Addendum No. 2
March 27, 2026

The following additions, clarifications and revisions have been made to the Contract Documents:

REVISIONS:

1. Revisions To Trade Package Manual
    a. Section 00 24 13 Bid Packages – Provided updated Section 00 24 13 Bid Packages. Changes are highlighted in Red.

2. Fanning/Howey Associates Addendum No. 2 dated March 26, 2026
    a. Narrative
    b. Revisions to Project Manual Sections
    c. Revised Drawing Sheets

SECTION 00 24 13 – BID PACKAGES

1.1 GENERAL

A. This section provides a guideline of the scope of work to be included with each bid package. This section includes scope and instructions which may not be specifically called out elsewhere in the Project Manual, Plans or Specifications. All bidders should read this section carefully in its entirety. This section is not all inclusive and is to be read in conjunction with the entire set of project documents. It is each subcontractor's responsibility to submit a complete bid.

B. Subcontractors may submit a bid on more than one (1) bid package but **a separate signed bid form in a separate envelope is required for each bid package** submitted complying with the provisions of Section 00 11 13 – Advertisement to Bid and Section 00 21 13 – Instructions To Bidders.

C. Where items are noted to be "provide(d)" or "include(s)" that shall indicate furnish, install, unloading, shake-out, fasteners, incidentals, equipment, and all work necessary for a complete system.

D. This specification shall have precedence for assignment of Scope of Work prior to and above any assignments of Scope of Work in the Drawings, Specifications, or elsewhere in the Contract Documents.

E. Subcontractor shall provide as many mobilizations as required to complete the Scope of Work as per the dates set forth on the monthly baseline and weekly look-ahead schedules.

F. This Project will perform a daily huddle and weekly workplan meetings, in which your competent foreman's participation will be required.

G. Easch Subcontractor is solely responsible for the coordination, accuracy, and completeness of each submittal provided by your company, as it relates to the intent of the plans and specifications. Each shop drawing and/or product data sheet, etc. shall be stamped by you to indicate your review and approval. Any deviation from the Contract Documents shall be clearly identified and appropriate material substitution request forms completed. All submittals shall be submitted in electronic format online using Procore, www.procore.com. Training is available online upon request. The subcontractor may request up to six (6) physical hard copies of submittals.

H. PROVIDE NECESSARY COORDINATION AND PARTICIPATION IN BIM COORDINATION

1.2 BID PACKAGES:

A. List of bid packages under this solicitation for Bid Release #1

1. Bid Package 02 – SITE CLEARING, EARTHWORK & SITE UTILITIES
2. Bid Package 06 – BUILDING & SITE CONCRETE
3. Bid Package 07 – MASONRY
4. Bid Package 08 – STRUCTURAL STEEL
5. Bid Package 10 – ROOFING
6. Bid Package 16 – PLUMBING & HVAC
7. Bid Package 18 – ELECTRICAL, FIRE ALARM, SYSTEMS & TECHNOLOGY

B. List of bid packages which will be issued for bid at a later date:
   1. Bid Package 01 – GENERAL TRADES
   2. Bid Package 03 – ASPHALT PAVING
   3. Bid Package 04 – LANDSCAPING
   4. Bid Package 05 – PLAYGROUND TURF & EQUIPMENT
   5. Bid Package 09 – ARCHITECTURAL CASEWORK
   6. Bid Package 11 – METAL STUDS, DRYWALL AND CEILINGS
   7. Bid Package 12 – SOFT FLOORING
   8. Bid Package 13 – HARD FLOORING
   9. Bid Package 14 – PAINTING
   10. Bid Package 15 – FOOD SERVICE EQUIPMENT
   11. Bid Package 17 – FIRE PROTECTION

1.3 BID PACKAGE SCOPES OF WORK

A. General notes applicable to **ALL** bid packages
   1. All trade packages are responsible for daily clean-up of general construction debris generated from their scope of work to the dumpster provided by the Construction Manager.
   2. All trade packages are responsible for clean-up of areas disturbed by them during completion of their final punch list work.
   3. All trade packages shall provide all survey, staking and layout as necessary to complete the bid package Scope of Work
   4. All trade packages shall provide all field measuring necessary for fabrication, installation, and as-built drawings as necessary to complete the bid package Scope of Work
   5. All trade packages shall provide all unloading, hoisting, shakeout, and material handling of items installed in the Scope of Work
   6. All trade packages shall provide all scaffolding, temporary shoring, guying, supports, bracing, and additional means and methods necessary to complete the bid package Scope of Work
   7. All trade packages shall provide testing as specified for your Scope of Work
   8. All trade packages shall provide scheduling and coordination of any Owner third party testing agencies for all specified testing by Others pertaining to your Scope of Work
   9. All trade packages shall provide all training and owner demonstration as required as specified for your Scope of Work
   10. All trade packages shall provide full dust control measures to contain dust from spreading outside the contract work areas. Cost for dust control shall be included by each bid package as it pertains to your Scope of Work. All areas dirtied due to insufficient dust control shall be remedied by the responsible contractor/bid package contractor.
   11. All trade packages shall provide all attic stock/extra materials as specified for your Scope of Work
   12. All trade packages shall provide all delegated design as specified for your Scope of Work. This includes all engineering (by a licensed engineer) as well as the cost of design.
   13. All trade packages shall provide all mockups as specified for your Scope of Work including removal of any non-in-situ mockups.
   14. All trade packages shall obtain criminal background checks for all on-site personnel. The costs of criminal background checks shall be included. Background checks shall be submitted to CORE prior to start of work.
   15. All trade packages shall provide all costs associated with Textura Payment Management System (Reference Section 00 50 00c – Oracle's Textura Payment Management
   16. All trade packages shall provide all costs associated with meeting minimum insurance requirements outlined in 00 50 00b – Standard Form of Agreement Between Owner and Contractor. This includes

the costs of additional waivers and endorsements that might be required to meet specified requirements.

17. All bids shall reflect the project schedule (Reference Section 00 31 13a – Schedule) and site logistics plan (Reference Section 00 31 13b – Site Logistics Plan) including adequate staffing, timely material procurement, acceleration, and additional mobilizations.
18. All items shall be provided per Contract Documents. Manufacturer's standard details, finishes, insurance, etc. shall not be relied upon as the basis for pricing.
19. During the performance of work, Contractor shall protect from harm all existing structures to remain. Any damage to existing structures to remain shall be corrected at the Subcontractor's expense
20. All prime contractors are required to protect all flooring and floor coverings from damage by their construction operations, dropped items, and wheeled traffic

B. <u>Bid Package 02 – SITE CLEARING, EARTHWORK & SITE UTILITIES</u>

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Specification Section 31 10 00 – SITE CLEARING
   d. Specification Section 31 20 00 – EARTH MOVING
   e. Specification Section 31 23 19 – DEWATERING
   f. Specification Section 32 25 00 – EROSION CONTROL
   g. Specification Section 33 05 00 – COMMON WORK RESULTS FOR UTILITES
   h. Specification Section 33 11 13 – FACILITY WATER DISTRIBUTION FOR PIPING
   i. Specification Section 33 42 00 – STORMWATER CONVEYANCE
   j. Specification Section 33 46 05 – SUBDRAINAGE

3. **Scope of Work**

   a. <u>SITE CLEARING & EARTHWORK</u>

   1) Refer to part 1.3.A – General notes applicable to **ALL** bid packages for additional scope applicable to this bid package
   2) Secure and purchase all permits and licensing for your work.
   3) This Contractor shall review the Landscaping series and Playground series of drawings and coordinate them with the Civil series of drawings.
   4) This Contractor shall review Civil series of drawings and coordinate them with Landscape and Site Utility series of drawings.
   5) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.
   6) Includes haul off and disposal of all site demolition debris. Including all trees, bushes, etc. Also includes removal of all associated stumps.
   7) Provide all saw-cutting as required for your scope of work.
   8) Provide all tree protection as required for trees called out to remain.
   9) Include utilizing a vacuum truck where standard excavations cannot be completed.
   10) By submission of a bid for this Bid Package, this Contractor confirms that all onsite/existing conditions have been thoroughly reviewed and accounted for.

11) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
12) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
13) This Contractor is responsible for locating underground utilities (contacting Indiana 811.) prior to the execution of any earthwork, utility, and/or excavation work. This includes private locates.
14) This Contractor is responsible for the repair of any damage to existing utilities and utility structures, curbs, sidewalks, and paving, which are damaged as the result of this work.
15) This Contractor shall coordinate with local authorities having jurisdiction of ALL inspection required. The Construction Manager will NOT be making calls for inspections for your work.
16) Include access to and around the construction site including installation and removal of construction entrance(s), temporary roads, road plates, and protection of sidewalks as needed. Reference Section 00 31 13b – Site Logistics Plan in addition to civil plans for determining scope of work
17) Legally remove and dispose of all demolition items in this Scope of Work. Provide any dumpsters required for demolition and for daily clean-up debris removal as needed for this Scope of Work.
18) Include capping/sealing and abandoning site utilities in place for removing site utilities where required.
19) Remove and salvage flagpole.
20) Include all street cutting and patch per City of Indianapolis standards as required for this Scope of Work, this includes any damaged curbs, sidewalks, etc. Includes any site restoration as required.
21) Include all site grading, earthwork, compaction, subgrade preparations and all work necessary to bring site to specified grades including within +/- 0.1’ of finish elevation for all asphalt paving, concrete paving, concrete sidewalks and concrete curbs. Include importing/exporting of all fills/cuts as necessary
22) Include proof rolling of all required areas
23) Include dust control measures as needed, include all temporary water costs including water connection, metering, trucking, and fees as necessary.
24) Include trench backfill for utilities under paved areas.
25) Include buildup of building pad to subgrade using suitable fill material in lifts per specifications. Grade to +/- 0.1’
26) Include spreading and regrading of topsoil, Grade to +/- 0.1’, as well as importing of additional topsoil if necessary.
27) Include tapping saddle, traffic control, pavement patching, and all costs necessary to connect to existing water service.
28) Include dewatering of rainwater for your Scope of Work.
29) Include providing stone for the mechanical yards
30) Include traffic control and pedestrian control as required for this Scope of Work.

31) This Contractor shall include all costs associated with carrying out work in accordance with the project schedule and site logistics plan.
32) Include scheduling and coordination of Owner's 3rd party testing agency for all specified testing pertaining to this Scope of Work unless noted otherwise.
33) For debris tracked on streets by this Contractor's operations, this contractor shall provide all street sweeping as required for maintaining clean streets and adjacent drives within 4 hours and provide flagman as necessary.
34) This Contractor shall backfill all the exterior footing foundations and wall (if applicable). All interior of footing and interior foundations to be backfilled by Bid Package 06 Contractor.
35) This Contractor shall provide ALL aggregate bases under playground surfaces per details on drawing G4.00.

b. EROSION CONTROL

1) Include and maintain **all erosion control measures**, including but not limited to, silt fence, inlet protection, ditch checks, erosion control blankets, maintenance, SWPPP reporting.
2) Include temporary seeding as needed per SWPPP and for stabilization on any ponds, embankments, and slopes
3) Removal of all erosion control measures prior to project completion and final inspection.
4) Include construction entrance and FODS composite mat trackout control system

c. SANITARY SEWER SYSTEM

1) Include **complete sanitary sewer system** including but not limited to connection to existing structures, new structures, cleanouts, two-way monitoring cleanout, all new piping, fittings, tracer wire and all necessary components for a complete sanitary system to within 5' of building. Make final connection to the plumbers building stub out if it is already in place.
2) Includes all excavation and imported backfill, removal of spoils, tapping fees, testing, pavement removal and replacement as required for this scope of work.
3) This Contractor shall coordinate sanitary elevations with plumbing documents and plumbing contractor prior to installation of sanitary pipe.
4) Bid Package 03 Contractor will provide 18" concrete collar per detail N on drawing G1-07.

d. WATER AND FIRE SERVICE

1) Include complete **water/fire service**, water piping, boring, indicator valves, valves, hydrant work, thrust blocks, water meters, tracer wires, castings, pressure/leak testing, and sterilization. Include all water samples, blow-off, disinfection, and testing as required.
2) This Contractor shall extend the domestic water line into the Mechanical Room D114 in Unit D and extend the domestic water line to 12" above the floor with a flange. Test and flush this line from the street to the flange. Provide test results for local board of health.
3) This Contractor shall furnish and install fire line and PIV into the Mech Room D114 in Unit D and extend the fire line to 12" above the floor with a flange. Test and flush this line from the street to the flange. Provide test results.
4) FDC connection will be by Fire Protection Contractor.
5) Includes all excavation and imported backfill, removal of spoils, tapping fees, testing, pavement removal and replacement as required for this scope of work.

e. STORM SEWER PIPING

1) Include **complete storm sewer system.**
2) Provide and install all storm sewer piping including all structures, castings, piping, flared ends, connection to existing structures, cleanouts, etc.
3) Includes all piping to within 5' of building and making final connections to the plumbers stub out if it's already in place.
4) Includes all excavation and importing of backfill. Haul off spoils associated with this scope of work as required.
5) Provide complete ADS Stormtech SC-310 underground detention systems
6) Include playground underdrain system
7) Include concrete headwall for existing CMP culvert
8) Include diversion structures and outlet control structures
9) Include swale underdrain per Detail T/SU2-2
10) Includes all pavement removal and replacement for this scope of work.
11) Includes all testing of piping as required.
12) Provide stub-ups to finish grade for building downspouts. After downspouts are installed , this Contractor shall furnish and install connections to downspouts.
13) Bid Package 03 Contractor will provide 18" concrete collar per detail N on drawing G1-07
14) This Contractor shall include Playground Underdrain system per detail 1/G4.00.

