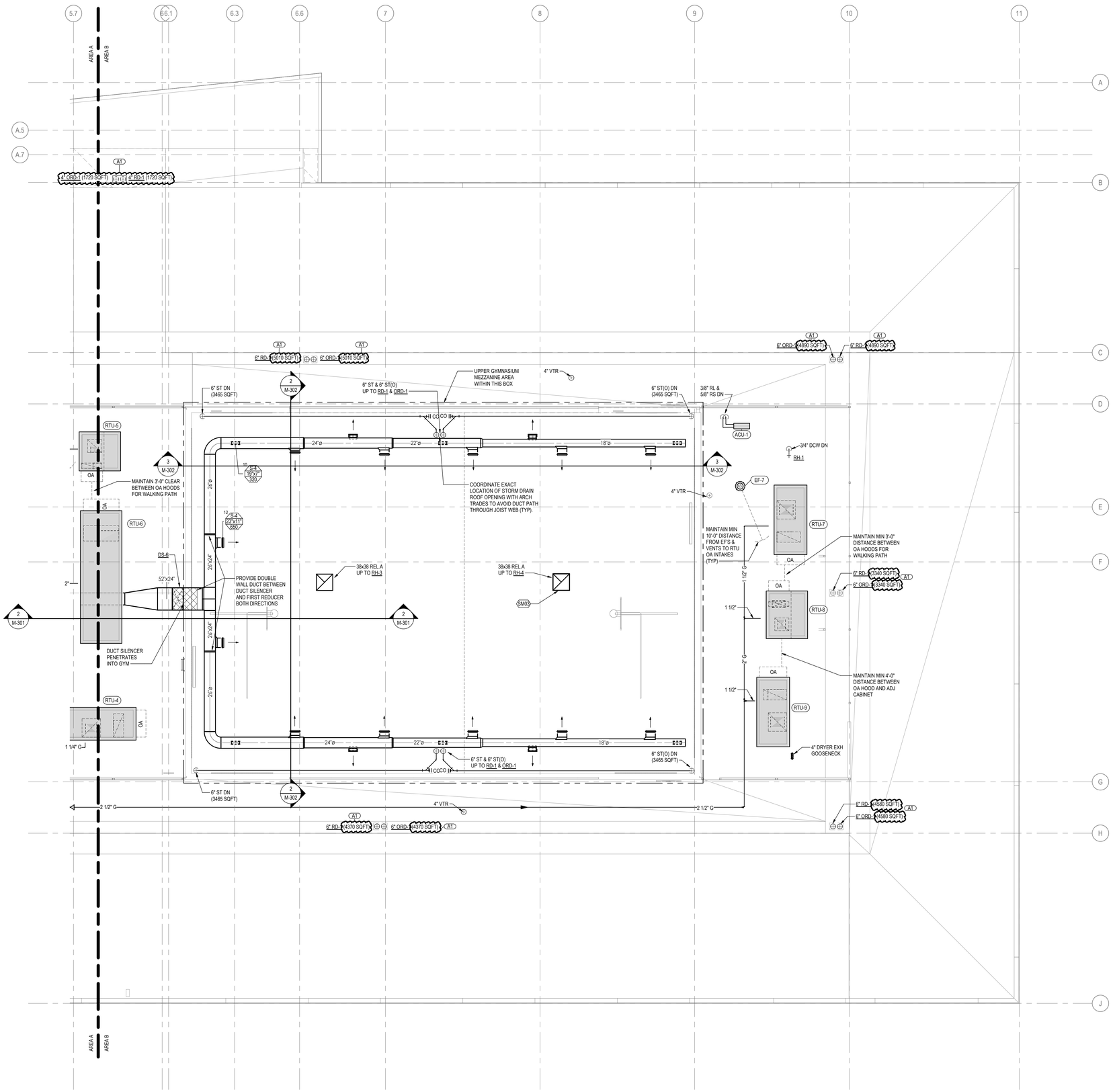
Addendum 1



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.

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PLUMBING GENERAL NOTES

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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.

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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.

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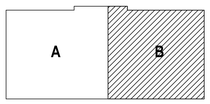
19 SEE PLUMBING FIXTURE SCHEDULE ON P601 FOR BRANCH PIPING SIZES TO INDIVIDUAL PLUMBING FIXTURES.

(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

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-112B

100% CONSTRUCTION DOCUMENTS

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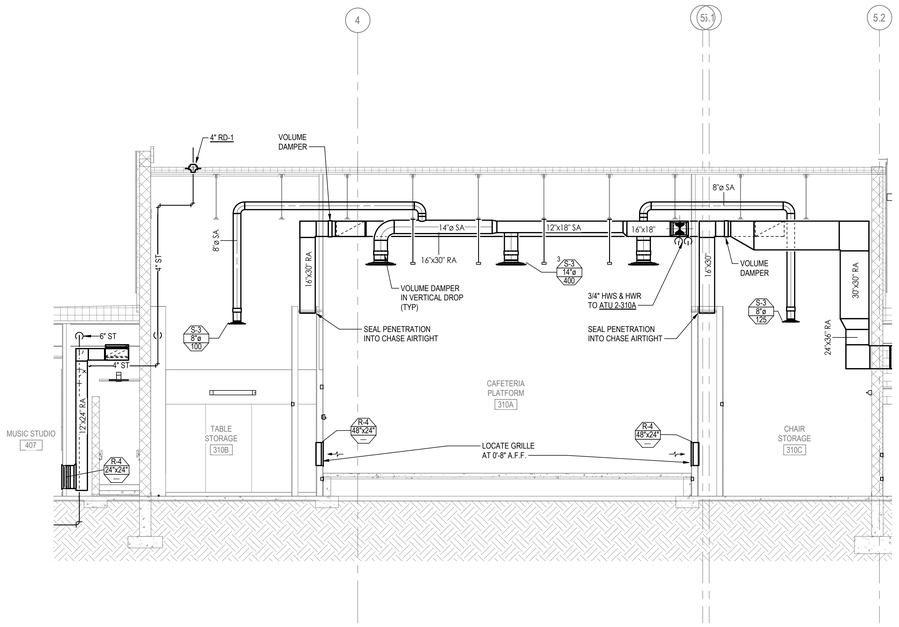
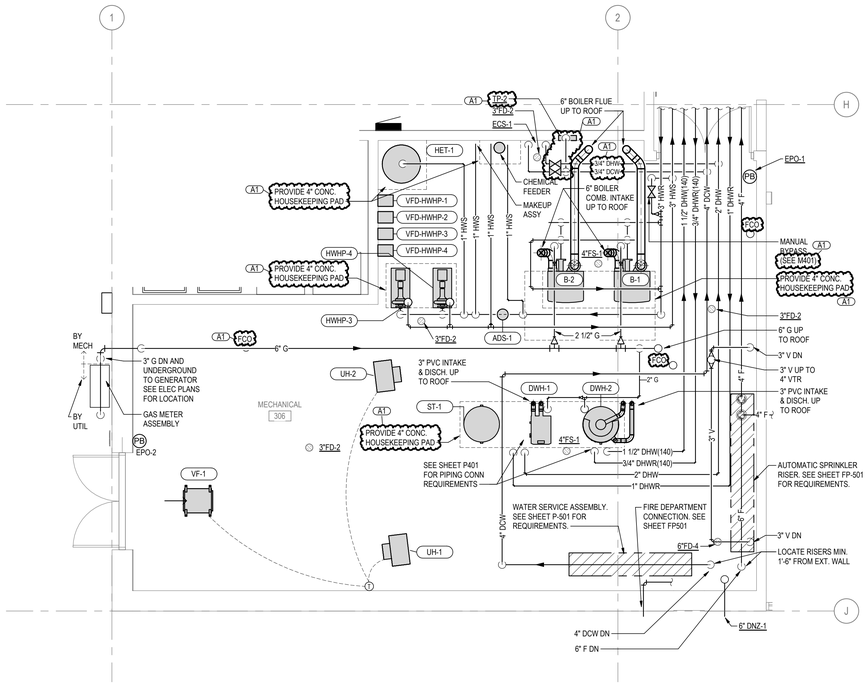
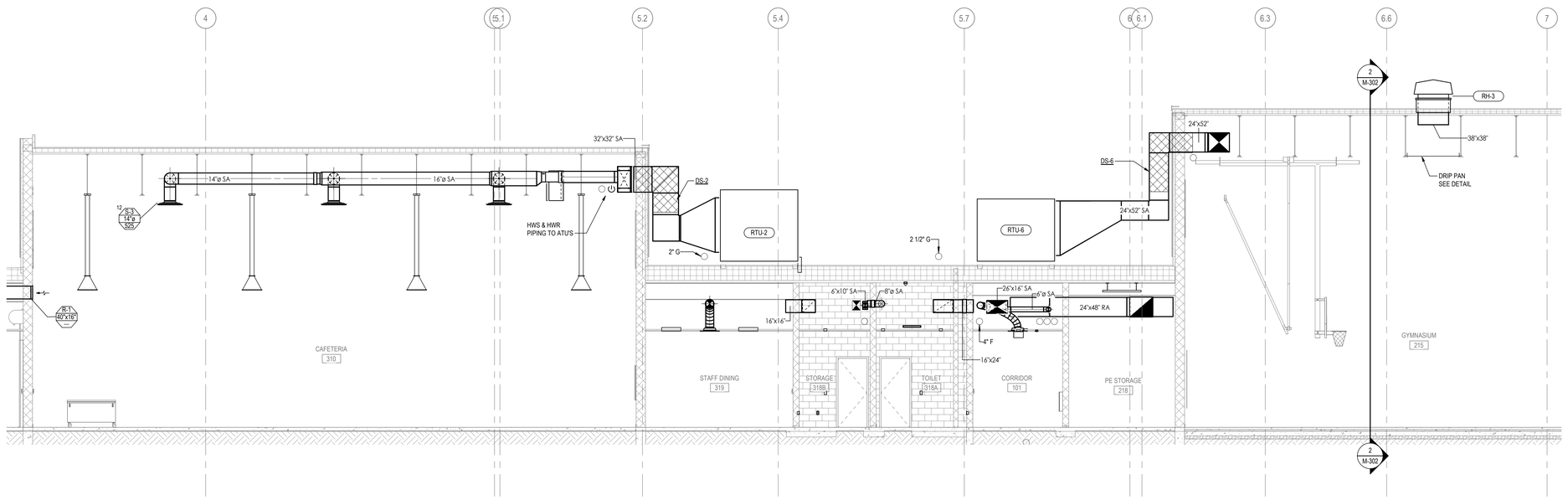
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver



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"

THE BAR BELOW SHOWS GRAYSCALE FROM WHITE TO SOLID BLACK
WE RECYCLE

7/21/2023 3:04:16 PM
Autodesk Docs://220116_LSD - Mt HOPE\Mt_Hope.rvt

DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

ENLARGED MECHANICAL PLANS AND SECTIONS

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-301

100% CONSTRUCTION DOCUMENTS
Addendum 1

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

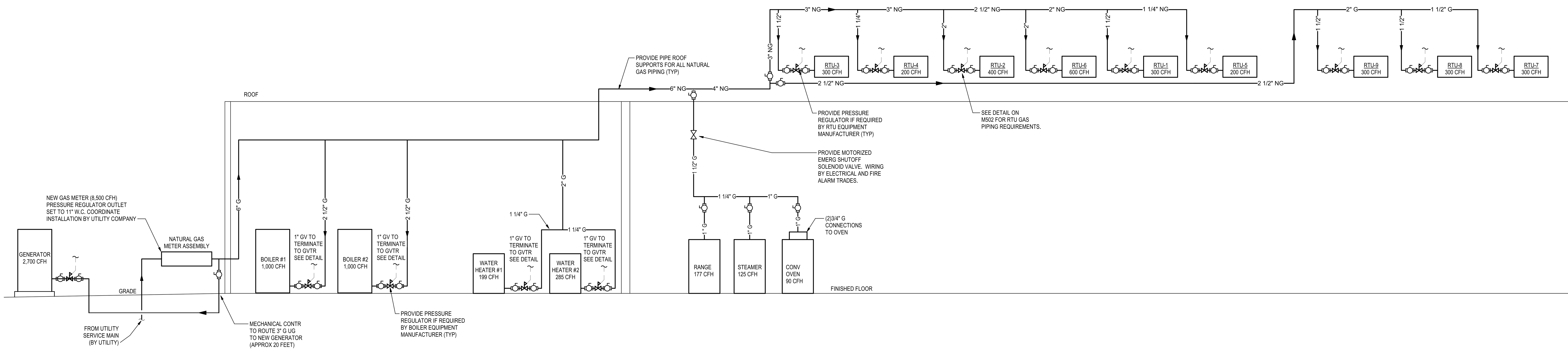
NOTES:
NATURAL GAS PIPING SYSTEM FROM BUILDING REGULATOR TO NEW EQUIPMENT IS BASED ON 8,500 CFH WITH A TOTAL FARTHEST DISTANCE RUN OF 375 FEET, 1.0 INCH WATER COLUMN LOSS, 0.6 SPECIFIC GRAVITY GAS, SCHEDULE 40 PIPING. REFER TO SCHEDULE BELOW.