C. Bid Package 06 – SITE AND BUILDING CONCRETE

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Specification Section – 031000 – CONCRETE FORMWORK
   d. Specification Section – 032000 – CONCRETE REINFORCEMENT
   e. Specification Section – 033000 – CAST IN PLACE CONCRETE
   f. Specification Section – 033500 – CONCRETE SURFACE TREATMENT
   g. Specification Section – 036000 – EPOXY GROUT
   h. Specification Section – 036001 - GROUTING
   i. Specification Section – 036200 – NON-SHRINK GROUTING
   j. Specification Section – 321726 – TACTILE WARNING SURFACES
   k. Specification Section – 321313 – CONRETE PAVING
   l. Specification Section – 321373 – CONCRETE PAVING JOINT SEALANTS

3. **Scope of Work**

a. SITE CONCRETE

1) Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
2) SITE CONCRETE including, but not limited to, sidewalks, ADA ramps, speed control table, flagpole base, concrete equipment pads, pipe bollards (install only), stoops, aprons, and concrete collars at inlets.
3) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.

4) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
5) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
6) Standing concrete curbs at paving (details F & G/G1-07) to be provided by Asphalt Contractor
7) Include concrete work as show on Playground G1 and G4 drawings
8) Include coordination and scheduling of testing required for this Scope of Work with Owner's Testing and Inspection Agency
9) For debris tracked on streets by this Contractor's operations, the contractor shall provide all street sweeping as required for maintaining clean streets and adjacent drives within 4 hours and provide flagman as necessary.
10) Include daily clean-up of debris, waste, dirt, dust, waste, or other Construction impediments generated by this Scope of Work to the dumpsters supplied by the Construction Manager.
11) Include clean-up of areas disturbed by this Contractor during completion of this Contractors final punch list work.
12) Include maintenance, clean-up, and removal of a concrete wash out area.
13) Include All reinforcing steel and dowels associated with the site concrete work.
14) Include all caulking and isolation joints between site pavements and proposed building.
15) Refer to site logistics plan and schedule for multiple mobilizations needed.
16) Include all sawing, jointing, and sealants for site concrete.
17) Include granular fill and fine grade for site concrete work.
18) Include setting of site bollards furnished by others for both traffic control and site signage.
19) Contractor to include hand tooled joints for all concrete sidewalks per note 3 on detail C of drawing G1-07.
20) Bid Package 03 Contractor to provide and install 18" concrete collar per detail N on drawings G1-07.
21) Contractor shall install all site bollards per not 26 on drawings G1-01, G1-02, G1-03, and G1-04.

b. BUILDING CONCRETE

1) Include all **BUILDING CONCRETE**, including but not limited to, footings, foundation, walls, and slabs on grade.
2) Include excavation and backfill for foundation work. Include all haul-off and import as required.
3) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out

of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.

4) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
5) Provide necessary coordination and participation in BIM Coordination.
6) Include all reinforcement as required.
7) Include concrete pump placement as required to comply with specifications for slabs.
8) Include field and office coordination with MEPFP trades. Include coordination to determine slab and foundation wall openings.
9) Include coordination and scheduling of testing required for this Scope of Work with Owner's Testing and Inspection Agency
10) For debris tracked on streets by this Contractor's operations, the contractor shall provide all street sweeping as required for maintaining clean streets and adjacent drives within 4 hours and provide flagman as necessary.
11) Include daily clean-up of debris, waste, dirt, dust, waste, or other Construction impediments generated by this Scope of Work to the dumpsters supplied by the Construction Manager.
12) Include under slab granular fill, fine grading and under slab vapor barrier for building concrete work.
13) Include maintenance, clean-up, and removal of a concrete wash out area.
14) Refer to site logistics plan and schedule for multiple mobilizations needed.
15) Furnish and install all foundation insulation.
16) Include all forming, shoring, bracing, anchorage, boxouts, form removal, form design, water stops, and concrete accessories.
17) Include layout and setting of anchor bolts, sleeves, all steel embeds, and all items intended to be cast into concrete assemblies provided under this Scope of Work furnished by other bid packages. Provide anchor bolt survey by a licensed surveyor. Provide survey to Steel Erection & Fabricator Contractor.
18) Provide concrete curing per Contract Documents for cast-in-place concrete furnished under this Scope of Work.
19) Include all sawing, jointing, and sealants for cast-in-place concrete furnished under this Scope of Work.
20) Provide all grouting of column baseplates.
21) Contractor shall include any excavation of thickened slabs, foundations inside the building footprint, and freezer/cooler slab. Plumbing and Electrical contractors are responsible for their own excavation and backfill.
22) Contractor shall install anchor bolts provided by Bid Package 08 Contractor. This contractor shall set (1) nut at proper elevation. Provide as-built survey for all anchor bolts for Structural Steel Contractor.

c. FLAGPOLE

1) Install Ground-Set Flagpoles Concrete Base, Flagpole provided by Bid Package #01

D. Bid Package #07 – MASONRY

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Division 04 – Masonry
   d. Specification Section 072100 – THERMAL INSULATION
   e. Specification Section 072726.00 – CLOSED-CELL, MEDIUM-DENSITY, SPRAY FOAM AIR BARRIER
   f. Specification Section 072726.02 – FLUID APPLIED MEMBRANE AIR BARRIER
   g. Specification Section 076200 – SHEET METAL FLASHING and TRIM
   h. Specification Section 078413 – PENETRATION FIRESTOPPING
   i. Specification Section 078443 – JOINT FIRESTOPPING
   j. Specification Section 079200 – JOINT SEALANTS
   k. Specification Section 081213 – HOLLOW METAL FRAMES (As Applicable)
   l. Specification Section 089119 – FIXED LOUVERS (As Applicable)

3. **Scope of Work**

   a. <u>MASONRY</u>

   1) Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
   2) Include insulation and fluid applied air barrier behind masonry
   3) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.
   4) Provide necessary coordination and participation in BIM Coordination.
   5) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
   6) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
   7) Include furnishing and installing all below-grade masonry as indicated by the contract documents grout and reinforcement related to these masonry assemblies.
   8) Include installation of all steel lintels per the contract documents. Lintels made of steel are to be provided by Structural Steel contractor, under Bid Package #08.
   9) Include caulking of all expansion joints as it relates to masonry work.
   10) Furnish and install all rigid insulation when installed behind masonry per the contract documents. Include all taping, flashing and sealing of joints, penetrations, door/window openings, etc, as required by manufacturer.
   11) This contractor shall be responsible for street cleaning/street sweeping of public/private streets/approaches/walks for dirt/mud/debris/etc. tracked onto these surfaces by their operations.
   12) Include all washdown/clean-up of installed masonry to remove excess mortar, stains, etc.
   13) Install masonry in such a manner to avoid excessive mortar; remove excessive mortar in all locations where present. All CMU that receives thermal insulation/air barrier is to have joints struck flush. Remove all mortar droppings from wall ties, shelf angles, and brick shelves prior to the thermal insulation/air barrier installation.
   14) Include all clean-up debris associated with this scope of work on a daily basis including scraping and sweeping of floors.

15) Includes all colored mortar as required.
16) Includes all bull nose block as required.
17) Includes all joint sealants required for your scope of work. Includes caulking of masonry to Hollow Metal Frames.
18) Includes all water repellant in mortar as required.
19) All flashings for your scope of work, prefinished as required. Colors to be selected from manufacturer's full range.
20) Protection of surrounding areas and adjacent surfaces to prevent damage.
21) Includes all expansion joints per contract documents and industry standards.
22) Furnish and install all through wall flashing.

E. Bid Package #08 – STRUCTURAL STEEL

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Specification Section 051200 – STRUCTURAL STEEL FRAMING
   d. Specification Section 052100 – STEEL JOIST FRAMING
   e. Specification Section 053100 – STEEL DECKING
   f. Specification Section 055000 – METAL FABRICATIONS

3. **Scope of Work**

a. STRUCTURAL STEEL AND STEEL ERECTION

1) Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
2) Provide necessary coordination and participation in BIM Coordination.
3) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.
4) Furnish and install all structural steel and metal fabrications
5) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
6) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
7) Provide steel reinforcement including any frames and rooftop opening for HVAC, kitchen equipment or other equipment.
8) Furnish all anchor bolts, lintels, embeds, bollards, and miscellaneous steel components where they are to be installed by others unless noted otherwise.
9) Furnish and install all epoxy and expansion anchors as required for your scope of work.
10) Include all clean-up debris associated with this scope of work on a daily basis.

11) Include touch-up paint/galvanizing coat and patching at connections and other areas damaged by this contractor. Include touch up painting of field welds.
12) Includes all outriggers and spacers.
13) Includes all engineered shop drawings.
14) Includes all coordination with all trades for chases, openings, frames and penetrations.
15) Provide a complete Steel Erection scope of work.
16) Includes all mats and temporary supports required for crane.
17) Include steel and bracing for operable partitions support. Include pre-punching holes in steel for hanger rod attachment.
18) Includes cribbing under all materials when stockpiled on site as required.
19) Provide all brick support angles. Installation by Bid Package 07 Contractor.
20) Includes setting of leveling nuts as needed at anchor bolts.
21) Includes install and maintenance of safety cables and posts. Includes removal when required.
22) All field welds shall be wire brushed and cleaned, then touched up painted as required.
23) Furnish and install roof support frames.
~~24) Furnish and install any steel not sized on drawings.~~ (note deleted)
25) All prime contractors are required to protect all flooring and floor coverings from damage by their construction operations, dropped items, and wheeled traffic.
26) Plumbing Contractor shall furnish all roof drain sump pans sized and configured to accommodate the specified roof drains and roof assembly thickness. This Contractor shall be responsible for installation of sump pans, including cutting of deck openings, framing, support and attachment to the structure.

F. Bid Package #10 – ROOFING

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Specification Section 072100 – THERMAL INSULATION
   d. Specification Section 074113.16 – STANDING-SEAM METAL ROOF PANELS
   e. Specification Section 074293 – MANUFACTURED SOFFIT SYSTEMS
   f. Specification Section 075400 – THERMOPLASTIC MEMBRANDE ROOFING (PVC AND KEE)
   g. Specification Section 076200 – SHEET METAL FLASHING AND TRIM
   h. Specification Section 077100 – ROOF SPECIALTIES
   i. Specification Section 077129 – MANUFACTURED ROOF EXPANSION JOINTS
   j. Specification Section 077200 – ROOF ACCESSORIES

3. **Scope of Work**

   a. ROOFING, SOFFITING AND ROOF SPECIALTIES

   1) Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
   2) Furnish and install complete Roofing Systems, Soffit Systems and Roof Specialty Systems as specified in the Contract Documents
   3) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.

4) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
5) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
6) Include removal of existing coping and cleats per detail 2/AR101
7) Include prefabricated roof curbs for all items supplied by this Scope of Work including roof hatches.
8) Include underlayment/nailbase insulation as required under standing seam metal roofing.
9) Include all fascia, gutters and downspouts
10) Provide rood expansion joints as required per manufacturer and/or contract documents.
11) Include specified manufacturer's warranty.
12) Include all required flashings and boots for items on the roof including MEPFP equipment.
13) Include temporary roofing measures required to maintain a fully watertight roof at all times.
14) Includes all roofing modifications resultant from work performed under Plumbing and HVAC.
15) Include field testing per manufacturers' requirements and Contract Documents.
16) Include coordination and scheduling with roofing manufacturer for field inspections.
17) Include clean-up of areas disturbed by this subcontractor during completion of this subcontractor's final punch list work.
18) Haul and dispose of clean up debris to dumpsters provided by Construction Manager.

G. Bid Package #16 – PLUMBING and HVAC

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Specification Section 078413 – PENETRATION FIRESTOPPING
   d. Specification Section 078443 – JOINT FIRESTOPPING
   e. Specification Section 079200 – JOINT SEALANTS
   f. Specification Section 083113 – ACCESS DOORS AND FRAMES
   g. Specification Section 089119 – FIXED LOUVERS
   h. Division 22 – Complete
   i. Division 23 – Complete

3. **Scope of Work**

   a. PLUMBING

   1) Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
   2) Provide necessary coordination and participation in BIM coordination.

3) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.
4) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
5) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
6) Include all PLUMBING demolition indicated on drawings.
7) Include all hookups and connections for Owner provided equipment.
8) Include furnish and install of any additional access panels not shown on drawings that would be required for a complete system installation and maintenance.
9) This contractor is responsible for any required housekeeping pads as required for your scope of work.
10) Include coordination for commissioning.
11) This contractor shall provide daily clean-up associated with their scope of work to the dumpster provided by the Construction Manager.
12) Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during this Contractor's operations. This Contractor shall be responsible for Scheduling, Contacting and Coordinating with 811 for utility locations within their area of work.
13) Include utilizing a vacuum truck or hand digging to verify utility location prior to excavations within 5' of an existing utility.
14) Provide any necessary coring or sleeves required for this bid package.
15) All start-up, owner training and demonstration.
16) Coordinate all shutdowns with the Construction Manager.
17) All permits and fees for your scope of work.
18) All prime contractors are required to protect all flooring and floor coverings from damage by their construction operations, dropped items, and wheeled traffic.
19) Furnish and install complete Plumbing systems as outlined in plans and specifications, including all related excavation, spoil haul-off, backfill and compaction of plumbing trenches.
20) Bid Package 02 – Site Utility Contractor shall extend the domestic water line into the Mechanical Room D114 in Unit D and extend the domestic water line to 12" above the floor with a flange. This Contractor shall connect to 12" flange. Include flushing, testing and disinfection of lines.
21) Include all labeling, joint sealant, caulking, fire caulking and firestopping as required for your work.
22) Provide all core drilling, cutting, and patching for your scope of work.
23) Furnish and install all final connections to equipment, including equipment provided by others, as required.
24) Final connections of natural gas piping for HVAC Equipment
25) All underground layout to be performed by subcontractor.
26) Include connection of storm and sanitary sewer piping to piping 5'0" outside the building.

27) Provide owner training as required per specifications.
28) Provide final connections for HVAC.
29) Column lines shall be pinned by this Contractor's subcontractor surveyor.
30) Include coordination with Food Service Equipment Contractor for necessary connections.
31) Furnish and install all boots for through-roof penetrations with temporary water proofing until Roofing Contractor permanently flashes in.
32) Contractor shall include all plumbing and kitchen hook-ups as called out on 'K' Series or Food Service Drawings by Reitano.
33) Contractor shall include all excavation and backfill of the Grease Trap shown on drawing PF10C. This Contractor shall furnish the GI-1 Grease Interceptor as called out on drawing P-501 Plumbing Equipment Schedule.

b. HVAC

1) Refer Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
2) Provide necessary coordination and participation in BIM coordination drawings.
3) Provide complete HVAC system per Contract Documents.
4) This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.
5) This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.
6) This Contractor shall further be responsible for any resulting impacts and non-conformance to other trades, including but not limited to delay, rework, any required premium time to maintain project schedule, or disruption of their work
7) Furnish and install prefabricated roof curbs for items furnished under this Bid Package. units. Include insulated roof curb caps as shown on mechanical drawings. Include cutting of necessary openings in metal roof deck.
8) Furnish and install all louvers. Include all fasteners, filler panels, flashing and sealants at louver openings.
9) Include all start-up, Owner training, and maintenance service per Contract Documents.
10) Include all manufacturer field services per Contract Documents
11) Include all controls, including rough-in and wiring, and programming, certified testing, and balancing as required for a fully functioning system.
12) Include all fire and smoke dampers as required.
13) Include all condensate piping as required.
14) Include extended warranties as required to meet Specifications in conjunction with the Project Schedule. Warranties shall start on the day the certificate of Substantial Completion is executed. Units to be started prior to Substantial Completion in accordance with the project schedule for startup, test and balance, and commissioning.
15) Include all construction filters for equipment provided under this Scope of Work. Filters are to be replaced immediately prior to occupancy.
16) Include coordination with the Owner's Commissioning Agent.
17) Include all hookups and connections for Owner provided equipment.

18) Include cutting/patching, sleeves, and/or core drilling of all walls, floor, and roof penetrations and/or openings for this Scope of Work
19) Include all firestop and sound sealant at all pipe penetrations through rated walls, ceilings, floors, and roofs for penetrations by this subcontractor.
20) Include any necessary concrete housekeeping or equipment pads for equipment installed under this Scope of Work.
21) Include access doors as required to access items installed under this Scope of Work.
22) All starters, disconnects, service outlets, etc. are to be reviewed during the bidding period and are to be provided as a part of the unit from the equipment manufacturer wherever possible.
23) Include all requirements for fire alarm tie in. This includes duct smoke detectors and controllers that integrate with fire alarm systems.
24) Include daily clean-up of debris, waste, dirt, dust, waste, or other Construction impediments generated by this Scope of Work to the dumpsters supplied by the Construction Manager.
25) Include clean-up of areas disturbed by this subcontractor during completion of this subcontractor's final punch list work.
26) Include joint sealants as they relate to this Scope of Work.
27) Included cutting the deck for any new equipment.
28) Include all trade permit and inspection fees.
29) Provide all layout for your scope of work.
30) Coordinate with Masonry Contractor for in wall rough-ins.

H. Bid Package #18 – ELECTRICAL, FIRE ALARM, SYSTEMS & TECHNOLOGY.

1. Overview. – Bidder shall perform a complete Scope of Work for all contract documents, drawings, specifications, and the elaborations below. This Scope of Work shall include all labor, materials, equipment, and related items necessary to complete the work.

2. Applicable Specifications:
   a. Division 00 – Complete
   b. Division 01 – Complete
   c. Specification Section 078413 – PENETRATION FIRESTOPPING
   d. Specification Section 078443 – JOINT FIRESTOPPING
   e. Specification Section 079200 – JOINT SEALANTS
   f. Specification Section 083113 – ACCESS DOORS AND FRAMES
   g. Division 26 - Complete
   h. Division 27 - Complete
   i. Division 28 - Complete

3. **Allowances: See section 00 43 21 – Project Specific Allowances**
   a. Include Light Fixture WL6 (4 fixtures): $45,000

4. **Scope of Work**
   a. Refer to part 1.3.A - General Notes applicable to **ALL** bid packages for additional scope applicable to this bid package.
   b. Provide necessary coordination and participation in BIM coordination.
   c. This Contractor shall review and understand the site logistic plan (Reference Section 00 31 13b – Site Logistics Plan). This project will be phased.

d. This Contractor shall be fully responsible for all layout, field measurements, grades, elevations, and horizontal control required for execution of its work. CM will provide 3 control points for reference only. This contractor shall verify all control points and establish all additional layout necessary to complete its work. This contractor shall be solely responsible for accuracy of its layout and installation. Any work found to be out of alignment, out of plumb/level, or otherwise not in conformance with construction documents shall be corrected at no additional cost to Construction Manager or Owner.

e. Provide complete Electrical system, Communications system and Electronic Safety & Security systems as outlined in the contract documents

f. Include all ELECTRICAL demolition indicated on drawings.

g. Furnish and/or install all disconnects as indicated on the contract documents.

h. This subcontractor is responsible for layout and cutting of electrical decking penetrations.

i. Include single phase and (3) three-phase temporary power connections for other trades. Include removal of temporary power.

j. Include installation and removal of temporary power connection at construction trailer.

k. Include temporary lighting at all areas of construction per OSHA standards and removal when directed by construction manager.

l. Include conduit, wiring, install final connections, testing, and adjusting for all electrified door hardware.

m. Include electrical conduit, wiring and final connections for all HVAC, Fire Suppression, plumbing equipment, and kitchen equipment.

n. Include inspections/testing as specified.

o. Provide cutting/coring of all openings and penetrations required to install your work.

p. Include coordinating and scheduling with all local utilities and authorities having jurisdiction.

q. Include all trade permit and inspection fees.

r. Include extended warranties as required to meet Specifications in conjunction with the Project Schedule. Warranties shall start on the day the certificate of Substantial Completion is executed. Equipment to be started prior to Substantial Completion in accordance with the project schedule for startup, test and balance, and commissioning.

s. Include coordination with the Owner's Commissioning Agent.

t. Include all excavation, backfill, compaction, and spoil removal for this Scope of Work. Include import of backfill material as required.

u. Include all hookups and connections for Owner provided equipment.

v. Include all firestop and sound sealant at all pipe penetrations through rated walls, ceilings, floors, and roofs for penetrations by this Contractor.

w. Include access doors/panels as required to access items installed under this Scope of Work.

x. Lights, exit signage, and smoke detector must be centered in the ceiling panels in which they occur.

y. Include daily clean-up of debris, waste, dirt, dust, waste, or other Construction impediments generated by this Scope of Work to the dumpsters supplied by the Construction Manager.

z. All prime contractors are required to protect all flooring and floor coverings from damage by their construction operations, dropped items, and wheeled traffic

aa. Include clean-up of areas disturbed by this Contractor during completion of this Contractors final punch list work.

bb. Include all labeling, caulking, fire caulking and firestopping as required for your work.

cc. Provide all interior and exterior concrete pads required for your work.

dd. Provide all light pole bases, generator pads and transformer pads.

ee. Include all start-up, commissioning, demonstration, and training as required prior to substantial completion.

ff. Install variable frequency drives furnished by the HVAC Systems contractor.

gg. Furnish and install all conduit, wiring and final connections to HVAC equipment and components unless noted otherwise. Control wiring will be furnished and installed by the HVAC Systems contractor. Provide electrical power per HVAC schedules as indicated.

hh. Furnish and install all boots for through-roof penetrations with temporary water proofing until Roofing Contractor permanently flashes in.

ii. Provide all data/communications rough-in and wiring as specified.

jj. Reroute existing electrical and technology as

kk. Include coordination/shop drawings depicting all equipment, conduit and related components. Coordinate with the Fire Protection Contractor, Plumbing Contractor and HVAC Contractor.

ll. This Contractor shall include all Electrical, Fire Alarm, Systems & Technology associated with the kitchen and kitchen equipment as per 'K' Series or Food Service Drawings that were developed by Reitano. This Contractor shall provide all final equipment hook-ups.

mm. This Contractor shall complete electrical work in coordination with requirements of Section 21 100.1.3.

END OF SECTION 00 24 13

A D D E N D U M N O. 2

Nathaniel Jones Early Learning Center Addition and Expansion

MSD of Pike Township
Indianapolis, Indiana

Index of Contents

Addendum No. 2: 27 Items, 6 pages

Revised Project Manual Sections:

Table of Contents
11 68 00 – Playground Equipment and Structures
22 31 00 – Domestic Water Softeners
22 34 00 – Fuel-Fired Domestic Water Heaters
22 40 00 – Plumbing Fixtures
23 05 23 - General-Duty Valves for HVAC Piping
23 05 29 - Hangers & Supports for HVAC Piping & Equip
23 05 48 - Vibration & Seismic Controls for Piping & Equip
23 09 00 - Instrumentation and Control for HVAC
23 09 93 - HVAC Sequence of Operation
23 21 13 - Hydronic Piping
23 25 00 - HVAC Water Treatment
23 31 13 - Metal Ducts
23 34 23 - HVAC Power Ventilators
23 34 33 - Air Curtain
23 36 00 - Air Terminal Units
23 37 13 - Diffuser Registers and Grilles
23 52 16 - Vibration & Seismic Controls for Piping & Equip
23 64 23 - Scroll Water Chillers
23 73 13 - Modular Indoor Central Station Air Handling Units
23 82 37 - Unit Heaters
27 15 13 – Communications Copper Horizontal Cabling
27 41 33 - Integrated AV Equipment
27 51 17 - Classroom Sound Reinforcement

Deleted Project Manual Sections:

11 68 00 – Playground Equipment and Structures
32 18 13 – Playground Synthetic Grass Surfacing
32 18 16 – Playground Surfacing

Revised Drawing Sheets:

G1-01; G1-02; G1-03; G1-04; G3-01; G3-02; G3-03; G3-04; G3-05; G3-06; G3-07; G3-08; A-11C; A-201; A-202; A-601; AQ11C; AF203; PL11C; P-401; P-501; MV11C; MV11D; MP11C; MP11D; MC11C; MC11D; MR11C; MR11D; M-401; M-402; M-501; M-502; M-601; M-602; M-701; M-702; M-704; ET11C; ET502; T-001; T-11C; T-11D; T-501; T-601; TS101

Date: March 26, 2026

I hereby certify that this Addendum was prepared by me or under my direct supervision and that I am a duly registered Architect/Engineer under the Laws of the State of Indiana.