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

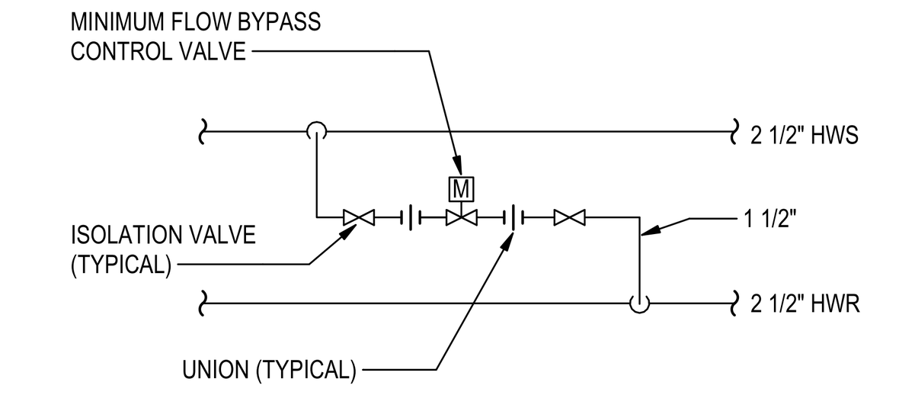
NOTES:
SCHEDULE IS BASED ON INTERNATIONAL FUEL GAS CODE LOW PRESSURE GAS EQUATION.

Q=(D*19.17(H/Cr*L)^.206)^(1/.381)

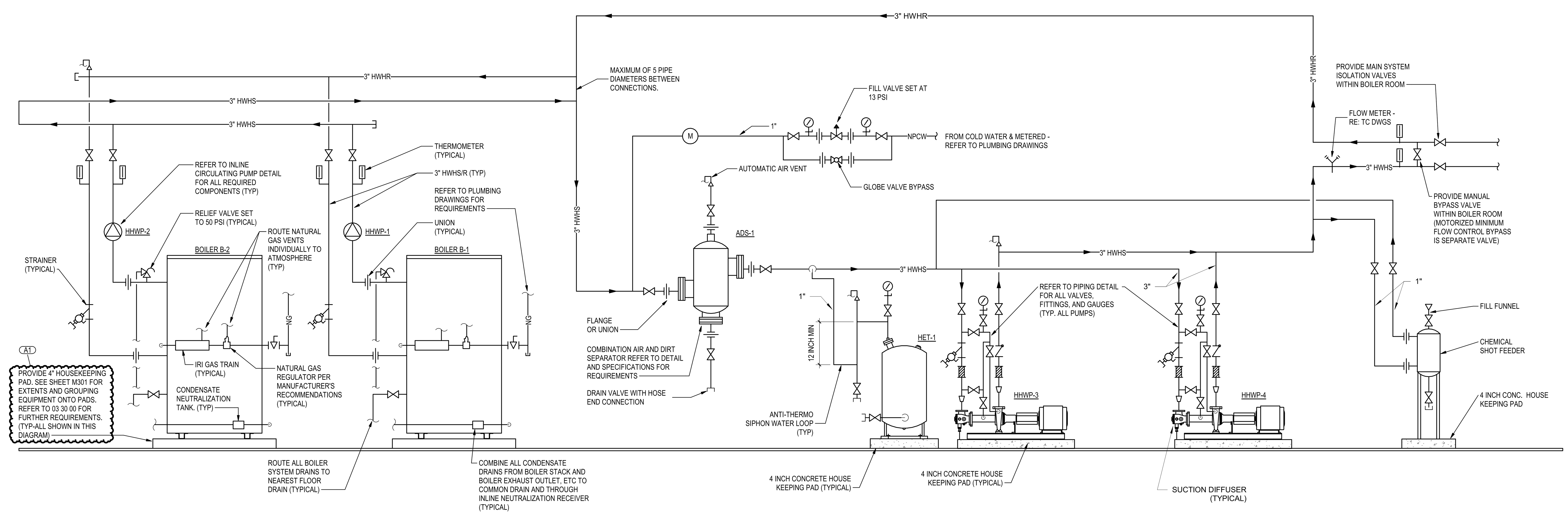
Q= CAPACITY (CUBIC FEET PER HOUR)
D= INSIDE PIPE DIAMETER (INCHES)
L= LENGTH OF PIPE (FEET)
H= PRESSURE DROP (INCH WATER COLUMN)
Cr= 0.6094



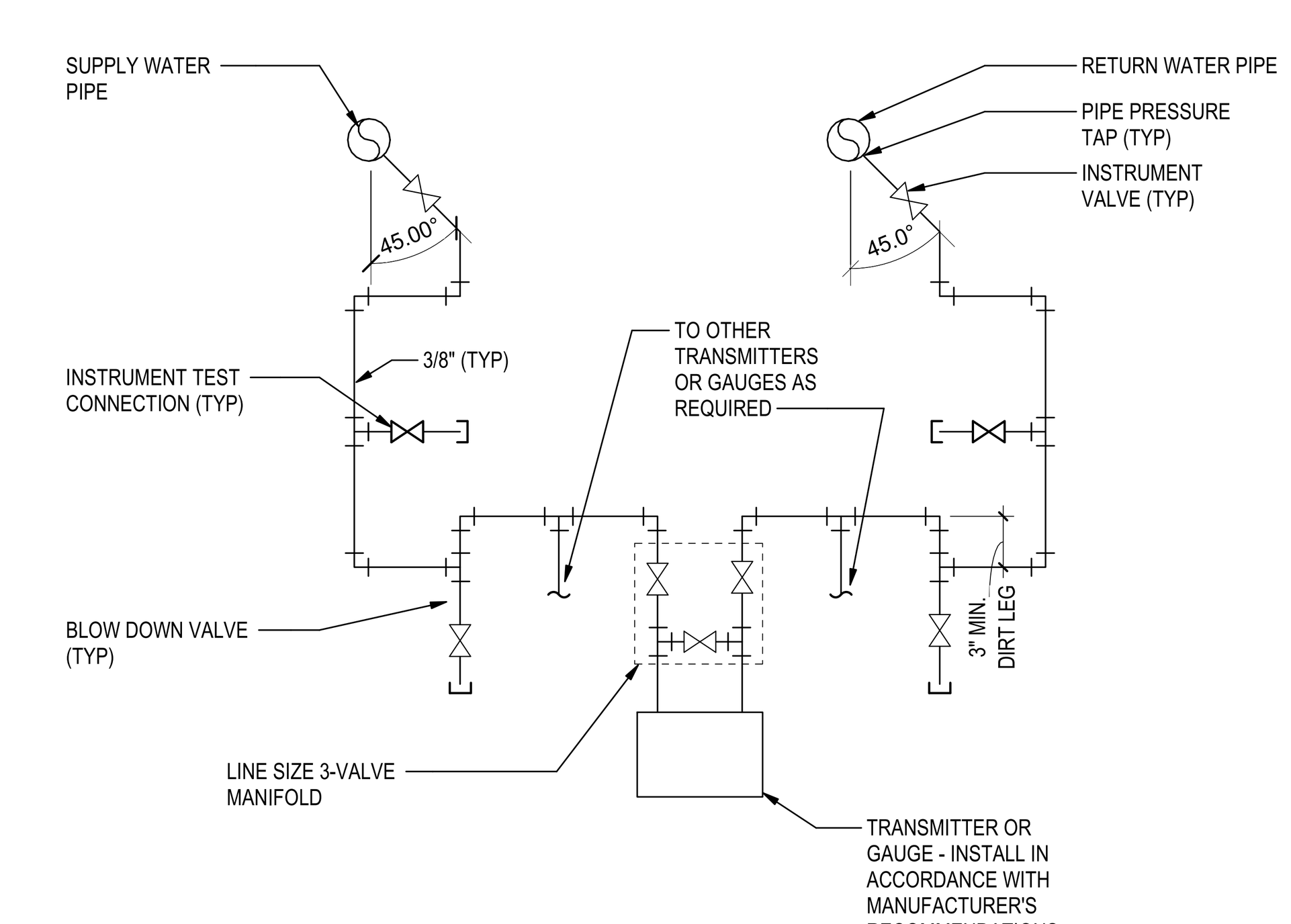
1 NATURAL GAS RISER DIAGRAM
NTS



MINIMUM FLOW CONTROL BYPASS VALVE
SCALE: NONE



3 NEW HEATING HOT WATER SYSTEM DIAGRAM
NTS



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

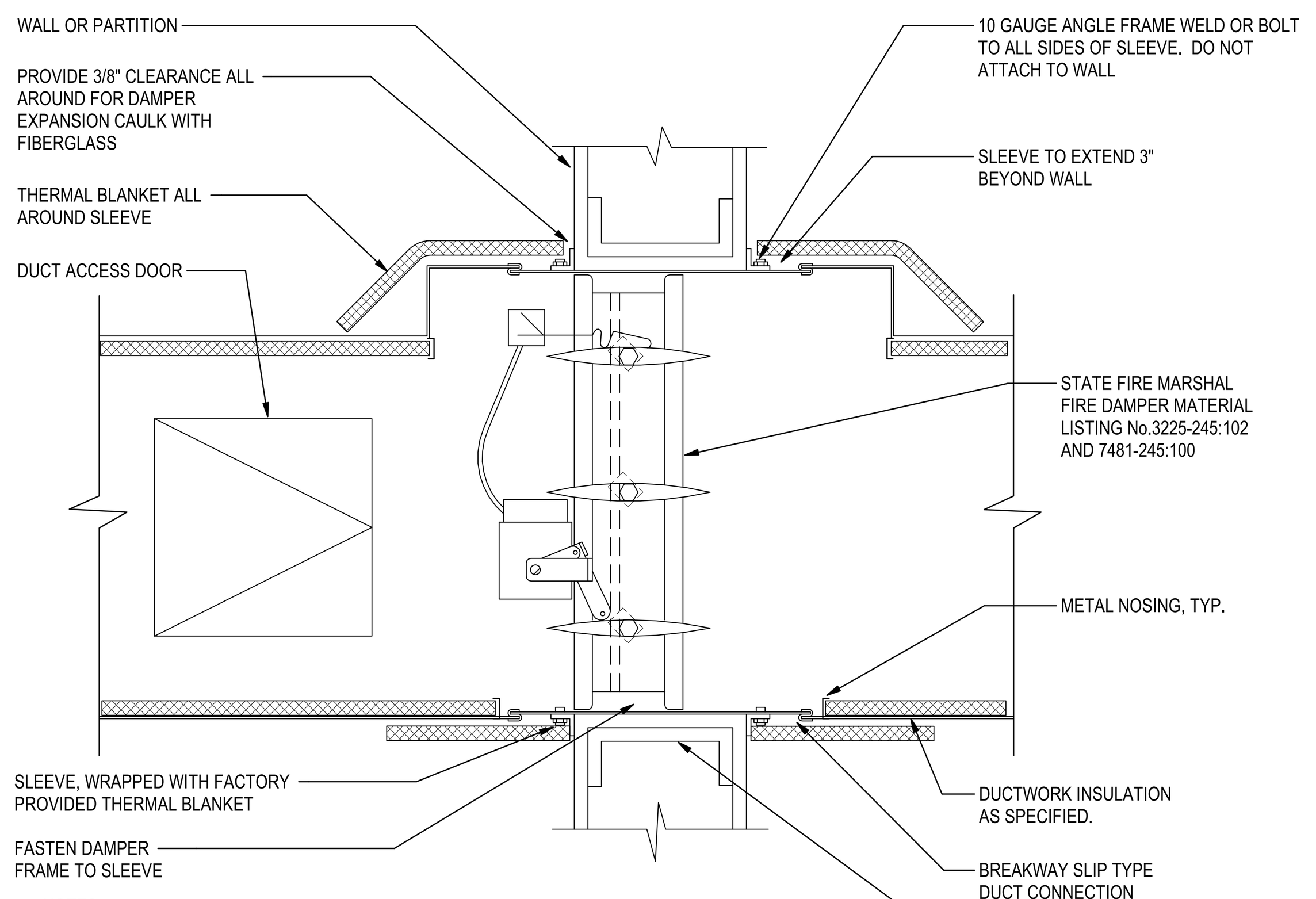
REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ #: 220116
DATE: 23-JUN-2023
SHEET
M-401