FANNING/HOWEY ASSOCIATES, INC.
ARCHITECTS/ENGINEERS/CONSULTANTS



Paul A. Miller, License No. AR10800161
Expiration Date: 12/31/2027

TO: ALL BIDDERS OF RECORD

ADDENDUM NO. 2 to Drawings and Project Manual, dated March 13, 2026, for MSD of Pike Township, 3950 W. 56th Street, Indianapolis, Indiana 46278; as prepared by Fanning/Howey Associates, Inc., Indianapolis, Indiana. This Addendum shall hereby be and become a part of the Contract Documents the same as if originally bound thereto.

The following clarifications, amendments, additions, revisions, changes, and modifications change the original Contract Documents only in the amount and to the extent hereinafter specified in this Addendum.

Each bidder shall acknowledge receipt of this Addendum in his proposal or bid.

NOTE: Bidders are responsible for becoming familiar with every item of this Addendum. (This includes miscellaneous items at the very end of this Addendum.)

RE: ALL BIDDERS

ITEM NO. 1. PROJECT MANUAL, TABLE OF CONTENTS

A. Book 2, Page 00 01 10-2, DIVISION 11: Delete Section 11 68 00 – Playground Equipment and Structures.

B. Book 3, Page 00 01 10-3, DIVISION 32: Delete Sections 32 18 13 – Playground Synthetic Grass Surfacing and 32 18 16 – Playground Surfacing.

ITEM NO. 2. PROJECT MANUAL, SECTION 11 68 00 – PLAYGROUND EQUIPMENT AND STRUCTURES

A. Delete this Section in its entirety.

ITEM NO. 3. PROJECT MANUAL, SECTION 22 31 00 – DOMESTIC WATER SOFTENERS

A. Replace 2.1, A., as follows:

"A. Acceptable Manufacturers:
1. WaterCare Commercial (Basis of Design)
2. Culligan
3. US Water Systems"

A. Replace 2.1, B., as follows:

"B. The tank shall be designed for a working pressure of 100 psi and hydrostatically tested at 50 percent in excess of the working pressure. A minimum freeboard volume of 50 percent shall be provided to assure adequate bed expansion during backwash. Each tank shall be manufactured of fiberglass reinforced polyester with a 4"-8 threaded top opening. The exterior sideshell shall be reinforced by a continuous roving glass filament overwrap of the same color as the tank shell. A molded polypropylene structural base shall support the tanks. Including the base, each vessel shall have the dimensions of 24-inch diameter by 72-inch height."

B. Replace 2.2, A., as follows:

"A. The mineral tank shall be provided with 10 cubic feet of high-capacity, nonphenolic resin having a minimum exchange capacity of 300,000-350,000 grains per cubic foot when regenerated with 15 pounds of salt per cubic foot. The media shall be solid, of the proper particle size (not more than 4 percent through 40-mesh U.S. standard screen, wet screening) and shall contain no plates, shells, agglomerates, or other shapes, which might interfere with the normal function of the water softener."

C. Add 2.4, D., as follows:

"D. BAS Integration Module – Module shall be BACnet MSTP or Modbus RTU supported protocols. Module shall have the following BAS data points:
1. Online tank status.
2. Flow rate.
3. Totalized flow.
4. Regeneration status.
5. Alarm conditions
6. Optional brine level monitoring."

ITEM NO. 4. PROJECT MANUAL, SECTION 22 34 00 – FUEL-FIRED DOMESTIC WATER HEATERS

A. Replace 2.1, A., as follows:

"A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lochinvar (Basis of Design)
2. A.O. Smith
3. Bradford-White"

A. Add 2.2, E., as follows:

"E. The water heater shall have an additional communication module to allow integration into the BAS system. Additional communication module shall be equal to Modbus module RTU (RS-485) or BACnet module MSTP (RS-485), which allows integration through the units smart control communication port."

ITEM NO. 5. PROJECT MANUAL, SECTION 22 40 00 – PLUMBING FIXTURES

A. Replace 2.1, A., B., C., and D., as follows:

"A. Lavatories:
1. American Standard, Kohler, Eljer.
2. Trim: T&S Brass, Chicago, Sloan.

B. Water Closets and Urinals:
1. Water Closet and Urinal: American Standard, Kohler, Crane, Eljer, Sloan.
2. Seats: Beneke, Olsonite, Bemis, Church, Centoco.

C. Sinks:
1. Elkay, Just.
2. Trim: T&S Brass, Chicago, Sloan.

D. Mop Basin:
1. Sink: Fiat, Swan, Acorn, Mustee.
2. Trim: T&S Brass, Chicago, Cambridge Brass, Speakman, Moen Commercial."

ITEM NO. 6. PROJECT MANUAL, SECTION 23 05 23 – GENERAL-DUTY VALVES FOR HVAC PIPING

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 7. PROJECT MANUAL, SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 8. PROJECT MANUAL, SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 9. PROJECT MANUAL, SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 10. PROJECT MANUAL, SECTION 23 09 93 – HVAC SEQUENCE OF OPERATION

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 11. PROJECT MANUAL, SECTION 23 21 13 – HYDRONIC PIPING

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 12. PROJECT MANUAL, SECTION 23 25 00 – HVAC WATER TREATMENT

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 13. PROJECT MANUAL, SECTION 23 31 13 – METAL DUCTS

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 14. PROJECT MANUAL, SECTION 23 34 23 – HVAC POWER VENTILATORS

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 15. PROJECT MANUAL, SECTION 23 34 33 – AIR CURTAIN

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 16. PROJECT MANUAL, SECTION 23 36 00 – AIR TERMINAL UNITS

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 17. PROJECT MANUAL, SECTION 23 37 13 – DIFFUSER REGISTERS AND GRILLES

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 18. PROJECT MANUAL, SECTION 23 52 16 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 19. PROJECT MANUAL, SECTION 23 64 23 – SCROLL WATER CHILLERS

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 20. PROJECT MANUAL, SECTION 23 73 13 – MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 21. PROJECT MANUAL, SECTION 23 82 39 – UNIT HEATERS

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 22. PROJECT MANUAL, SECTION 27 15 13 – COMMUNICATIONS COPPER HORIZONTAL CABLING

A. Replace table in PART 1, 1.3, B:

TELECOMMUNICATIONS CABLE COLOR LEGEND				
SYSTEM	TERMINATION (RJ45)	CABLE GENERAL	PATCH CABLE (PATCH PANEL)	PATCH CABLE (STATION)
DATA	BLUE	BLUE	BLUE	BLUE
WIRELESS (CAT6A)	GREEN	GREEN	GREEN	GREEN
CAMERAS (CAT6A)	YELLOW	YELLOW	YELLOW	YELLOW
ACCESS CONTROL	PURPLE	PURPLE	PURPLE	PURPLE
HVAC	GREY	GREY	GREY	GREY

B. Revise PART 2, 2.0, as follows:
Approved Outlet/Connector Manufacturers: ~~Panduit~~ Leviton
Approved Faceplate Manufacturers: ~~Panduit~~ Leviton
Approved Patch Panel/Patch Cable Manufacturers: ~~Panduit~~ Leviton

C. Provide Leviton equivalents to products specified in PART 2, 2.2-2.7.

D. Revise PART 2, 2.13, as follows:
"2.13 WIRELESS ACCESS POINTS~~, CAMERA~~ AND VIDEO PROJECTOR LOCATIONS.
A. Cable Connection
1. Provide two port plenum rated surface mount boxes to terminate the appropriately rated RJ45 jack and cable.
2. Provide 5-foot patch cord as required.
3. Patch the wireless access point~~, camera~~ and video projector to the data jack in the box above the ceiling.
4. Place a color dot sticker on the ceiling grid to locate the cable location from the floor in common areas.
5. If cable run is under 295', leave a 25' cable coil on these cables for flexibility of mounting the associated equipment. Do not leave this excess if the coil will make the overall cable be over footage.
6. ~~BASIS OF DESIGN – PANDUIT CBX SERIES~~ Approved Manufacturer – Leviton"

ITEM NO. 23. PROJECT MANUAL, SECTION 27 41 33 – INTEGRATED AV EQUIPMENT

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 24. PROJECT MANUAL, SECTION 27 51 17 – CLASSROOM SOUND REINFORCEMENT

A. Replace this section in its entirety. The new revised section, dated 3/26/2026, is included with and hereby made a part of this Addendum.

ITEM NO. 25. PROJECT MANUAL, SECTION 32 18 13 – PLAYGROUND SYNTHETIC GRASS SURFACING

A. Delete this Section in its entirety.

ITEM NO. 26. PROJECT MANUAL, SECTION 32 18 16 – PLAYGROUND SURFACING

A. Delete this Section in its entirety.

ITEM NO. 27. REVISED DRAWING SHEETS

A. Drawing Sheets: The following sheets in the document set have been revised, dated 3/26/26, and are included with and hereby made a part of this Addendum. These Drawings supersede the original documents.

G1-01	AQ11C	M-502
G1-02	AF203	M-601
G1-03	PL11C	M-602
G1-04	P-401	M-701
G3-01	P-501	M-702
G3-02	MV11C	M-704
G3-03	MV11D	ET11C
G3-04	MP11C	ET502
G3-05	MP11D	T-001
G3-06	MC11C	T-11C
G3-07	MC11D	T-11D
G3-08	MR11C	T-501
A-11C	MR11D	T-601
A-201	M-401	TS101
A-202	M-402	
A-601	M-501	

END OF ADDENDUM

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ball valves.
2. Iron, single-flange butterfly valves.
3. Iron, grooved-end butterfly valves.
4. Bronze, grooved-end butterfly valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron, grooved-end swing-check valves.
8. Iron, grooved-end spring-actuated check valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Lubricated plug valves.
12. Drain valves.

B. Related Sections:
1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene-propylene-diene monomer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
1. Grooved-end valves shall be of the same manufacturer as the grooved components.
2. No yellow brass containing more than 15 percent zinc.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle that allows operation of valve without disturbing insulation.
2. Butterfly Valves: With extended neck.

E. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606 or copper tube dimensions.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo.
b. NIBCO INC.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
e. Hammond Valve.
~~f. Jamesbury; a subsidiary of Metso Automation.~~
g. Kitz Corporation.
~~h. Marwin Valve; a division of Richards Industries.~~
i. Milwaukee Valve Company.
~~j. RuB Inc.~~
k. Watts

2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: ASTM B584 C8440.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel.
   j. Port: Full.

B. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel or Chrome-Plated Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
   d. Hammond Valve.
   e. Jamesbury; a subsidiary of Metso Automation.
   f. Kitz Corporation.
   g. Marwin Valve; a division of Richards Industries.
   h. Milwaukee Valve Company.
   i. RuB Inc.
   j. Watts
   k. Victaulic Company
   l. Anvil Gruvlok
   m. Tyco-Grinnell
2. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: ASTM B584 C8440.
   e. Ends: Threaded.
   f. Seats: PTFE or TFE.
   g. Stem: Stainless steel or chrome-plated brass.
   h. Ball: Stainless steel.
   i. Port: Regular.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   ~~a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.~~
   b. Bray Controls; a division of Bray International.
   c. Conbraco Industries, Inc.; Apollo Valves.
   ~~d. Cooper Cameron Valves; a division of Cooper Cameron Corp.~~
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   ~~g. DeZurik Water Controls.~~
   h. Hammond Valve.
   ~~i. Kitz Corporation.~~
   j. Milwaukee Valve Company.
   k. NIBCO INC.
   ~~l. Norriseal; a Dover Corporation company.~~
   ~~m. Red White Valve Corporation.~~
   ~~n. Spence Strainers International; a division of CIRCOR International.~~
   o. Tyco Valves & Controls; a unit of Tyco Flow Control.
   p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

2.4 IRON, GROOVED-END BUTTERFLY VALVES

A. 300 CWP, Iron, Grooved-End Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil Gruvlok.
   b. Tyco-Grinnell.
   ~~c. Kennedy Valve; a division of McWane, Inc.~~
   d. Mueller Steam Specialty; a division of SPX Corporation.
   e. NIBCO INC.
   ~~f. Shurjoint Piping Products.~~
   g. Victaulic Company.
2. Description:
   a. Standard: MSS SP-67, Type I.
   b. NPS 8 and Smaller CWP Rating: 300 psig.
   c. NPS 10 and Larger CWP Rating: 200 psig.
   d. Body Material: Coated, ductile iron.
   e. Stem: Two-piece stainless steel.
      1) Stem shall be offset from the disc centerline to provide full 360 degree circumferential seating.
   f. Disc: Coated, ductile iron, aluminum-bronze, or stainless steel.
   g. Seal: EPDM.

2.5 BRONZE, GROOVED-END BUTTERFLY VALVES

A. 300 CWP, Iron, Bronze Body Grooved-End Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company
   b. Tyco-Grinnell
   c. Anvil Gruvlok
2. Description
   a. CWP Rating: 300 psig.
   b. Body Material: Cast bronze.
   c. Stem: Integrally cast with disc.
   d. Disc: EPDM coated, ductile iron.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   ~~a. American Valve, Inc.~~
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   ~~f. Kitz Corporation.~~
   g. Milwaukee Valve Company.
   h. NIBCO INC.

i. ~~Powell Valves.~~
j. ~~Red-White Valve Corporation.~~
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. ~~Zy-Tech Global Industries, Inc.~~

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ~~American Valve, Inc.~~
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. ~~Kitz Corporation.~~
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. ~~Red-White Valve Corporation.~~
   i. ~~Zy-Tech Global Industries, Inc.~~
2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. ~~Kitz Corporation.~~
   f. Legend Valve.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. ~~Powell Valves.~~
   j. ~~Red-White Valve Corporation.~~
   k. ~~Sure Flow Equipment Inc.~~
   l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   m. ~~Zy-Tech Global Industries, Inc.~~
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Hammond Valve.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-71, Type I.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
      c. NPS 14 to NPS 24, CWP Rating: 300 psig.
      d. Body Design: Clear or full waterway.
      e. Body Material: ASTM A 126, gray iron with bolted bonnet.
      f. Ends: Flanged.
      g. Trim: Bronze.
      h. Gasket: Asbestos free.

2.8 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil Gruvlok.
      ~~b. Shurjoint Piping Products.~~
      c. Tyco-Grinnell.
      d. Victaulic Company.
   2. Description:
      a. CWP Rating: 300 psig.
      b. Body Material: ASTM A 536, ductile iron.
      c. Seal: EPDM.
      d. Disc: Spring operated, ductile iron or stainless steel.

2.9 IRON, GROOVED-END SPRING-ACTUATED CHECK VALVES

A. 300 CWP, Iron, Grooved-End Spring-Actuated Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company
      b. Tyco-Grinnell.
      c. Anvil Gruvlok
   2. Description
      a. CWP Rating: 300 psig.
      b. Body Material: ASTM A536, ductile iron.
      c. Seal: EPDM.
      d. Disc:
         1) NPS 2-1/2 and NPS 3: Aluminum-bronze.
         2) NPS 4 through NPS 12: Elastomer coated ductile iron.
         3) NPS 14 through NPS 24: Dual stainless steel disc.
      e. Spring and Shaft: Stainless steel.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:
   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. Hammond Valve.
d. ~~Kitz Corporation.~~
e. Milwaukee Valve Company.
f. NIBCO INC.
g. ~~Powell Valves.~~
h. ~~Red-White Valve Corporation.~~
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. ~~Zy-Tech Global Industries, Inc.~~

2. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. ~~Kitz Corporation.~~
f. Milwaukee Valve Company.
g. NIBCO INC.
h. ~~Powell Valves.~~
i. ~~Red-White Valve Corporation.~~
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. ~~Zy-Tech Global Industries, Inc.~~

2. Description:
a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.12 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Nordstrom Valves, Inc.
   2. Description:
      a. Standard: MSS SP-78, Type II.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A 48or ASTM A 126, cast iron with lubrication-sealing system.
      e. Pattern: Regular or short.
      f. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Nordstrom Valves, Inc.
   2. Description:
      a. Standard: MSS SP-78, Type II.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
      e. Pattern: Regular or short.
      f. Plug: Cast iron or bronze with sealant groove.

2.13 DRAIN VALVE (HOSE END)

A. For Low Pressure Drainage Service
   1. Threaded ends 2 inches and smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4 inch hose outlet connection with cap and chain.
   2. Soldered ends 2 inches and smaller: Class 125 bronze body, screwed bonnet, rising stem, composition disc, 3/4 inch hose outlet connection with cap and chain.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Examine grooved-ends for form and cleanliness. Grooved-ends shall be clean and free from indentations and projections in the area from valve end to groove.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions, grooved joint couplings or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball, butterfly, or globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

G. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or butterfly.
   2. Butterfly Valve Dead-End Service: Grooved-end or single-flange (lug) type.
   3. Throttling Service: Globe, ball, or butterfly valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger: Iron swing or spring-actuated check valves.

B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
   7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.
   8. For NPS 2 and Smaller: Valve ends may be press fit in lieu of soldered copper or threaded steel.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Ball Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves:
      a. One piece, full or regular port, with stainless-steel trim.

b. Two-piece, regular port, with press fit ends.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 24: 300 CWP.
3. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
4. Iron, Grooved-End Check Valves
a. NPS 3 to NPS 12: 300 CWP.
b. NPS 14 to NPS 24: 230 CWP.
5. Iron Globe Valves: Class 250.

~~3.6 CONDENSER-WATER VALVE SCHEDULE~~

~~A. Pipe NPS 2 and Smaller:~~
~~1. Ball Valves: May be provided with solder-joint ends instead of threaded ends.~~
~~2. Ball Valves:~~
~~a. One piece, full or regular port, with stainless-steel trim.~~
~~b. Two-piece, regular port, with press fit ends.~~
~~3. Bronze Swing Check Valves: Class 125, bronze disc.~~
~~4. Bronze Globe Valves: Class 125, bronze disc.~~

~~B. Pipe NPS 2-1/2 and Larger:~~
~~1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.~~
~~2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 24: 300 CWP.~~
~~3. Iron Swing Check Valves: Class 250, metal seats.~~
~~4. Iron, Grooved-End Check Valves~~
~~a. NPS 3 to NPS 12: 300 CWP.~~
~~b. NPS 14 to NPS 24: 230 CWP.~~
~~5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250.~~

3.7 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Ball Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves:
a. One piece, full or regular port, with stainless-steel trim.
b. Two-piece, regular port, with press fit ends.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 24: 300 CWP.
3. Iron Swing Check Valves: Class 250, metal seats.
4. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
a. NPS 3 to NPS 12: 300 CWP.
b. NPS 14 to NPS 24: 230 CWP.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250.

~~3.8 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)~~

~~A. Pipe NPS 2 and Smaller:~~
~~1. Ball Valves: Two-piece, full or regular port, with stainless-steel trim.~~
~~2. Bronze Swing Check Valves: Class 150, bronze disc.~~
~~3. Bronze Globe Valves: Class 150, bronze disc.~~

~~B. Pipe NPS 2-1/2 and Larger:~~
~~1. Iron Swing Check Valves: Class 250, metal seats.~~
~~2. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250.~~

~~3.9 STEAM-CONDENSATE VALVE SCHEDULE~~

~~A. Pipe NPS 2 and Smaller:~~
~~1. Ball Valves: Two piece, full or regular port, with stainless-steel trim.~~
~~2. Bronze Swing Check Valves: Class 150, bronze disc.~~
~~3. Bronze Globe Valves: Class 150, bronze disc.~~

~~B. Pipe NPS 2-1/2 and Larger:~~
~~1. Iron Swing Check Valves: Class 250, metal seats.~~
~~2. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250.~~

3.10 DRAIN VALVE SCHEDULE

A. At all points in the piping system.

B. Where indicated on the drawings.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   ~~5. Fastener systems.~~
   6. Pipe stands.
   7. Equipment supports.
   8. Duct hangers and supports.
   9. Structural roof curbs.
   10. Pipe curbs.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 07 Section “Roof Accessories” for general information concerning roof accessories.
   3. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
   4. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
   5. Division 23 Section(s) "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

~~C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.~~

D. Provide additional supplemental steel as required to support equipment, ductwork, piping, etc. from structure above.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.2, "Structural Welding Code--Aluminum."
   3. AWS D1.3, "Structural Welding Code--Sheet Steel."
   4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.
   3. B-Line Systems, Inc.; a division of Cooper Industries.
   4. Carpenter & Paterson, Inc.
   5. Empire Industries, Inc.
   6. ERICO/Michigan Hanger Co.
   7. Globe Pipe Hanger Products, Inc.
   8. Grinnell Corp.
   9. GS Metals Corp.
   10. National Pipe Hanger Corporation.
   11. PHD Manufacturing, Inc.
   12. PHS Industries, Inc.
   13. Piping Technology & Products, Inc.
   14. Tolco Inc.
   15. Anvil International

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

~~2.6 FASTENER SYSTEMS~~

~~A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.~~
~~1. Manufacturers:~~
~~a. Hilti, Inc.~~
~~b. ITW Ramset/Red Head.~~
~~c. Masterset Fastening Systems, Inc.~~
~~d. MKT Fastening, LLC.~~
~~e. Powers Fasteners.~~

~~B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.~~
~~1. Manufacturers:~~
~~a. B-Line Systems, Inc.; a division of Cooper Industries.~~

b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
1. Manufacturers:
a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
1. Manufacturers:
a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Manufacturers:
a. Portable Pipe Hangers.
2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 DUCT HANGERS AND SUPPORTS

A. Support horizontal ductwork runs with suitable strap or trapeze hangers. When weight of duct between hangers does not exceed 60 pounds, hangers shall be 1 inch wide by 18 gauge. For greater weights, use trapeze hangers, as approved by A/E.

B. Contractor may use load rated cable suspension system. Suspension system shall have a specified manufacturers safe working load and supplemental safety factor of at least five times the safe working load.
   1. Suspension system shall be verified by SMACNA Testing and Research Institute to be in compliance with SMACNA Duct Construction Standards Guidelines (1995 CH.4).
      a. Manufacturers:
         1) Dura-Dyne
         2) Gripple

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

2.11 ROOF CURBS/EQUIPMENT SUPPORTS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment”.

B. 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 C1071, Type I or II.
      b. Thickness: 1-1/2 inches.
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C916, 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 C916, Type I.
      e. Metal Counterflashing: Manufacturer’s standard, removable, fabricated of same metal and finish as equipment support. Coordinate with roofing contractor.
      f. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
      g. Fabricate equipment supports to minimum height of 12 inches above finished roof surface, unless otherwise indicated.
      h. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.12 PIPE CURBS

A. Pipe curb shall consist of a heavy gauge galvanized steel roof curb, unitized construction, with integral base plate, 3 pound density insulation, and 2 by 2 nailer. Curb shall be covered with a thermoplastic cover, fastening screws, graduated step boots with stainless steel adjustable clamps.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
   10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
   11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
   12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
   15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
   16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
   17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
   18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
   19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Swivel connections shall be utilized for attachment to sloping structure. Threaded rod shall not be bent.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

~~N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction. The use of powder-actuated fasteners or mechanical-expansion anchors may only be used after approval from the structural engineer.~~

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

~~E. Fastener System Installation:~~

1. ~~Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.~~
2. ~~Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.~~

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Isolation pads.
2. Isolation mounts.
3. Spring isolators.
4. Elastomeric hangers.
5. Spring hangers.
6. Restrained vibration isolation roof-curb rails.
7. Vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:
1. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

B. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.7 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads : Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

J. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

~~2.2 AIR-MOUNTING SYSTEMS~~

~~A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~
~~1. California Dynamics Corporation.~~
~~2. Firestone Industrial Products Company.~~
~~3. Kinetics Noise Control.~~
~~4. Mason Industries.~~
~~5. Vibration Eliminator Co., Inc.~~

~~B. Air Mounts : Freestanding, single or multiple, compressed-air bellows.~~
~~1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows.~~
~~2. Maximum Natural Frequency: 3 Hz.~~
~~3. Operating Pressure Range: 25 to 100 psig.~~
~~4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.~~
~~5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch.~~

~~C. Restrained Air Mounts : Housed compressed-air bellows.~~
~~1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows and spring, with angle-iron frame having vertical-limit stops and channel-section top with leveling adjustment and attachment screws.~~
~~2. Maximum Natural Frequency: 3 Hz.~~
~~3. Operating Pressure Range: 25 to 100 psig.~~
~~4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.~~
~~5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch.~~

2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Thybar Corporation.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.

C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.

D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators.
   a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
   b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

a. Resilient Material: Oil- and water-resistant.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:
1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

C. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

END OF SECTION 23 05 48

SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to the details and schedules on the Drawings for additional requirements.

1.2 SUMMARY

A. The temperature control contractor shall furnish and install a new, fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as herein specified. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number, and sequence of operation all bearing the name of the manufacturer. The installing manufacturer shall certify, in writing, that the shop drawings have been prepared by the equipment manufacturer and that the equipment manufacturer shall certify, in writing, that the shop drawings were prepared by their company and that all temperature control equipment was installed under their direct supervision.