100% CONSTRUCTION DOCUMENTS

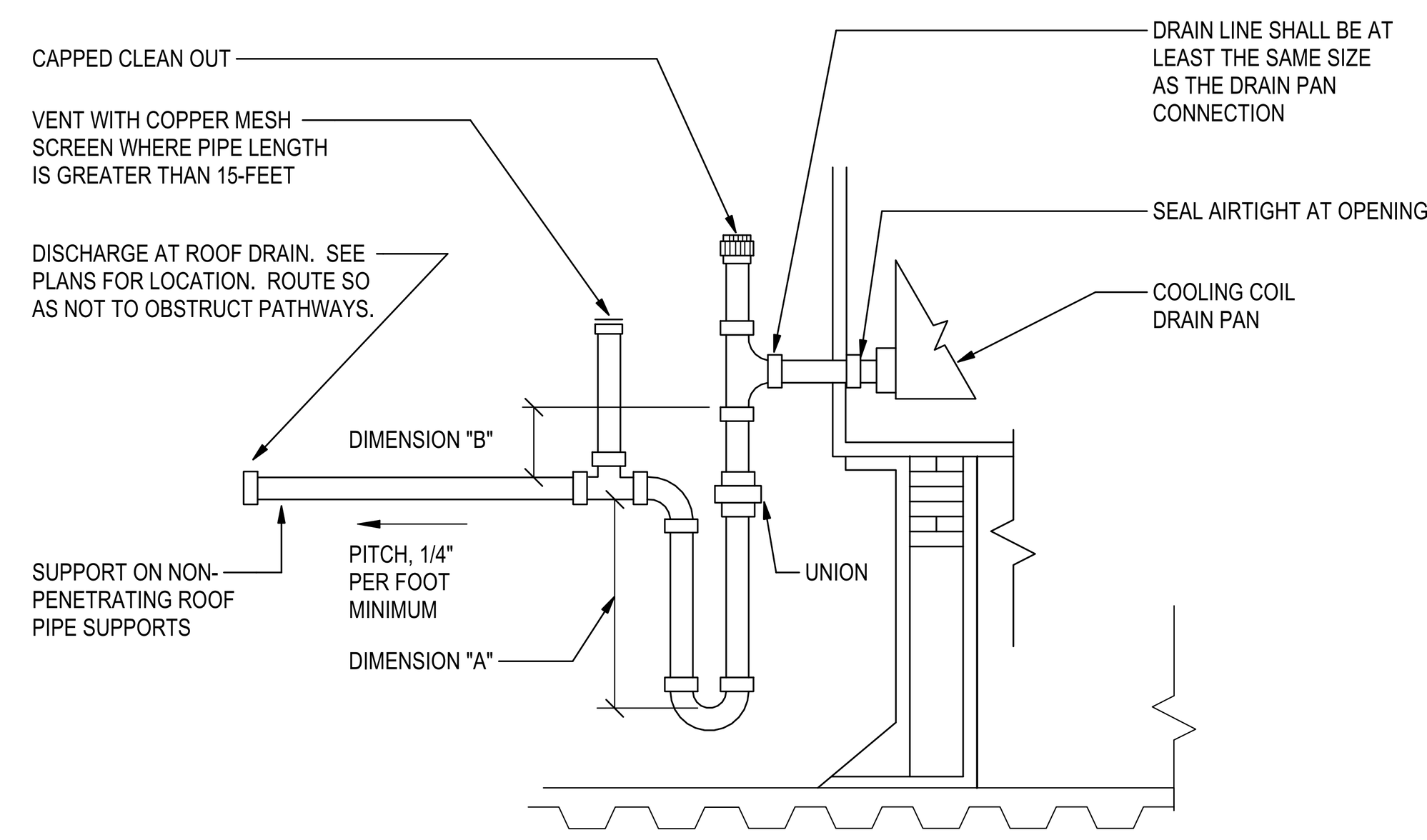
Addendum I



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

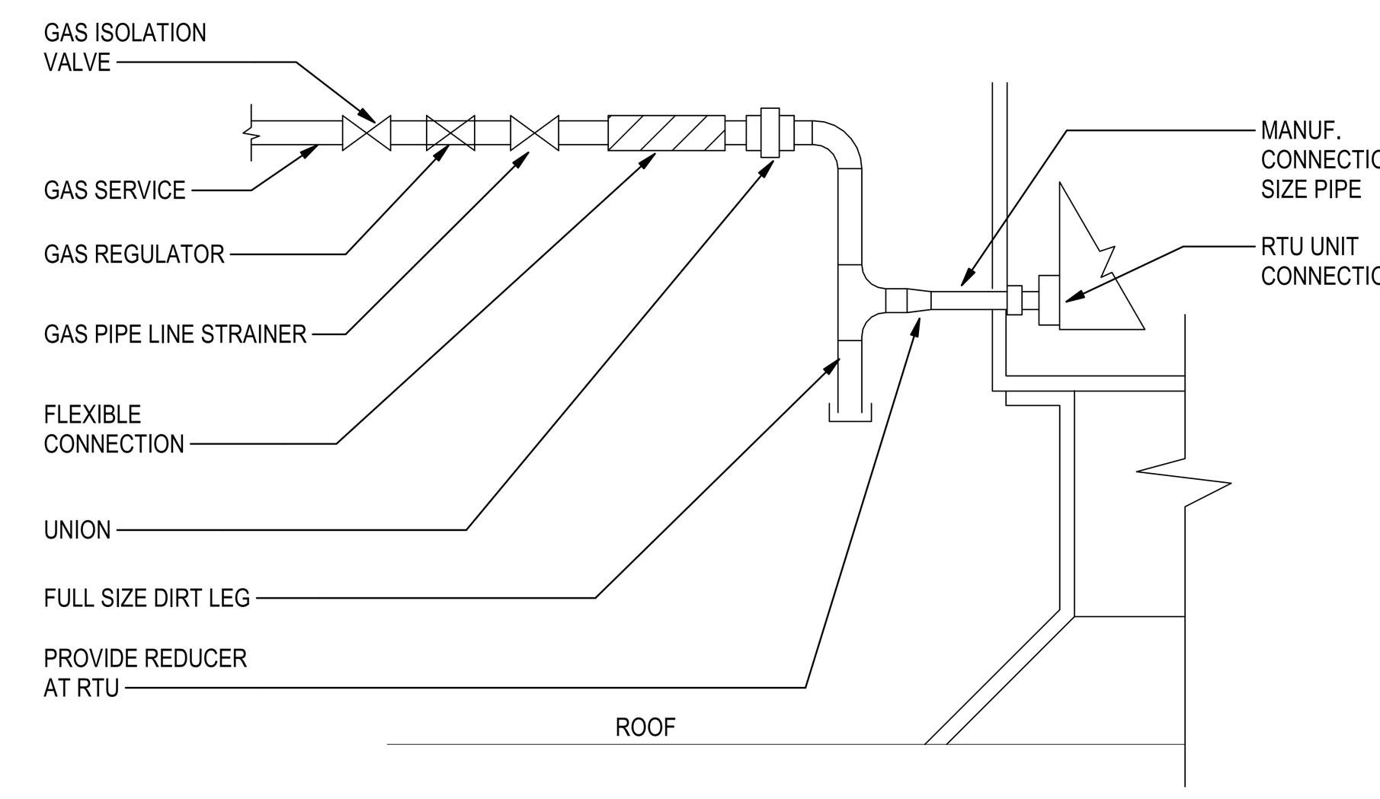
SCALE: NONE



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. IN ADDITION TO COOLING COIL CONDENSATE DRAIN, PROVIDE ENERGY RECOVERY SECTION DRAIN TRAP PIPING FOR RTU-1,2 AND 8. ENERGY RECOVERY DRAIN PIPING SHALL TERMINATE ADJACENT TO RTU IN LIEU OF ROUTING TO ROOF DRAIN AS INDICATED ABOVE AND SHALL BE WRAPPED WITH HEAT TRACE. (A1)