B. Temperature control contractor shall be responsible for:
1. Providing of a complete DDC electronic automatic temperature control system.
2. Phased removal of existing pneumatic control system in conjunction with the Mechanical Contractor.
3. Control of heating water system, chilled water system, air handling units, variable speed pumps, VAV terminals, hydronic radiation, cabinet heaters, propeller unit heaters, ventilation fans and exhaust fans, as denoted on drawings, etc. in accordance with requirements herein specified.
4. Providing of control devices, valves, instruments, and the like, as herein specified and as required to comply with required sequences of automatic control.
5. Providing of wiring for secondary control devices, relay switches, safety low limit controls, etc., and such interlock wiring required.
6. Providing of interlock wiring between outdoor chillers, indoor evaporators, and chiller control panels.
7. Providing of interlock wiring between modular boilers and boiler control panel.
8. Furnishing adequate supervision on Work performed for him by others to insure proper operation and the neatest and best possible arrangement.
9. Testing, maintenance of system as herein specified.

C. The temperature control contractor shall read all other Drawings and Specifications, become familiar with requirements and scope of the Project, and include such coordination work as may be required.

D. Related Sections include the following:
1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
2. Division 23 Section "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this Section.
3. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 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 45 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 deg 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 deg F
      e. Ducted Air Temperature: Plus or minus 1 deg F
      f. Outside Air Temperature: Plus or minus 2 deg F
      g. Dew Point Temperature: Plus or minus 3 deg F
      h. Temperature Differential: Plus or minus 0.25 deg F
      i. Relative Humidity: Plus or minus 5 percent.
      j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
      k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
      l. Airflow (Terminal): Plus or minus 10 percent of full scale.
      m. Air Pressure (Space): Plus or minus 0.01-inch wg
      n. Air Pressure (Ducts): Plus or minus 0.1-inch wg
      o. Carbon Monoxide: Plus or minus 5 percent of reading.
      p. Carbon Dioxide: Plus or minus 50 ppm.
      q. Electrical: Plus or minus 5 percent of reading.

1.5 ACTION 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. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. 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. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including flow characteristics.
7. 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.
8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
9. 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. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

D. Samples for Verification: For each color required, of each type of thermostat or sensor cover/guard.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

B. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.

C. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.

D. Printout of software application and graphic screens.

E. Software license required by and installed for DDC workstations and control systems.

F. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

G. Coordinate paragraph below with qualification requirements in Division 01 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.
H. Qualification Data: For Installer and manufacturer.
I. Field quality-control test reports.

1.7 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
a. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
b. Interconnection wiring diagrams with identified and numbered system components and devices.
c. Keyboard illustrations and step-by-step procedures indexed for each operator function.
d. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
e. Calibration records and list of set points.

1.8 QUALITY ASSURANCE

A. Electrical components shall be UL listed.

1.9 CONTRACTOR RESPONSIBILITIES

A. The temperature control contractor shall be responsible for final design drawings, installation of all control wiring and control devices in accordance with National Electric Code. The temperature control contractor shall also be responsible for startup and complete checkout of the systems.

B. This Contractor shall furnish complete drawings, component lists, specification sheets and sequences of operation to the Engineer for approval before start of installation.

C. After corrections and any job installation changes, 1 sets of full drawings, parts lists, specification sheets, and operation and maintenance manuals are to be furnished to the mechanical contractor for delivery to the Owner, as well as a digital copy in the format preferred by the Owner.

D. All DDC logic diagrams shall be updated as built and included in the Operation and Maintenance Manuals for the Owner.

E. The temperature control contractor is responsible to use all room numbers developed and approved by the school district in the development of the temperature control system for this building.

1.10 PROJECT CONDITIONS

A. Contractor shall be responsible for the accurate location of their Work and for informing themselves of the nature and arrangement of the materials, equipment, and construction to which their Work attaches or passes through.
B. In general, work shall be concealed in walls in conduit and above ceilings in wire management systems, conduit in chases and in equipment rooms, insofar as is practical; so that such work will not interfere with the proper coordinated installation work of other trades or Contractors.

C. In general, wiring and conduit shall be installed parallel (or at right angles) to the building walls, and at such heights as not to obstruct any portion of windows, doorways, stairways, pipe space, tunnels, or passageways, and properly concealed to not interfere with the proper coordinated installation of other trades or Contractors. Where interferences develop in the field, the Work shall be offset or routed as required to clear such interferences. Consult all bid documents and coordinate with other Contractors before installing work.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The temperature control contractor shall have 10 years experience in the installation of the same size and type of control system as proposed.

B. The temperature control system shall be bid and installed by Siemens factory branch.

2.2 DAMPERS

A. Dampers intended for automatic control, unless part of a factory made unit, shall be furnished by the temperature control contractor. Automatic dampers installed in unitary equipment furnished by the manufacturer shall be checked for proper size and design by the Temperature Control Contractor. Should any features of these dampers appear to be unsatisfactory, full details shall be given to the Engineer, in writing, and suggestions made for necessary corrections.

B. Return Air Dampers
1. Return air dampers, unless otherwise specified, shall be "low leakage" dampers, and shall be designed for tight shut-off such that for a 1500 FPM damper, leakage does not exceed 1.7 CFM at 1 inch W.G. differential static pressure.
2. Damper frame shall be 4” deep constructed of extruded aluminum (6063T5) not less than .080 (2.03mm) inches thick.
3. Damper Blades shall be constructed of extruded aluminum (6063T5) and airfoil design. Aluminum end caps shall be press fitted to the blade ends.
4. Silent closing replaceable silicone seals shall be provided on each blade and on all four sides of the frame. Louver linkage to be concealed in frame channel outside of the air stream. Bearings shall be constructed of a celcon inner bearing fixed to a 7/16” aluminum hexagon type blade pin rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal to metal contact or metal to plastic contact.
5. Blade and frame seals shall be secured in an integral slot within the aluminum extrusions.
6. Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
7. Modulating dampers shall be opposed blade type.
8. Whenever practicable, damper size shall be based on 1000 to 1500 FPM air velocity.
9. Dampers shall be designed to operate in temperature ranges from –40 degrees F and 212 degrees F.
10. Acceptable manufacturers: Tamco Model 1500 or approved equal

C. Outside Air and Relief Air Dampers
1. Automatic dampers used for outside air and relief air applications shall have similar type of construction as described above for return air dampers, but shall include extruded aluminum blade shell internally insulated with expanded polyurethane foam and thermally broken.
2. Damper frame shall be extruded aluminum, minimum 4” deep and insulated with Styrofoam on all four sides of the damper.

3. Blade and frame seals shall be extruded silicone and secured in an integral slot within the aluminum extrusions.
4. Dampers shall not exceed 4 cfm per sq. ft. against 4" w.g. and shall be AMCA Rated.
5. Standard control dampers are not acceptable in outside air and relief air applications to avoid possible freeze conditions.
6. Acceptable manufacturers: Tamco Model 9000 SC or approved equal.

2.3 VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Globe Valves NPS 2" and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Valves shall have allowable media temperature of 20°F to 281°F to assure that the valve packing will have a long life (valves will narrower allowable media temperatures have no reserve packing capability for long term watertight seal).

C. Globe Valves NPS 2-1/2" and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

D. Hydronic system globe valves shall have the following characteristics:
1. Rating: Class 125 for service at 125 psig and 250°F operating conditions.
2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
3. Sizing: 3 psig. maximum pressure drop at design flow rate.
4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

E. Butterfly Valves: 200 psig. maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Wafer, Lug, or Grooved.
2. Disc Type: Nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron, Epoxy-coated ductile iron.
3. Sizing: 1 psig maximum pressure drop at design flow rate.

F. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250ºF operating conditions.
2. Sizing: 3 psig maximum pressure drop at design flow rate, to close against pump shutoff head.

G. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

H. Sizing of Valves: Valves shall be furnished to the HVAC Contractor who will mount them as piping is installed. Valve sizes shall be as recommended by the temperature control manufacturer who shall be responsible for their proper sizing, regardless of indicated valve or line size on Drawings. Water valves shall not exceed 5 psi pressure drop, unless otherwise stipulated.

2.4 VALVE AND DAMPER OPERATORS

A. Electronic Damper and Valve Actuators: Electronic Direct-coupled type designed for minimum 100,000 full-stroke cycles at rated torque. Actuator manufacturer shall provide a minimum two-year unconditional warranty from date of substantial completion.
   1. Acceptable manufacturers for actuators are as follows:
      a. Belimo
      b. Siemens
   2. Valves: Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
      a. Valve actuators shall be spring return for normally open or normally closed operation, as called out in the sequence of operation. Control valves on air handling unit heating coils shall be spring return to open position.
   3. Dampers: Size for running torque calculated as follows:
      a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
      b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
      c. Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ftdamper.
      d. Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
      e. For dampers with 2 to 3 Inches wg. of pressure drop, or face velocities of 1000 to 2500 FPM, multiply minimum full-stroke cycles above by 1.5.
      f. For dampers with 3 to 4 Inches wg. of pressure drop, or face velocities of 2500 to 3000 FPM, multiply minimum full-stroke cycles above by 2.0.
      g. Damper operators on outside air intakes and exhausts shall be spring return closed.
   4. Coupling: V-bolt and V-shaped, toothed cradle.
   5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
   6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
   7. Power Requirements (Two-Position Spring Return): 24V ac.
   8. Power Requirements (Modulating): Maximum 15 VA at 24-V ac.
   9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
   10. Temperature Rating: -22°F to 122ºF.
   11. Run Time: 200 seconds open, 40 seconds closed.
   12. Pulse width modulation will <u>not</u> be allowed on valve actuators.

2.5 RELAYS

A. Electric
   1. Where required, provide relays for energizing or re-energizing the various branch circuits, in response to master control panels. Relays shall be UL labeled and sized for not less than 140 percent of the connected amperage load. Relays shall be rated for the system voltage and have proper throw and poles.

2.6 SENSING DEVICES

A. Electronic Temperature Sensors
   1. Provide temperature sensors and other temperature indicating sensors of commercial grade quality located at the point of measurement and installed according to the manufacturer's recommendations.
   2. Thermistor temperature sensors shall be 10,000 ohm at 77 F with Precon type-3 material. Accuracy shall be +/-0.36 F between the range of 32.0 - 158.0 F.
   3. Provide temperature sensors such that the BAS shall be able to convert the resistive input signal available from the element into a digital signal for use by the BAS.
   4. Provide outside air temperature sensors with a watertight fitting and adequate protection from the effects of solar radiation.

5. Provide water temperature sensors of the bulb type, mounted within brass or stainless steel wells filled with a heat conductive compound and in direct contact with the water within the pipe.
6. All field mounted sensors shall be labeled as to their function and name used in the control program.

B. Electronic Room Temperature Sensors
1. Temperature sensors shall be Precon type-3 or equal thermistors utilizing a 10K ohm thermistor. Sensors shall be manufactured in a durable epoxy housing and shall be enclosed for protection from elements when installed in the sensors operating environment. The sensor cover shall be provided with tamperproof screws.
2. Equal to QAA2200 series.
3. The range of set point adjustment shall be initially programmed for +/- 2 °F.
4. Temperature sensor shall be “sensing only” with no LCD display.

C. Metal-Plate Temperature Sensor
1. To be utilized as the room temperature sensor in gymnasiums.
2. Equal to Siemens 540-984 metal flush-mount room temperature sensor.
3. The sensor shall be self-contained, non-intrusive, and tamper-resistant.
4. Sensor shall utilize a 10K ohm Type 2 thermistor.

D. Electronic Duct Temperature Sensors
1. All duct sensors shall be installed within metal enclosures that are suitable for the
2. application.
3. AHU Duct Sensors
   a. All duct sensors shall be true averaging type sensors with capillary lengths not less than 20 feet long. The only exceptions will be return air and outdoor air sensors. TCC to ensure proper air dispersion over installed capillary length for accurate reading.
4. VVR/VVF/FCU Duct Sensors
   a. At minimum, all duct sensors shall have capillary lengths extending the width of the duct. The TCC shall be responsible for ensuring adequate temperature readings with the given airflow stream. TCC shall install either rigid probe or flexible probe duct temperature sensors, whichever is deemed more suitable for application..

E. Sensor Guards
1. Provide guard of clear colored, mounted with back frame to wall and tamperproof screws where denoted on drawings with a sub "G".
2. Guards shall be Honeywell TG511A1000. Verify size of temperature sensor and cover prior to order.