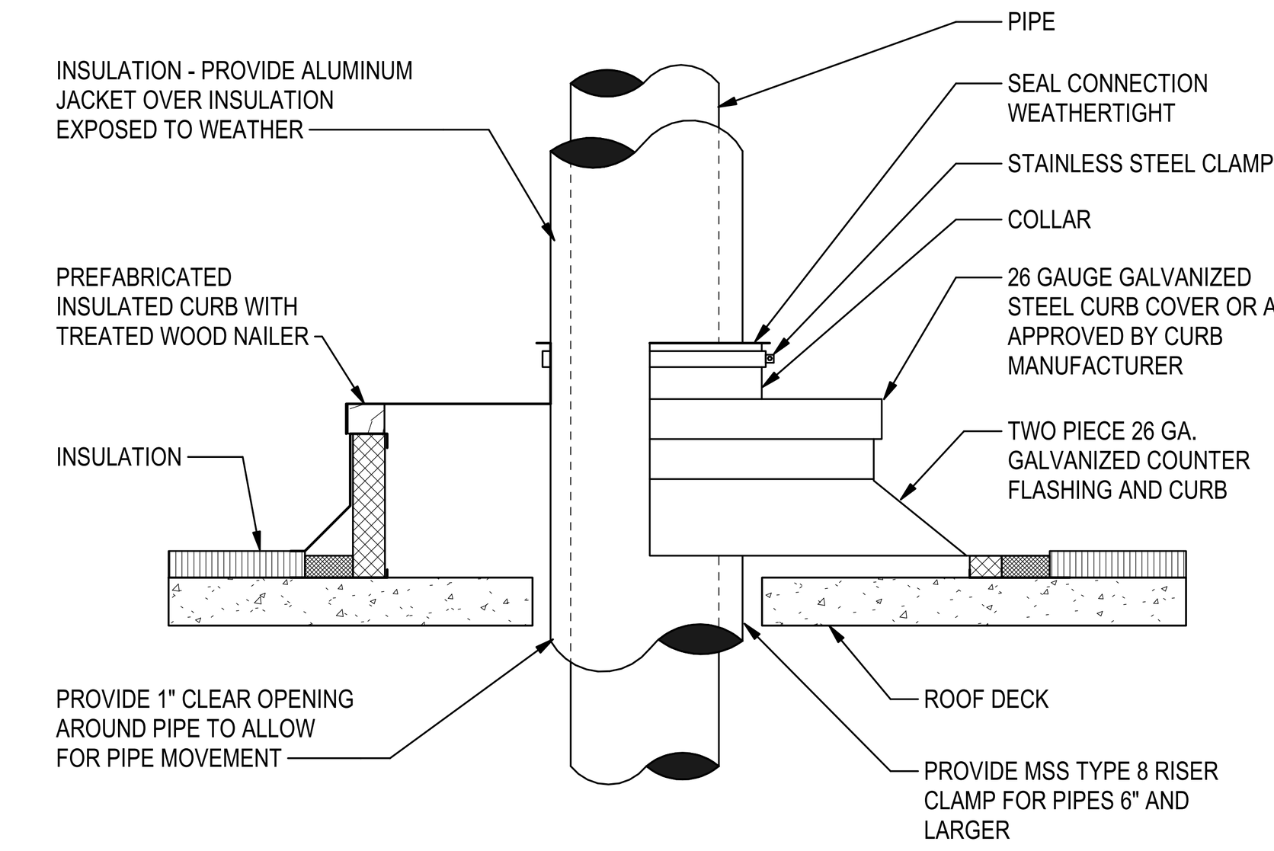
COOLING COIL AND ENERGY RECOVERY SECTION CONDENSATE DRAIN TRAP PIPING DETAIL

SCALE: NONE



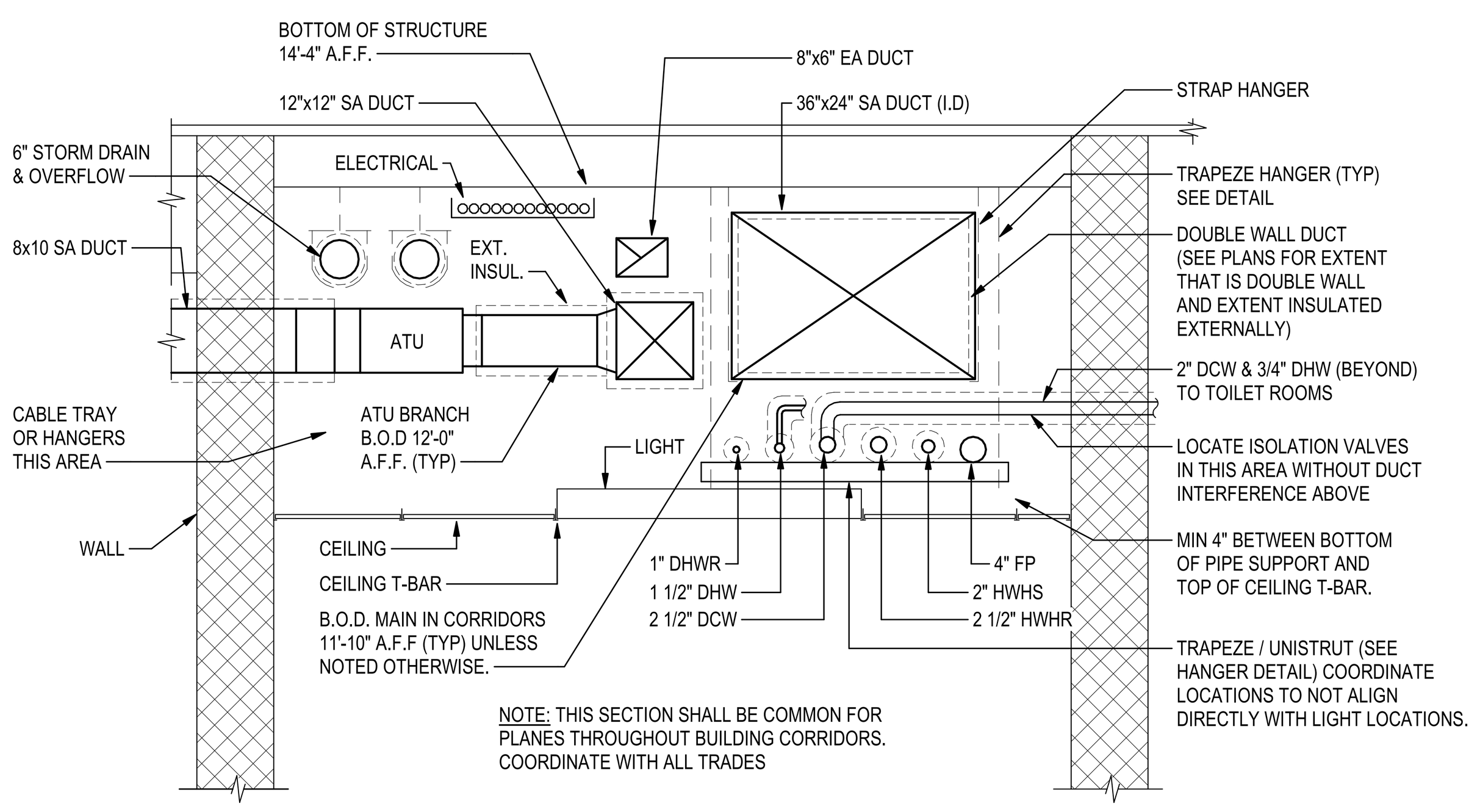
RTU GAS PIPING DETAIL

SCALE: NONE



PIPE ROOF PENETRATION DETAIL

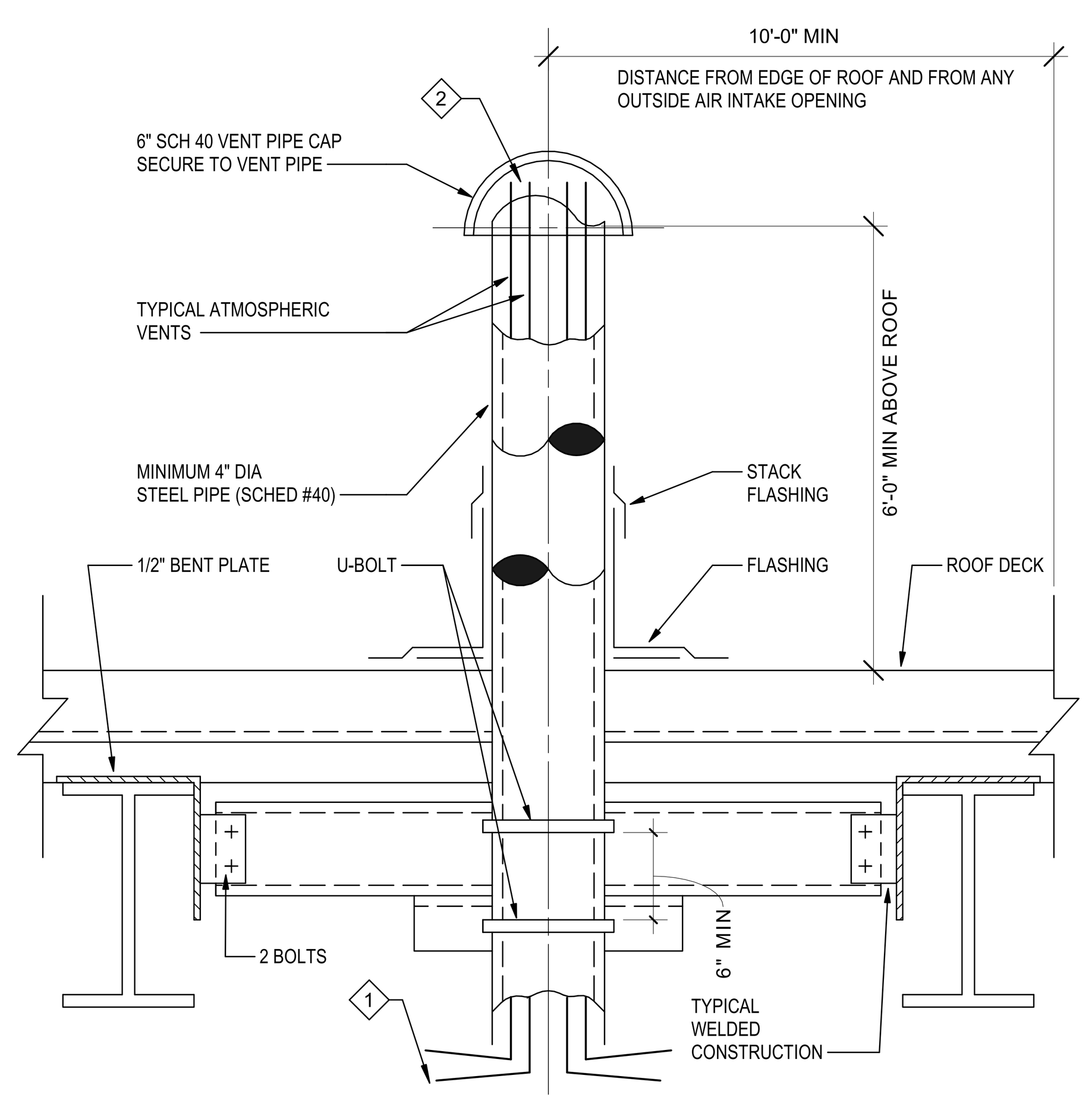
SCALE: NONE



NOTE: THIS SECTION SHALL BE COMMON FOR PLANES THROUGHOUT BUILDING CORRIDORS. COORDINATE WITH ALL TRADES

CORRIDOR 101 SECTION VIEW

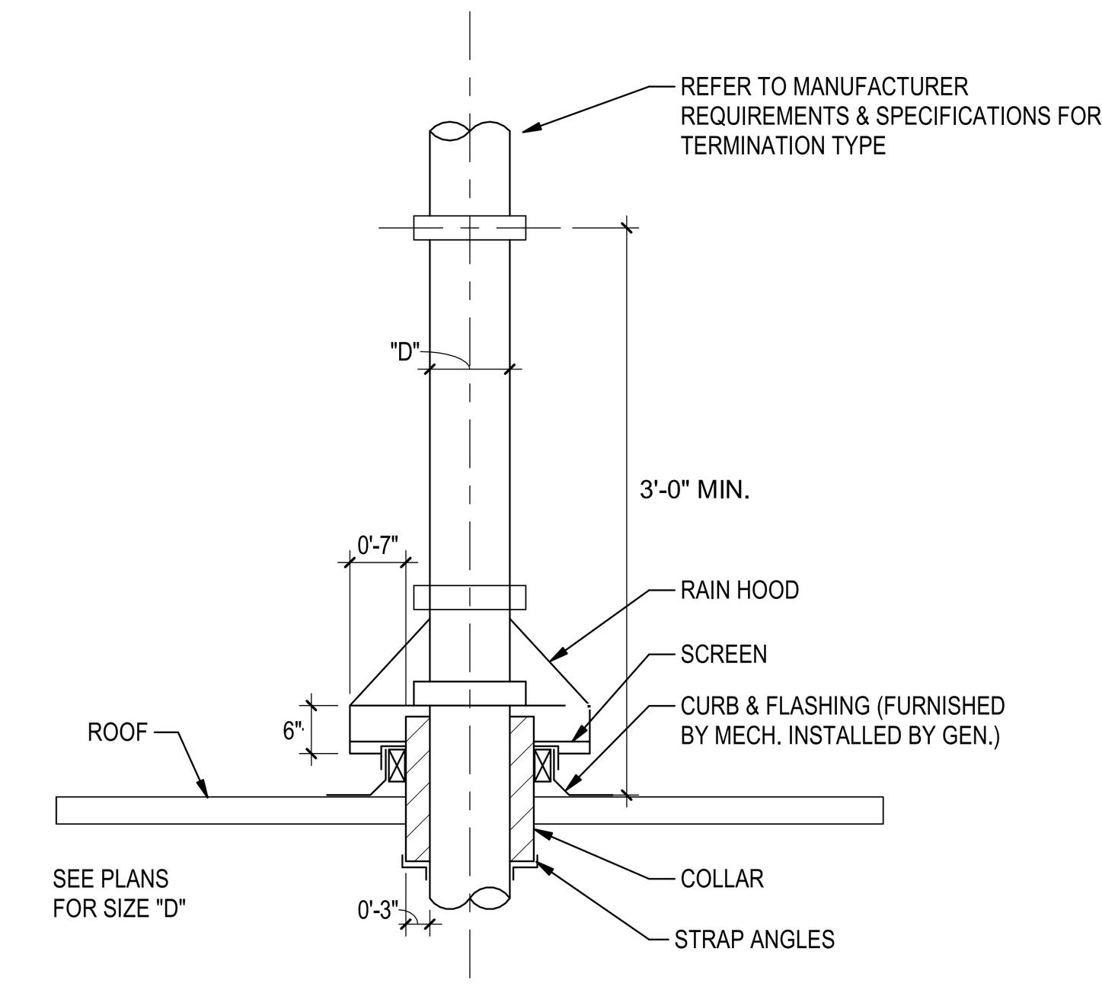
SCALE: 1/2" = 1'-0"
(LOOKING SOUTH OUTSIDE ROOM 108)



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

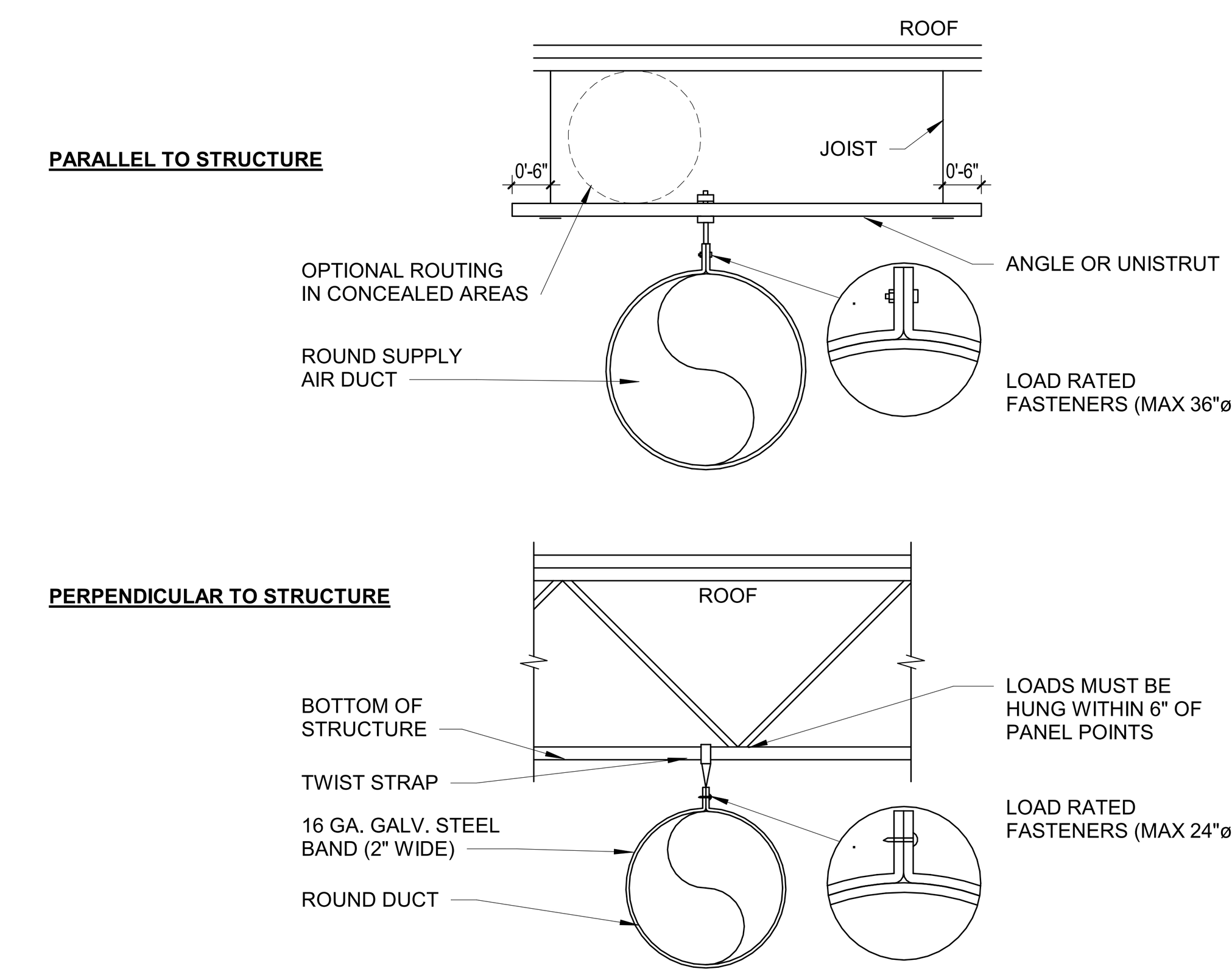
SCALE: NONE



NOTE:
PROVIDE COLLAR, STRAP ANGLES, ETC., FOR ADDITIONAL PENETRATION THRU CEILING CONTRUCTION.