F. Boiler Emergency Push Buttons
1. Indoor emergency push button
   a. NEMA Rating: 1
   b. Display: Highly visible yellow/black background with label “BOILER SHUT DOWN.”
   c. Integral breakglass with metal break-tool.
   d. Button: Red push button
   e. Mount: Surface mount
   f. Operating Temperature: -13° to 158°F (-25° to 70°C)
   g. Mechanical Life: Contact 10 million operations
   h. Contact Type: Self-cleaning silver contacts
   i. Contact Resistance: <25 milli-Ohms, Closed
   j. Equivalent to Kele ESB Series
2. Outdoor emergency push button
   a. NEMA Rating: 3R
   b. Display: Highly visible yellow/black background with label “BOILER SHUT DOWN.”

c. Integral breakglass with metal break-tool.
d. Button: Red push button
e. Mount: Surface mount
f. Operating Temperature: -13° to 158°F (-25° to 70°C)
g. Mechanical Life: Contact 10 million operations
h. Contact Type: Self-cleaning silver contacts
i. Contact Resistance: <25 milli-Ohms, Closed
j. Equivalent to Kele ESB Series

G. Safety Low Limit Thermostats
1. Safety low limit thermostats with flexible sensing elements shall serpentine full length of duct or coil. Instrument to be sensitive to lowest temperature at any 12 inch increment on its 20 foot length. Thermostat shall have a range of 34 degrees F. to 60 degrees F. with a fixed 5 degrees F. differential.
a. Safety low limit thermostats shall be capable of being reset through software at the building energy management computer.

H. Electronic Pressure Sensors
1. Provide pressure sensors and other pressure indicating sensors of commercial grade quality located at the point of measurement and installed according to the manufacturer's recommendations.
2. Provide pressure sensors of the direct acting or reverse acting, unidirectional or bi-directional type such that the BAS shall be able to convert the 0 to 5 volts DC input signal available from the sensor into a digital signal for use by the BAS.
3. Provide pressure sensors utilizing the smallest possible operating range which will sufficiently cover the range required for normal operating conditions.
4. Provide pressure sensors of the ultra precision type with a tolerance at 70 degrees F of no greater than plus/minus .8 percent of full scale and an end-to-end (full scale) accuracy of plus/minus 2 percent of full scale.
5. All field mounted sensors shall be labeled as to their function and name used in the Building Automation System software program.

I. Humidity Sensors
1. Shall be a "Current Type" humidity transducer. Sensor shall produce a linear 4-20mA current representing the span of the sensor. This signal shall be produced by the sensor itself through a current convertor supplied with the sensor.
2. Outdoor air humidity sensor shall be enclosed in a weathertight enclosure and shall be located in a place to provide best representation of outdoor air relative humidity. Sensor span shall be 10 to 90 percent relative humidity and shall be accurate within $\pm$ 2 percent of span.
3. Space humidity sensor shall be enclosed in a durable enclosure for mounting in interior zones. Sensor shall have a range of 0 to 100 percent relative humidity and shall be accurate with $\pm$ 2 percent of span.
4. Duct humidity sensor shall be a probe type with all wiring enclosed in an electrical box. Sensor shall have a range of 0 to 100 percent with an accuracy of $\pm$ 3 percent of span.
5. Provide one exterior humidity sensor.

J. Current Sensing Status Switch
1. Shall be capable of detecting changes in flow of current to motors in determining accurate and reliable equipment status.
2. Ampere rating for 0 - 135 amps continuous.
3. Sensor supply voltage shall be included from monitor conductor.
4. Minimum current required is 1 amp.
5. Trip setpoint shall be adjustable to +/- 1 percent of range.
6. Shall be equal to Model No. 705 (Hawkeye) by Veris Industries, Inc.

K. Air Flow Measuring Station

1. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet sensors shall not be substituted for duct or plenum sensor probes indicated on the plans.
   a. Duct and plenum mounted sensors shall be fabricated of anodized aluminum alloy tube with 303/304 stainless steel mounting brackets.
   b. Fan inlet probes shall be field adjustable to fit the fan inlet and have 303/304 stainless steel mounting feet.
2. Each measuring device shall consist of one or more multi-point measuring probes and a single microprocessor-based transmitter. Each transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to be displayed as a velocity or volumetric rate.
3. Each transmitter shall operate on 24 VAC.
4. Each sensing point shall independently determine the airflow rate and temperature, which shall be equally weighted and averaged by the transmitter prior to output. Devices, which average multiple non-linear sensing point signals, are not acceptable. Pitot tube arrays are not acceptable.
5. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location. Probes and transmitters shall not require field matching for proper operation.
6. The operating airflow range shall be 50-5,000 FPM unless otherwise indicated on the plans.
7. The operating temperature range for the measuring probes shall be -20° F to 140° F. The operating humidity range for the measuring probe shall be 0-99% RH (non-condensing).
8. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
9. Each independent airflow sensor shall have a laboratory accuracy of +/-2% of reading over the entire operating airflow range and be wind tunnel calibrated.
10. Each independent temperature sensor shall have a laboratory accuracy of +/-15° F over the entire operating temperature range and be calibrated.
11. The number of sensors for each location shall be as follows:
    a. Ducts and plenums:

Area (sq.ft.)	Sensors
<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=16	16

    b. Fan inlets: 2 per inlet
12. The airflow/temperature measuring device shall be capable of displaying the airflow and temperature readings of each sensor on the transmitter's LCD display.
13. The transmitter shall be capable of communicating with the host controls using the following interface options:
    a. Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire)
    b. RS-485: Field selectable ModBus-RTU and Johnson Controls N2 Bus
    c. 10 Base-T Ethernet: Field selectable ModBus TCP and TCP/IP
    d. LonWorks Free Topology
14. Airflow/Temperature measuring devices shall be UL listed as an entire assembly.
15. The manufacturer's authorized representative shall review and approve the placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.
16. Manufacturer: Ebtron, Gold Series or approved equal

L. Remote Differential Pressure Transmitter (DPT)

1. Differential Pressure Transmitters shall be provided by the Temperature Control Contractor to be completely self-contained, variable capacitance type gauge pressure transmitters. Wiring terminals and electronics shall be in separate compartments, so the electronics remain sealed during installation. Reverse polarity protection shall be included to keep wiring mishaps from damaging the transmitter. The 4-20mA DC signal shall be transmitted over a pair of No. 22 gauge or larger wire directly to the control enclosure.
2. Design range shall be as required by system. External zero and span adjustments, over pressure to 2,000 PSI and no humidity effects.
3. Minimum accuracy shall be +/-0.25 percent of calibrated span. Includes combined effects of linearity, hysteresis and repeatability. Stability shall be +/-0.25 percent of upper range limit for 6 months. No internal mechanical linkages shall be used in the transmitter.

M. Flow Transducers (FT)

1. Flow meters with transducers shall be installed where indicated on the Drawings and wired by the Temperature Control Contractor.
2. The flow transducers shall utilize a nonmagnetic sensing mechanism with a forward-swept rotating impeller to produce a frequency signal proportional to flow. The flow transducers shall have an achievable accuracy of +/-1 percent of flow rate with flow velocities of 1 to 30 fps.
3. The flow meter shall be constructed of brass with a glass reinforced impeller, tungsten carbide shaft and glass reinforced polyphenylene sulfide housing. The unit shall be both insertable and removable through a gate type valve when the pipe is under pressure.
4. Provide minimum of 10 straight pipe diameters upstream and 5 diameters downstream for each field installed flow transducer.
5. Provide an insertion/extraction tool to allow removal and replacement of flow transducer while the system is under pressure.

2.7 VARIABLE FREQUENCY DRIVES

A. Refer to Project Manual Section 232923 – Variable Frequency Motor Controllers.

B. Provide direct communication between the DDC/BAS system and the variable frequency drives (VFD). VFD fan/pump control data as well as drive power data (minimum voltage, current, and frequency) shall be available for data collection and trending at the DDC/BAS operator's workstation.

2.8 CONTROL CABINETS/ENCLOSURES

A. Control cabinet/enclosure shall be extruded aluminum, galvanized steel or factory-hardened plastic with key locks and hinged doors. Electric panels shall be of code steel construction with UL label.

1. The control cabinet/enclosure shall be required to house devices not enclosed as a part of the DDC building automation system panels. Pre-wire with internal wiring terminated at labeled terminal strips. Thermometers and switches shall be mounted on the cover of the panel. Relays, transformers, and components shall be mounted inside the panel. Devices, whether interior or exterior, shall be provided with legend plates of engraved formica or equal. Cabinets shall be located as approved by the Architect/Engineer or as indicated on the Drawings.
2. Where two or more control items or accessories (thermostats, thermometer, relay, etc.) are to be mounted at a single location, such equipment shall be mounted in a suitable cabinet. Cabinets shall be located as approved by the Architect/Engineer or indicated on the Drawings.

3. Local type panels need not contain graphic representations or symbols, unless specified below, but must contain approved nameplates, legends, etc., for each device.
4. Where panels contain any wiring, panels shall be UL approved cubicles.
5. Control panels shall be provided with 120V power as specified and provided by Div 26.
6. Temperature control panels shall be provided with ethernet connection to the buildings IT network. Ethernet wiring to be provided and routed by Div 26 as specified. TC responsible for integrating new BMS points into Siemens BAS server.

2.9 BUILDING AUTOMATION SYSTEM

A. Furnish a complete Direct Digital Control system.
1. The entire system shall be totally DDC with electric/electronic actuation. No pneumatics shall be utilized.

B. The following HVAC equipment shall be controlled by the Building Automation System <u>including sequences:</u>
1. Air handling units
2. Heating water system
3. Chilled water system
4. All VAV terminal units.
5. Cabinet unit heaters
6. Exhaust Fans and ventilation fans
7. Cabinet heaters, propeller unit heaters
8. Exterior lighting circuits

C. Personal Computer Operator Workstation Description
1. No personal hardware shall be provided as part of this project. Existing computer/tablet shall be utilized to access BMS.
2. Existing IT hardware be used for command entry, information management, network alarm management, and data base management functions. All real-time control functions shall be resident in the standalone DDC panels to facilitate greater fault tolerance and reliability.
   a. Existing IT hardware shall be connected to the internet remotely using the owners existing Wi-Fi/Wide Area Network. The contractor shall coordinate the connection with the owner's IT personnel. The contractor shall provide all necessary programming, computer software programs, connections, and the like to allow a complete installation.
   b. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format. Provide to the Engineer at the time of the final punch of the building a copy of all necessary software and an account and password to allow remote viewing of the Building Management System.
   c. Existing IT hardware shall be linked to the central Building Management System located in the school system's maintenance building via the Wide Area Network. Provide all software and programming required to add this terminal to the central system.

d. Existing IT hardware shall have field device technician tool interface software, allowing a direct connection to installed field devices. It shall give the Owner the capability for field device service and programming, along with the capability to access the front-end computer workstation graphical user interface software (GUI) using Internet Explorer™ or Netscape Navigator™.

D. Hardware - Communications

1. The Global Control Module, (GCM), shall provide a minimum of two communication ports, one RS-232C for local direct connect communications and one for remote dial up communications. All communication ports shall be bidirectional data communicators.
2. Storage of software programs and communication logic shall be maintained without battery-backed assistance.

E. Host Software

1. Shall be fully accessible and functional through Internet Explorer, Google Chrome, or related/similar applications.
2. Host software shall take advantage of daily energy management report generation capability of the GCM and all remote DDC controllers. The host computer shall automatically poll direct or remotely connected sites, gather the data, archive it and generate daily, weekly, monthly and yearly summaries as needed. Multiple meter applications shall be supported at the host allowing totalization of meter consumption.
3. The host software shall permit acquisition and long term storage of up to 200 independent trend logs. Trends shall be operated by the host directly or automatically uploaded from the GCM or remote DDC controllers at user specified intervals. Trend data shall be graphically represented using a dynamic process graphics report generator in a bar chart or line format.
4. Host software will contain alarm and exception processing systems. Events including point alarm, point faults, device diagnostics, maintenance time reminders, actual control programs and log on/off shall be recorded in the system status log. The System Status log shall define automatically generated exception reports based on user selectable criteria such as point type, operator, time and date of occurrence, etc. The program shall prioritize alarms for display with the most critical alarm first. An operator shall also be able to user define individual alarms to interrupt a user and display the system status log.
5. Provide icon selection of users programs such as database programming and monitoring. Provide menus with highlighted active commands, context commands descriptions and help files. A standard mouse interface shall interface and normal keyboard operation shall access all programs. Provide continuous display of system status, and text monitoring screens with highlighted alarm conditions and automatic report generation.
6. Any action taken by an operator shall be logged to the systems status log to render an audit trail of operator actions. User access definitions shall be completely definable and modifiable by the system's manager.
7. Dynamic Graphics shall be installed on the personal computer workstation. The graphics system shall allow the operator to see current system status pictorally. Abnormal conditions shall be highlighted with color. Provide pre-defined instrument and symbol library and graphics monitoring screen editing capability. Provide points editor function to allow up to 128 dynamic points per frame and dynamic user defined screen placement. Each graphic screen may be linked to up to 128 other user defined monitor graphic screens.
   a. The following graphics shall be minimum required for the system:
      1) Chiller plant including pumps
      2) Boiler plant including pumps
      3) Floor plan showing all space temperatures and operation of heating/cooling equipment.