FLUE THROUGH ROOF DETAIL

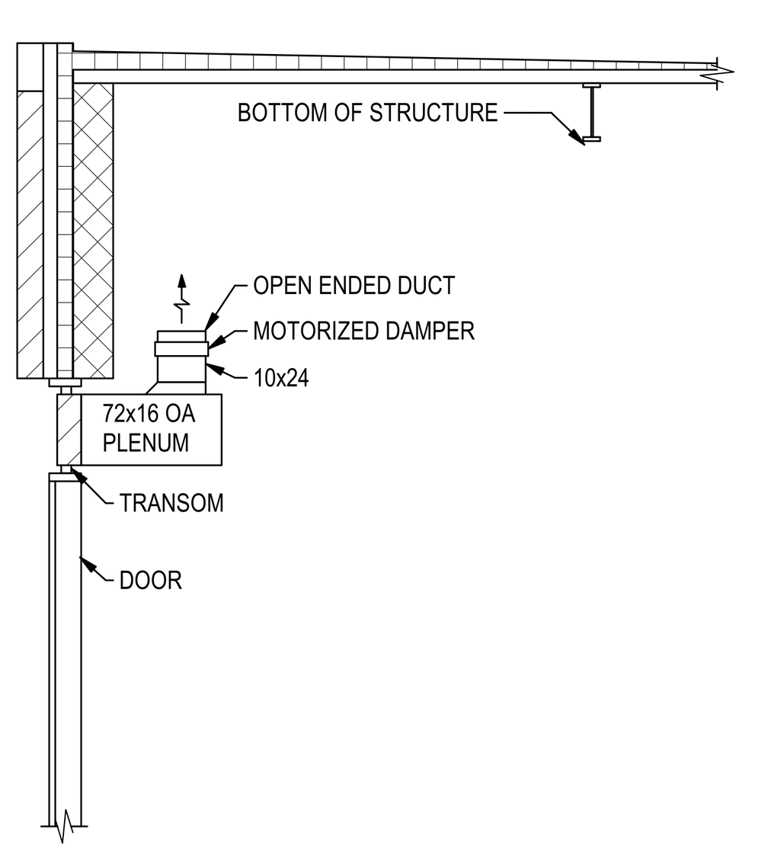
SCALE: NONE



NOTES:
1. USE THREADED ROD FOR ALL DUCTS LARGER THAN 60"ø WIDE

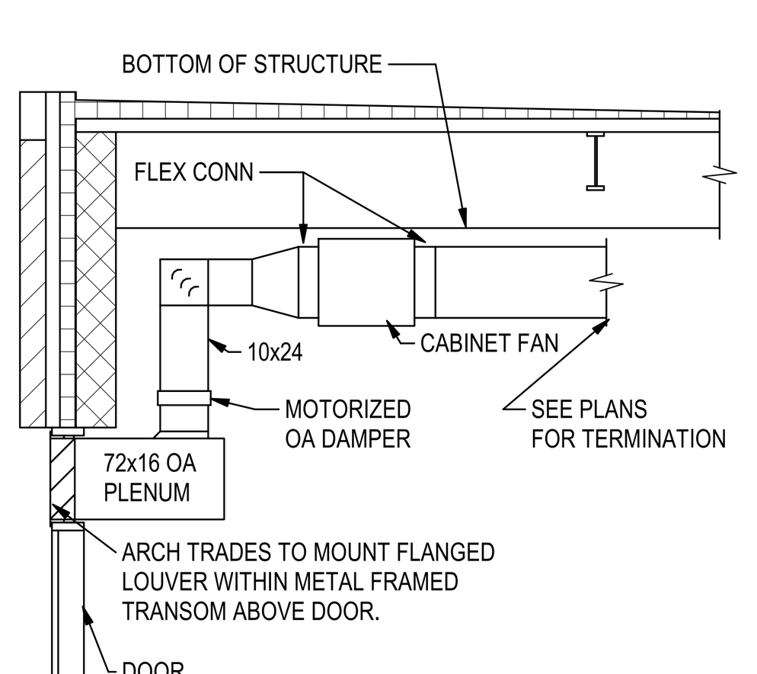
ROUND DUCT SUPPORT DETAIL

SCALE: NONE



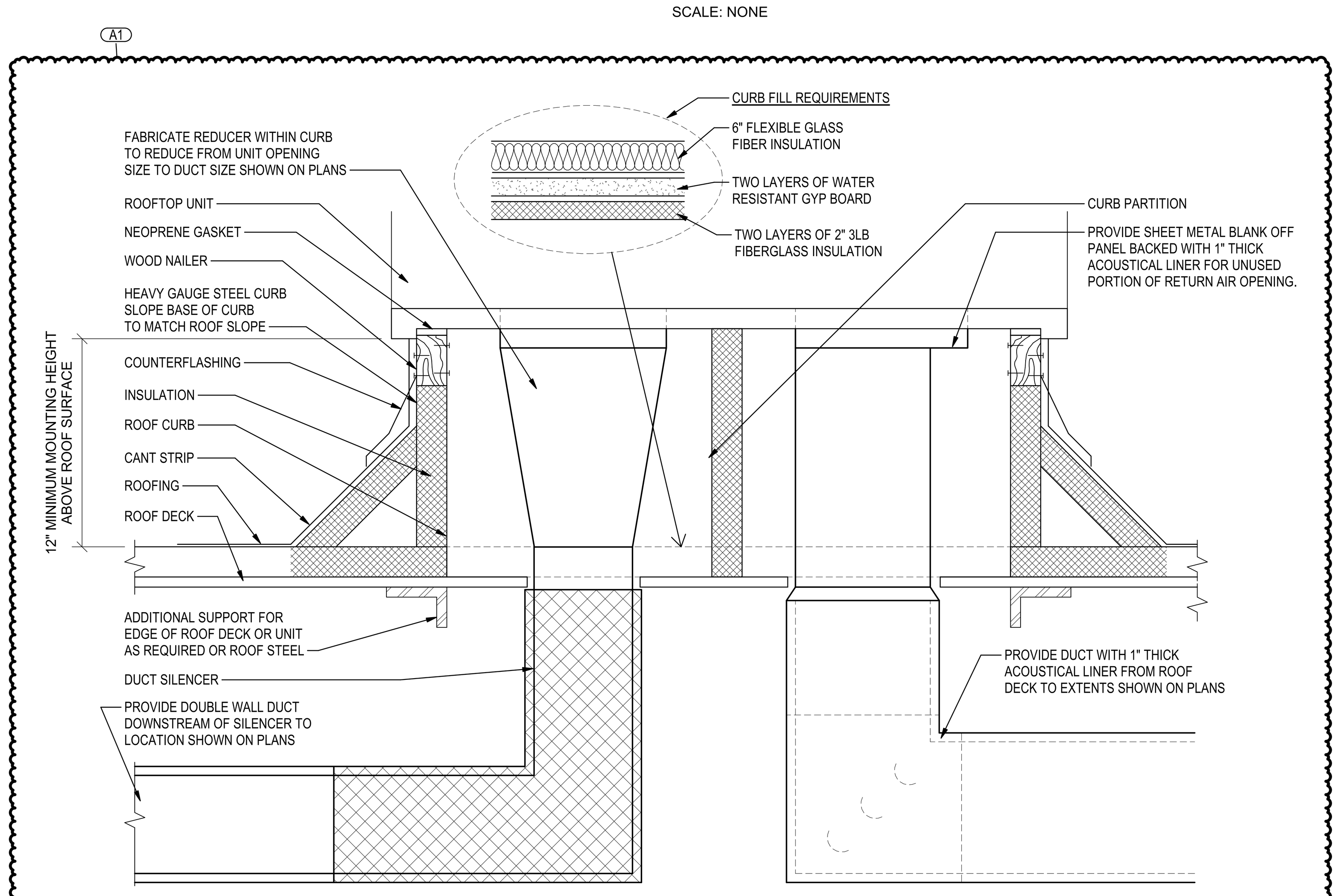
ELECTRICAL AND ATS ROOM AIR INTAKE SECTION VIEW

SCALE: NONE



MECHANICAL AND RECEIVING ROOM AIR INTAKE SECTION VIEW

SCALE: NONE



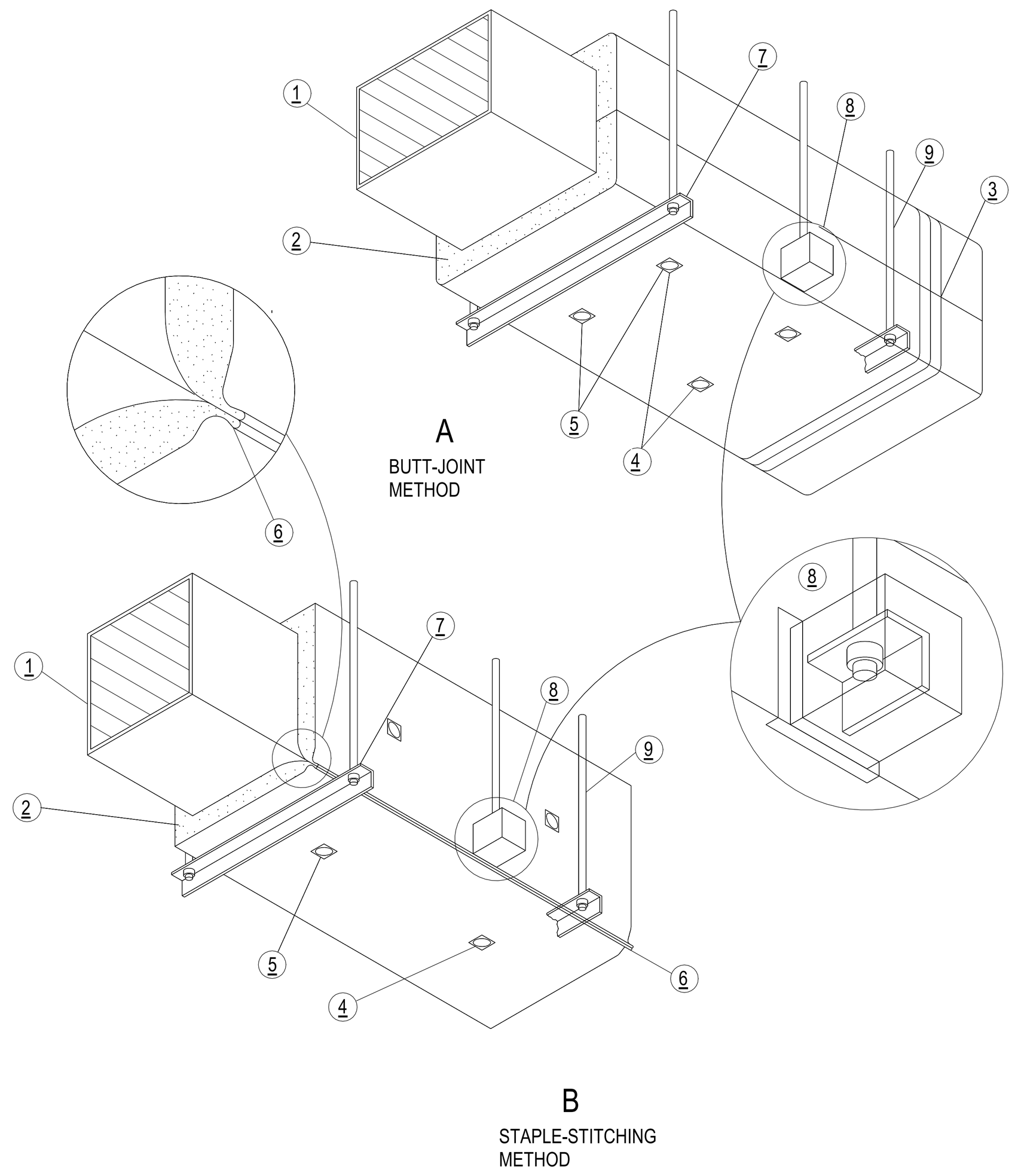
ROOFTOP EQUIPMENT CURB AND DUCT DROP DETAIL

SCALE: NONE

NOTES:
1. ALL DUCT, PIPING, AND ELECTRICAL CONNECTIONS TO UNIT BELOW CURB SHALL HAVE FLEXIBLE CONNECTIONS.

2. CUT INSULATION, GYP BOARD, ROOFING INSULATION, AND ROOF DECKING PENETRATIONS TIGHT TO ITEMS PENETRATING THROUGH THE ASSEMBLY. SEE CURB FILL REQUIREMENTS ABOVE.

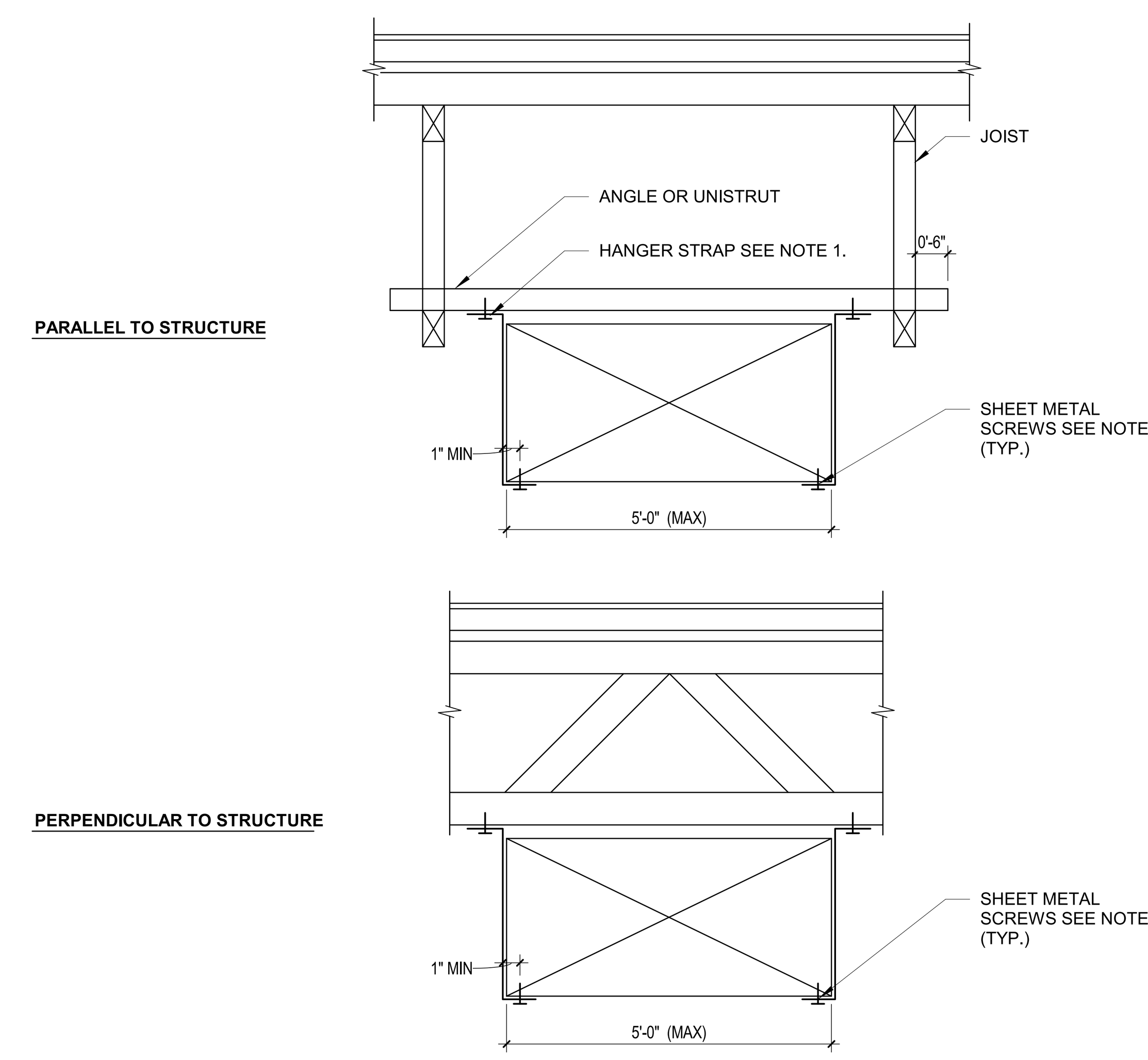
3. PACK ALL PENETRATION OPENINGS WITH FLEXIBLE INSULATION. PROVIDE SEALS AND GASKETS AT ALL ROOFTOP PENETRATIONS.



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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MECHANICAL DETAILS

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM I	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-502

100% CONSTRUCTION DOCUMENTS

DESIGNED BY:
CHECKED BY:
APPROVED BY: Approver

ROOF TOP UNIT SCHEDULE - PART A

UNIT IDENTIFICATION					AIRFLOW						PHYSICAL CHARACTERISTICS				FILTER			INDIRECT GAS FIRED HEATING SECTION							
												MAXIMUM UNIT DIMENSIONS													
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)
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

UNIT IDENTIFICATION		COMPONENTS								CONDENSER SECTION				FANS									CAPACITY AND PERFORMANCE				ELECTRICAL							
		DX COOLING COIL							HOT GAS REHEAT		COMPRESSORS				SUPPLY				EXHAUST															
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
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	86.2	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

UNIT IDENTIFICATION				WINTER OPERATION										SUMMER OPERATION										CONTROLS						
				CAPACITY		SUPPLY						EXHAUST	MIXED AIR			CAPACITY		SUPPLY					EXHAUST	MIXED AIR							
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)	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)	TOTAL AIRFLOW (CFM)	LDB (F)	LWB (F)	FROST CONTROL	PURGE	ECONO BYPASS	RECIRC DAMPER	MANUFACTURER	MODEL NUMBER	NOTES
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	39.8	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:
1. PROVIDE CONDENSATE DRAIN FOR RTU ENERGY RECOVERY SECTION IN ADDITION TO CONDENSATE DRAIN FOR DX COIL SECTION. WRAP ENERGY RECOVERY DRAIN WITH HEAT TRACE. A1

DUCT SILENCER SCHEDULE

UNIT IDENTIFICATION			AIRFLOW INFORMATION				PHYSICAL PROPERTIES												DYNAMIC INSERTION LOSSES DB													
											DUCT DIMENSIONS			CASING DIMENSIONS																		
MARK	NUMBER	UNIT/AREA SERVED	AIRFLOW (CFM)	DEVICE APD (IN-WG)	MAX APD W/ SYSTEM EFFECT...	VELOCITY (FPM)	TYPE	GEOMETRY	CASING GAUGE	FILL	FILM	HEIGHT (IN)	WIDTH (IN)	LENGTH (IN)	HEIGHT (IN)	WIDTH (IN)	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
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	ERM66/2B	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

A1

UNIT IDENTIFICATION						
MARK	NUMBER	LOCATION	UNIT SERVED	MOTOR HP	MAX RATED HP	NOTES
VFD	HHWP-1	MECHANICAL - 306	HHWP-1	1.5	1.5	1,2
VFD	HHWP-2	MECHANICAL - 306	HHWP-2	1.5	1.5	1,2
VFD	HHWP-3	MECHANICAL - 306	HHWP-3	5	5	1
VFD	HHWP-4	MECHANICAL - 306	HHWP-4	5	5	1
VFD	RTU-1S	ROOF (IN RTU-1)	RTU-1	15	15	1
VFD	RTU-3S	ROOF (IN RTU-3)	RTU-3	7.5	7.5	1
VFD	RTU-9S	ROOF (IN RTU-9)	RTU-9	7.5	7.5	1
VFD	EF-1	RECEIVING - 307	EF-1	1	1	1
VFD	EF-2	RECEIVING - 307	EF-2	1/4	1/4	1
VFD	EF-3	RECEIVING - 307	EF-3	1/4	1/4	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.
3. BASIS OF DESIGN RTU-2,4,5,6,7,8 SUPPLY FANS ARE BEING CONTROLLED BY RTU CONTROLLER SIGNAL TO ECM MOTOR. PROVIDE VFD IF REQUIRED BY EQUIPMENT SELECTION.
4. BASIS OF DESIGN RTU-1,2,3,4,5,6,7,8,9 EXHAUST FANS ARE BEING CONTROLLED BY RTU CONTROLLER SIGNAL TO ECM MOTOR. PROVIDE VFD IF REQUIRED BY EQUIPMENT SELECTION.

DUCT SYSTEM APPLICATION SCHEDULE

			DESIGN CRITERIA		CONSTRUCTION		PRODUCT			MATERIAL						LINER				INSULATION							FACTORY JACKET			FIELD JACKET					NOTES
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-SSS	FSK	VINYL	FABRIC	PVC	ALUMINUM	STAINLESS STEEL	SELF ADHESIVE	
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

UNIT IDENTIFICATION													
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
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	53L	
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

UNIT IDENTIFICATION						FAN WHEEL			FAN MOTOR						ELECTRICAL						
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
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
1210 E Mt Hope Ave, Lansing, MI 48910

MECHANICAL SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-601

100% CONSTRUCTION DOCUMENTS
Addendum 1

7/21/2023 3:05:03 PM
Autodesk Docs://220116_LSD - Mt HOPE\Mt_Hope.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

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	82.0	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	82.0	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	(AUTO) (A1)	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				OPERATING...							
MARK	NUMBER	SYSTEM SERVED	PIPE SIZE (IN)	MIN TEMP (F)	MAX TEMP (F)	APPROXIMATE EXPANSION (IN)	CONNECTION TYPE	CONFIGURATION	MANUFACTURER	MODEL NUMBER	NOTES
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											
MARK	NUMBER	SYSTEM SERVED	TYPE	CONNECTION SIZE (IN)	DIAMETER (IN)	HEIGHT (IN)	WEIGHT (LBS)	FLOW (GPM)	MAX WPD (FT)	MANUFACTURER	MODEL NUMBER	NOTES
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		X				X				1
									EXPOSED		X						X	X				X		1		X				X	X			1
									MECHANICAL ROOM		X						X	X				X		1		X				X	X			1
	2-1/2 TO 4	8	4.0	110-140	125	200	125	2.5	CONCEALED			X									X			1		X				X				1
									EXPOSED			X									X			1		X				X	X			1
									MECHANICAL ROOM			X									X			1		X				X	X			1

NOTES:
1. PIPE INSULATION THICKNESS BASED ON ASHRAE 90.1-2013.

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LANSING SCHOOL DISTRICT
Mt. Hope
1215 E Mt Hope Ave, Lansing, MI 48910

MECHANICAL SCHEDULES

REVISIONS

REV	DESCRIPTION	DATE
A1	ADDENDUM 1	21-JUL-2023

PROJ. #: 220116
DATE: 23-JUN-2023
SHEET
M-603

100% CONSTRUCTION DOCUMENTS

7/21/2023 3:05:28 PM
Autodesk Docs://220116_LSD - Mt HOPE\Mt_Hope.rvt
DESIGNED BY: Designer
CHECKED BY: Checker APPROVED BY: Approver

1. Summary

Meeting title	Mt. Hope Pre-Bid Meeting
Attended participants	55
Start time	7/13/23, 12:53:43 PM
End time	7/13/23, 2:23:52 PM
Meeting duration	1h 30m 8s
Average attendance time	56m

2. Participants

Name	First Join	Last Leave	In-Meeting Duration	Email	Participant ID (UPN)	Role
Andrew Dobbs	7/13/23, 12:58:14 PM	7/13/23, 2:23:52 PM	1h 12m 2s	andrew.dobbs@christmanco.com	andrew.dobbs@christmanco.com	Organizer
Karen Headley	7/13/23, 12:54:02 PM	7/13/23, 2:10:03 PM	1h 16m 1s	kheadley@mooretrosper.com	kheadley@mooretrosper.com	Presenter
Austin Brown	7/13/23, 12:54:20 PM	7/13/23, 2:10:12 PM	1h 15m 52s	austin.brown@christmanco.com	austin.brown@christmanco.com	Presenter
Chris Churchill (Guest)	7/13/23, 12:54:57 PM	7/13/23, 2:10:00 PM	1h 15m 2s			Presenter
Adam Wolthuis (Guest)	7/13/23, 12:55:32 PM	7/13/23, 2:10:04 PM	1h 14m 32s			Presenter
Danielle Kahler	7/13/23, 12:55:37 PM	7/13/23, 2:10:06 PM	1h 14m 28s	danielle.kahler@lansingschools.net	kahled0619@lansingschools.net	Presenter
Mark Hietala	7/13/23, 12:56:33 PM	7/13/23, 2:10:10 PM	1h 13m 36s	mark.hietala@christmanco.com	mark.hietala@christmanco.com	Presenter
Brian Lapham	7/13/23, 12:57:10 PM	7/13/23, 2:10:04 PM	1h 12m 53s	BrianL@summit.ws	BrianL@summit.ws	Presenter
Jurczuk, Steve	7/13/23, 12:57:29 PM	7/13/23, 1:39:24 PM	41m 55s	steve.jurczuk@C2AE.COM	steve.jurczuk@c2ae.com	Presenter
Sarah Barbachym	7/13/23, 12:57:35 PM	7/13/23, 1:26:57 PM	29m 21s	Sarah.barbachym@djslandscape.com	Sarah.barbachym@djslandscape.com	Presenter
Jett Moore	7/13/23, 12:58:39 PM	7/13/23, 2:10:06 PM	1h 11m 26s	jmoore@mooretrosper.com	jmoore@mooretrosper.com	Presenter
Joel Jarvis	7/13/23, 12:58:49 PM	7/13/23, 2:10:12 PM	1h 11m 22s			Presenter
Marc Alexa	7/13/23, 12:59:02 PM	7/13/23, 2:10:06 PM	1h 11m 3s	Marc.Alexa@plantemoran.com	Marc.Alexa@plantemoran.com	Presenter
Jim R	7/13/23, 12:59:23 PM	7/13/23, 2:10:03 PM	1h 10m 40s	jimr@jrafoodservicedesign.com	jimr_jrafoodservicedesign.com#EXT#@sevengenae.onmicrosoft.com	Presenter
Mike Holmes	7/13/23, 12:59:41 PM	7/13/23, 2:23:52 PM	1h 24m 10s	mike.holmes@djslandscape.com	mike.holmes@djslandscape.com	Presenter
Jon Laing	7/13/23, 12:59:52 PM	7/13/23, 2:10:14 PM	1h 10m 21s	jon.laing@lansingschools.net	laingj1219@lansingschools.net	Presenter
Steve McNutt	7/13/23, 1:00:04 PM	7/13/23, 2:10:24 PM	1h 10m 19s	steve.mcnutt@christmanco.com	steve.mcnutt@christmanco.com	Presenter
Roberts, Scott	7/13/23, 1:00:07 PM	7/13/23, 2:10:11 PM	1h 10m 3s	Scott.Roberts@stantec.com	scott.roberts@stantec.com	Presenter
Clint Miller (Guest)	7/13/23, 1:00:29 PM	7/13/23, 2:13:56 PM	1h 13m 27s			Presenter
Bacon, Eric	7/13/23, 1:00:50 PM	7/13/23, 2:10:10 PM	1h 9m 20s	Eric.Bacon@stantec.com	Eric.Bacon@stantec.com	Presenter
Alex Santiago	7/13/23, 1:00:57 PM	7/13/23, 2:10:02 PM	1h 9m 5s	Alex@metaltech.com	Alex@metaltech.com	Presenter
Jake Mortensen	7/13/23, 1:01:20 PM	7/13/23, 1:26:58 PM	25m 38s	jake.mortensen@djslandscape.com	jake.mortensen@djslandscape.com	Presenter
Malloy, Patrick	7/13/23, 1:01:39 PM	7/13/23, 2:10:10 PM	1h 8m 31s	patrick.malloy@C2AE.COM	patrick.malloy@C2AE.COM	Presenter
Derek Strong	7/13/23, 1:03:10 PM	7/13/23, 2:10:03 PM	1h 6m 53s	dstrong@csibas.com	dstrong@csibas.com	Presenter
Rick Shea RM Eectric	7/13/23, 1:03:37 PM	7/13/23, 1:21:10 PM	17m 32s			Presenter
tom dobie	7/13/23, 1:05:21 PM	7/13/23, 2:10:11 PM	1h 4m 49s			Presenter
Stenco (Guest)	7/13/23, 1:08:32 PM	7/13/23, 2:10:06 PM	1h 1m 33s			Presenter
Kevin Zimmerman	7/13/23, 1:08:37 PM	7/13/23, 2:10:15 PM	1h 1m 38s	kevin@candrelec.com	kevin@candrelec.com	Presenter
Dustin Schneemann	7/13/23, 1:08:44 PM	7/13/23, 1:58:10 PM	49m 25s	ds@mackenzieco.com	ds@mackenzieco.com	Presenter
Corey Abdella	7/13/23, 1:08:56 PM	7/13/23, 2:10:04 PM	1h 1m 7s	cabdella@wolverinefp.com	cabdella@wolverinefp.com	Presenter
Gerald R (Guest)	7/13/23, 1:09:14 PM	7/13/23, 2:08:31 PM	59m 17s			Presenter
Nick Prezzato	7/13/23, 1:09:19 PM	7/13/23, 2:10:17 PM	1h 57s	nick@superiorservicesrsh.com	nick@superiorservicesrsh.com	Presenter
Andrew Henry - Stenco (Guest)	7/13/23, 1:09:22 PM	7/13/23, 2:10:01 PM	1h 39s			Presenter
Dean Chance	7/13/23, 1:09:22 PM	7/13/23, 2:00:16 PM	50m 54s	dchance@brigadefire.com	dchance@brigadefire.com	Presenter
Bids	7/13/23, 1:09:24 PM	7/13/23, 1:59:26 PM	50m 1s	bids@whcanon.com	bids@whcanon.com	Presenter
Nick Percy	7/13/23, 1:09:26 PM	7/13/23, 1:32:45 PM	23m 19s	npercy@fesslerbowman.com	npercy@fesslerbowman.com	Presenter
Scott Jantz	7/13/23, 1:09:26 PM	7/13/23, 2:10:27 PM	1h 1m 1s			Presenter
Keith- Silverline (Guest)	7/13/23, 1:09:26 PM	7/13/23, 2:10:07 PM	1h 40s			Presenter
Spencer Palmer	7/13/23, 1:09:27 PM	7/13/23, 2:10:02 PM	1h 35s	spalmer@archmetalsinc.com	spalmer@archmetalsinc.com	Presenter
Melissa - RCI Electrical Contracting (Guest)	7/13/23, 1:09:28 PM	7/13/23, 1:45:09 PM	35m 41s			Presenter
Corey Hoover	7/13/23, 1:09:28 PM	7/13/23, 1:58:44 PM	49m 15s	choover@fesslerbowman.com	choover@fesslerbowman.com	Presenter
David Baxter	7/13/23, 1:09:32 PM	7/13/23, 1:57:22 PM	47m 49s	dbaxter@samorman.com	dbaxter@samorman.com	Presenter
Jake Grapentien	7/13/23, 1:09:33 PM	7/13/23, 1:51:17 PM	41m 44s	JG@integrity-interiors.com	JG@integrity-interiors.com	Presenter
Nick Rodgers	7/13/23, 1:09:40 PM	7/13/23, 2:10:01 PM	1h 20s	n.rodgers@gunthorpeplumbing.com	n.rodgers@gunthorpeplumbing.com	Presenter
Shawn Mill	7/13/23, 1:09:48 PM	7/13/23, 1:47:41 PM	37m 52s	shawn@ironhorsemi.com	shawn@ironhorsemi.com	Presenter
Jeremy	7/13/23, 1:10:29 PM	7/13/23, 1:26:38 PM	16m 9s			Presenter
	15173218222	7/13/23, 1:10:38 PM	7/13/23, 2:10:10 PM	59m 32s		Attendee
Eze Ejelonu	7/13/23, 1:10:52 PM	7/13/23, 2:14:42 PM	1h 3m 49s			Presenter

Dustin Barlow	7/13/23, 1:11:15 PM	7/13/23, 1:57:26 PM	46m 11s			Presenter
Buck Patrick	7/13/23, 1:13:47 PM	7/13/23, 2:10:06 PM	56m 19s	Buck@superiorfloorcoveringsllc.com	Buck@superiorfloorcoveringsllc.com	Presenter
Eric	7/13/23, 1:17:30 PM	7/13/23, 1:36:42 PM	19m 11s	eric@jperezconstruction.com	eric@jperezconstruction.com	Presenter
Michael Hull	7/13/23, 1:21:02 PM	7/13/23, 2:11:01 PM	49m 59s			Presenter
Twigg, Paul	7/13/23, 1:29:02 PM	7/13/23, 2:10:09 PM	41m 6s	Paul.Twigg@BartonMalow.com	Paul.Twigg@BartonMalow.Com	Presenter
Chris Dawson	7/13/23, 1:34:46 PM	7/13/23, 1:59:53 PM	25m 6s	Chris.Dawson@Bluum.com	Chris.Dawson@bluum.com	Presenter
Joe Breen	7/13/23, 2:01:17 PM	7/13/23, 2:10:07 PM	8m 49s	Joe@rciwire.com	Joe@rciwire.com	Presenter

3. In-Meeting Activities

Name	Join Time	Leave Time	Duration	Email	Role
Andrew Dobbs	7/13/23, 12:58:14 PM	7/13/23, 2:10:08 PM	1h 11m 54s	andrew.dobbs@christmanco.com	Organizer
Andrew Dobbs	7/13/23, 2:23:43 PM	7/13/23, 2:23:52 PM	8s	andrew.dobbs@christmanco.com	Organizer
Karen Headley	7/13/23, 12:54:02 PM	7/13/23, 2:10:03 PM	1h 16m 1s	kheadley@mooretrosper.com	Presenter
Austin Brown	7/13/23, 12:54:20 PM	7/13/23, 2:10:12 PM	1h 15m 52s	austin.brown@christmanco.com	Presenter
Chris Churchill (Guest)	7/13/23, 12:54:57 PM	7/13/23, 2:10:00 PM	1h 15m 2s		Presenter
Adam Wolthuis (Guest)	7/13/23, 12:55:32 PM	7/13/23, 2:10:04 PM	1h 14m 32s		Presenter
Danielle Kahler	7/13/23, 12:55:37 PM	7/13/23, 2:10:06 PM	1h 14m 28s	danielle.kahler@lansingschools.net	Presenter
Mark Hietala	7/13/23, 12:56:33 PM	7/13/23, 2:10:10 PM	1h 13m 36s	mark.hietala@christmanco.com	Presenter
Brian Lapham	7/13/23, 12:57:10 PM	7/13/23, 2:10:04 PM	1h 12m 53s	BrianL@summit.ws	Presenter
Jurczuk, Steve	7/13/23, 12:57:29 PM	7/13/23, 1:39:24 PM	41m 55s	steve.jurczuk@C2AE.COM	Presenter
Sarah Barbachym	7/13/23, 12:57:35 PM	7/13/23, 1:26:57 PM	29m 21s	Sarah.barbachym@djslandscape.com	Presenter
Jett Moore	7/13/23, 12:58:39 PM	7/13/23, 2:10:06 PM	1h 11m 26s	jmoore@mooretrosper.com	Presenter
Joel Jarvis	7/13/23, 12:58:49 PM	7/13/23, 2:10:12 PM	1h 11m 22s		Presenter
Marc Alexa	7/13/23, 12:59:02 PM	7/13/23, 2:10:06 PM	1h 11m 3s	Marc.Alexa@plantemoran.com	Presenter
Jim R	7/13/23, 12:59:23 PM	7/13/23, 2:10:03 PM	1h 10m 40s	jimr@jrafoodservicedesign.com	Presenter
Mike Holmes	7/13/23, 12:59:41 PM	7/13/23, 2:23:52 PM	1h 24m 10s	mike.holmes@djslandscape.com	Presenter
Jon Laing	7/13/23, 12:59:52 PM	7/13/23, 2:10:14 PM	1h 10m 21s	jon.laing@lansingschools.net	Presenter
Steve McNutt	7/13/23, 1:00:04 PM	7/13/23, 2:10:24 PM	1h 10m 19s	steve.mcnutt@christmanco.com	Presenter
Roberts, Scott	7/13/23, 1:00:07 PM	7/13/23, 2:10:11 PM	1h 10m 3s	Scott.Roberts@stantec.com	Presenter
Clint Miller (Guest)	7/13/23, 1:00:29 PM	7/13/23, 2:13:56 PM	1h 13m 27s		Presenter
Bacon, Eric	7/13/23, 1:00:50 PM	7/13/23, 2:10:10 PM	1h 9m 20s	Eric.Bacon@stantec.com	Presenter
Alex Santiago	7/13/23, 1:00:57 PM	7/13/23, 2:10:02 PM	1h 9m 5s	Alex@metaltech.com	Presenter
Jake Mortensen	7/13/23, 1:01:20 PM	7/13/23, 1:26:58 PM	25m 38s	jake.mortensen@djslandscape.com	Presenter
Malloy, Patrick	7/13/23, 1:01:39 PM	7/13/23, 2:10:10 PM	1h 8m 31s	patrick.malloy@C2AE.COM	Presenter
Derek Strong	7/13/23, 1:03:10 PM	7/13/23, 2:10:03 PM	1h 6m 53s	dstrong@csibas.com	Presenter
Rick Shea RM Eectric	7/13/23, 1:03:37 PM	7/13/23, 1:21:10 PM	17m 32s		Presenter
tom dobie	7/13/23, 1:05:21 PM	7/13/23, 2:10:11 PM	1h 4m 49s		Presenter
Stenco (Guest)	7/13/23, 1:08:32 PM	7/13/23, 2:10:06 PM	1h 1m 33s		Presenter
Kevin Zimmerman	7/13/23, 1:08:37 PM	7/13/23, 2:10:15 PM	1h 1m 38s	kevin@candrelec.com	Presenter
Dustin Schneemann	7/13/23, 1:08:44 PM	7/13/23, 1:58:10 PM	49m 25s	ds@mackenzieco.com	Presenter
Corey Abdella	7/13/23, 1:08:56 PM	7/13/23, 2:10:04 PM	1h 1m 7s	cabdella@wolverinefp.com	Presenter
Gerald R (Guest)	7/13/23, 1:09:14 PM	7/13/23, 2:08:31 PM	59m 17s		Presenter
Nick Prezzato	7/13/23, 1:09:19 PM	7/13/23, 2:10:17 PM	1h 57s	nick@superiorservicesrsh.com	Presenter
Andrew Henry - Stenco (Guest)	7/13/23, 1:09:22 PM	7/13/23, 2:10:01 PM	1h 39s		Presenter
Dean Chance	7/13/23, 1:09:22 PM	7/13/23, 2:00:16 PM	50m 54s	dchance@brigadefire.com	Presenter
Bids	7/13/23, 1:09:24 PM	7/13/23, 1:59:26 PM	50m 1s	bids@whcanon.com	Presenter
Nick Percy	7/13/23, 1:09:26 PM	7/13/23, 1:32:45 PM	23m 19s	npercy@fesslerbowman.com	Presenter
Scott Jantz	7/13/23, 1:09:26 PM	7/13/23, 2:10:27 PM	1h 1m 1s		Presenter
Keith- Silverline (Guest)	7/13/23, 1:09:26 PM	7/13/23, 2:10:07 PM	1h 40s		Presenter
Spencer Palmer	7/13/23, 1:09:27 PM	7/13/23, 2:10:02 PM	1h 35s	spalmer@archmetalsinc.com	Presenter
Melissa - RCI Electrical Contracting (Guest)	7/13/23, 1:09:28 PM	7/13/23, 1:45:09 PM	35m 41s		Presenter
Corey Hoover	7/13/23, 1:09:28 PM	7/13/23, 1:58:44 PM	49m 15s	choover@fesslerbowman.com	Presenter
David Baxter	7/13/23, 1:09:32 PM	7/13/23, 1:57:22 PM	47m 49s	dbaxter@samorman.com	Presenter
Jake Grapentien	7/13/23, 1:09:33 PM	7/13/23, 1:51:17 PM	41m 44s	JG@integrity-interiors.com	Presenter
Nick Rodgers	7/13/23, 1:09:40 PM	7/13/23, 2:10:01 PM	1h 20s	n.rodgers@gunthorpeplumbing.com	Presenter
Shawn Mill	7/13/23, 1:09:48 PM	7/13/23, 1:47:41 PM	37m 52s	shawn@ironhorsemi.com	Presenter
Jeremy	7/13/23, 1:10:29 PM	7/13/23, 1:26:38 PM	16m 9s		Presenter
	15173218222	7/13/23, 1:10:38 PM	7/13/23, 2:10:10 PM	59m 32s		Attendee

Eze Ejelonu	7/13/23, 1:10:52 PM	7/13/23, 2:14:42 PM	1h 3m 49s		Presenter
Dustin Barlow	7/13/23, 1:11:15 PM	7/13/23, 1:57:26 PM	46m 11s		Presenter
Buck Patrick	7/13/23, 1:13:47 PM	7/13/23, 2:10:06 PM	56m 19s	Buck@superiorfloorcoveringsllc.com	Presenter
Eric	7/13/23, 1:17:30 PM	7/13/23, 1:36:42 PM	19m 11s	eric@jperezconstruction.com	Presenter
Michael Hull	7/13/23, 1:21:02 PM	7/13/23, 2:11:01 PM	49m 59s		Presenter
Twigg, Paul	7/13/23, 1:29:02 PM	7/13/23, 2:10:09 PM	41m 6s	Paul.Twigg@BartonMalow.com	Presenter
Chris Dawson	7/13/23, 1:34:46 PM	7/13/23, 1:59:53 PM	25m 6s	Chris.Dawson@Bluum.com	Presenter
Joe Breen	7/13/23, 2:01:17 PM	7/13/23, 2:10:07 PM	8m 49s	Joe@rciwire.com	Presenter