4) Detailed layout of each air handling unit as a separate graphic
5) Graphic screen for each VVR/VVF terminal
6) Floor plan graphic to include system occupancy zones and exhaust fan status signals

2.10 BUILDING AUTOMATION EQUIPMENT

A. Global Control Module (GCM)
1. The Global Control Module shall be a modular multi-user, multi-tasking 16 bit microprocessor based direct digital controller. The GCM shall contain access protected user friendly English language, full alphanumeric 4 line 20 character displays, keypad, and dual RS-232 communications interface. Two RS-485 communication trunks shall be provided. The GCM software functions shall include prompted English language man-machine interface, direct digital control, energy management control facilities management system, floating point math and related logic functions. The GCM software shall include standard HVAC system applications such as single zone air handlers, water chiller systems, boiler systems and circulating pumps.
2. Software Functions
a. Built-in GCM software shall include a functional library of operations and applications which shall include, but not be limited to the following:
1) DDC Control functions including setpoint reset, ramp, fluctuating on/off, PI Loop control, linear and rotating sequences, high/low select, energy dead band.
2) Energy management control functions including optimal start/stop, electric demand limiting, weekly scheduling, calendar scheduling, and enthalpy control.
3) Facilities Management Functions including analog high/low alarm, digital alarms, trend log reports, weekly EMS reports, maintenance time reminders, BTUH trends.
3. A minimum 56 Kbaud Hayes Smartmodem or equivalent shall be provided for external monitoring using a serial connection.

B. Local Control Module (LCM)
1. The Local Control Module shall be a modular, multi-tasking, 16-bit microprocessor. The LCM shall contain accessible protected English language, alphanumeric, 40 character LCD display with keypad. The LCM shall include 16 universal points input/output point connections and 2 separate pulse counting points for KW monitoring.
2. The LCM shall contain a minimum of 512 kilobytes of EPROM, EEPROM, and RAM memory and shall have remote monitoring capabilities via modem to the central computer including the following:
a. Direct digital control functions
1) Setpoint reset
2) Fluctuating on/off
3) PI loop
4) Linear sequence
5) Rotating sequence
6) Thermostat
7) Binary sequencer
b. Energy Management Control Functions
1) Optimum start/stop
2) Electric demand limiting
3) Weekly scheduling
4) Calendar scheduling
c. Facilities Management Functions
1) Analog high/low alarm
2) Digital alarm

3) Trend log report
4) Weekly EMS report
5) Monthly EMS report
6) Maintenance time reminders
7) BTUH trend

C. AHU and Packaged Equipment Unitary Controllers

1. Each unitary DDC controller shall be a dedicated, stand-alone, microprocessor-based unitary DDC controller with sufficient capacity to handle all points associated with the control sequences as specified and as listed on the accompanying point charts. In addition, each controller shall have a minimum 15 percent spare point capacity. Unitary controllers shall be capable of being mounted within the equipment housing and shall have the capability to be programmed on-line and/or off-line as required to meet unique HVAC application needs as well as the various ASHRAE control cycles. Unitary controllers shall be capable of communicating global and critical variables to other unitary controllers residing on the same network without the intervention of a higher level controller.
2. Unitary controllers shall be a microprocessor-based, fully programmable DDC controllers with all operating parameters, setpoints and schedules stored in battery backed RAM, EEPROM or other nonvolatile memory.
3. Functions incorporated into the PUC shall include the following:
   a. MATH: Floating point arithmetic, trigonometric functions, mixed-mode math filtering and square root.
   b. DDC: High/low/average signal selectors, analog/digital selector, timer functions, pulse counting, start/stop, scheduling, floating point control, remote setpoint adjustment, thermostatic control.
   c. LOOP: PI control, soft start ramping.
   d. LOGIC: =, <>, <, <=, >, >=, and, or, xor.
4. An RJ-11 type connection serial post shall allow a local portable operator terminal to access all program blocks and attributes for complete programmability. The port shall also support complete up/downloading capability.
5. All input/output and control parameters may be utilized or shared throughout the network. All unitary controllers shall be accessible throughout the network.

D. VAV Terminal Controllers (VTC)

1. Control of the VAV boxes shall be accomplished by a microprocessor based stand-alone DDC controller (provided by TC) utilizing direct digital control working from software memory which is physically located in the VTC. An individual DDC controller shall be provided for each VAV reheat and fan-powered VAV terminal unit.
2. Each VTC shall contain a non-volatile resident program that modulates the box damper, controls the box fan and sequences the reheat water valve as indicated in the sequence of operation.
3. From the operator station it shall be possible per VTC to:
   a. reset room setpoint
   b. read/log/trend room temperature
   c. override day or night operation
   d. change maximum heating and cooling CFM flow rate
   e. change minimum heating and cooling CFM flow rate
   f. read CFM flow rate at each box
   g. read the discharge air temperature at each box
   h. assign daily occupied/unoccupied times
   i. read box type i.e. fan powered, etc.
4. Should communications to the VTC fail in any manner the VTC will have its configuration in non volatile memory and shall maintain room setpoint
5. The VTC shall be UL 916 listed.

6. The VTC control software shall be capable of being accessed from the room sensor as specified. Systems requiring any setpoint adjustment at the terminal unit will not be acceptable
7. All VTCs (TC provided) shall be factory-mounted in the VAV terminal control panel at the cost of the VAV terminal unit manufacturer. The enclosure assembly shall be mounted and positioned to be easily accessible to operating personnel.
8. The VTC shall consist of microprocessor, integral airflow transducer, power supply enclosure, field adjustments and operating/application software in a single integrated package.

2.11 GRAPHICAL USER INTERFACE SOFTWARE (GUI)

A. Operator tablet must be capable of supporting any LonMark compliant product. The operator shall not be able to distinguish the DDC points from different manufacturers when commanding, monitoring points or acknowledging alarms.

B. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows 2000 or NT 32-bit operating system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line FMCS alarms and monitoring information. If the software is unable to display several different types of displays at the same time, the FMCS contractor shall provide at least two operator workstations at each location specified.

C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
2. A gallery of HVAC and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.
3. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
4. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
5. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
   a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
   b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
6. Commands to start and stop binary objects shall be done by mouse command from the pop-up menu. No entry of text shall be required.
7. Adjustments to analog objects, such as set points, shall be done by mouse command using a graphical slider to adjust the value. No entry of text shall be required.

D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.

5. Generate hard copy records or control strategies on a printer.
6. Select points to be alarmable and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

H. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

1. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.
    a. Hardware - Communications
        i. The Global Control Module, (GCM), shall provide a minimum of two communication ports, one RS-232C for local direct connect communications and one for remote dial up communications. All communication ports shall be bidirectional data communicators.
        ii. Storage of software programs and communication logic shall be maintained without battery backed assistance.
    b. Host Software
        i. Host software shall take advantage of daily energy management report generation capability of the GCM and all remote DDC controllers. The host computer shall automatically poll direct or remotely connected sites, gather the data, archive it and generate daily, weekly, monthly and yearly summaries as needed. Multiple meter applications shall be supported at the host allowing totalization of meter consumption.
        ii. The host software shall permit acquisition and long term storage of up to 200 independent trend logs. Trends shall be operated by the host directly or automatically uploaded from the GCM or remote DDC controllers at user specified intervals. Trend data shall be graphically represented using a dynamic process graphics report generator in a bar chart or line format.

iii. Host software will contain alarm and exception processing systems. Events including point alarm, point faults, device diagnostics, maintenance time reminders, actual control programs and log on/off shall be recorded in the system status log. The System Status log shall define automatically generated exception reports based on user selectable criteria such as point type, operator, time and date of occurrence, etc. The program shall prioritize alarms for display with the most critical alarm first. An operator shall also be able to user define individual alarms to interrupt a user and display the system status log.

iv. Provide icon selection of users programs such as database programming and monitoring. Provide menus with highlighted active commands, context commands descriptions and help files. A standard mouse interface shall interface and normal keyboard operation shall access all programs. Provide continuous display of system status, and text monitoring screens with highlighted alarm conditions and automatic report generation.

v. Any action taken by an operator shall be logged to the systems status log to render an audit trail of operator actions. User access definitions shall be completely definable and modifiable by the system's manager.

2.12 GRAPHICS

A. Color graphic floor plan displays, and system schematics for each piece of mechanical equipment (including air handling units, VVR/VVF terminals, cabinet heaters, exhaust fans, chiller and chilled water systems, boilers and hot water systems, and so forth) shall be provided, as specified in the point list portion of this Specification, in order to optimize system performance analysis, speed alarm recognition, and simplify user interaction. The BAS Contractor shall fully configure the color graphics and plot all associated control/monitoring points on the screen. Preliminary copies of all color graphics screens shall be provided as color printouts to the Owner and Engineer for approval.

B. System Selection/Penetration

1. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, or test-based commands. Floor plans shall display room numbers and each zone shall be color-coded. The operator shall be able to point and click on a room or zone of rooms (in the case of an air handler that serves more than one zone). The room or zone will display an animated flow diagram of the mechanical equipment that serves that zone, with all control and monitoring points associated with that piece of equipment, including setpoints. Setpoints shall be overridden or modified from this screen.

C. Dynamic Animated Data Displays

1. Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention. Damper and valve positions, air and water flow shall be animated and shall represent actual, current conditions.

D. System Performance Analysis Screens

1. System performance analysis screens shall be provided for the major mechanical systems (such as air handlers, chillers, boilers, and so forth). For each of these systems, the screen shall be split into quadrants, simultaneously displaying the following data:
   a. Quadrant 1 – Dynamic animated flow diagrams.

b. Quadrant 2 – All analog values associated with the mechanical system shall be graphed on an X-Y axis graph. Five minute samples for the last 24 hour period shall be plotted. Scaling shall be automatic.
c. Quadrant 3 – Text sequence of operations from engineering as-built submittals.
d. Quadrant 4 – Space temperature summaries from each zone being served by mechanical system.

E. Windowing
1. The windowing environment of the PC Operator Workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

F. Alarm Annunciation
1. Any point in a state of alarm shall change the color of its symbol to red until it is no longer in alarm.

2.13 TEMPERATURE CONTROL WIRING

A. Wiring in air plenums shall be open wired UL listed plenum cable or shall be installed in conduit.

B. Conduit shall be 1/2-inch minimum size and shall be furnished and installed by the temperature control contractor. Run all control wiring exposed in mechanical rooms and similar spaces in conduit, in a neat, workmanlike manner. Conduit construction and sizing shall be in accordance with Project Manual Section 260533, Raceway and Boxes for Electrical Systems.

C. Concealed wiring and wiring in non-plenum ceiling cavities, which is operating under 100 volts, may be open wired if in compliance with Article 725, NFPA-70 (NEC). Open wiring shall be secured with plastic tie wraps to the permanent building structure as approved by the Architect/Engineer.

D. Terminations shall be performed by the Temperature Control Contractor.

E. Wire and conduit not indicated on the Drawings or in the Specifications, but required by the controls supplier, shall be paid for by the Temperature Control Contractor at no additional cost to the Owner.

F. Coordinate specific equipment graphics, control points and alarm reporting with the Owners' representative.

G. Temperature Control Contractor shall refer to all Divisions 23 and 26 Project Manual sections for unique requirements for each piece of equipment.

2.14 TEMPERATURE CONTROL CABLING

A. Cabling in air plenums shall be open wired UL listed plenum cable or shall be installed in conduit.

B. Conduit shall be 1/2-inch minimum size and shall be furnished and installed by the temperature control contractor. Run all control wiring exposed in mechanical rooms and similar spaces in conduit, in a neat, workmanlike manner. Provide bushings on any open end of conduit. Conduit construction and sizing shall be in accordance with Project Manual Section 260533, Raceway and Boxes for Electrical Systems.

C. Concealed wiring and wiring in non-plenum ceiling cavities, which is operating under 100 volts, may be open wired if in compliance with Article 725, NFPA-70 (NEC). Open wiring shall be supported as denoted below.

D. Terminations shall be performed by the Temperature Control Contractor.

E. Wire and conduit not indicated on the Drawings or in the Specifications, but required by the controls supplier, shall be paid for by the Temperature Control Contractor at no additional cost to the Owner.

F. Cable Supports
1. Provide cable supports that meet UL, NEC and TIA/EIA requirements for structured cabling systems.
2. The cable support system shall provide support for various types of low voltage cables, fiber optic cables, innerduct, and temperature control cabling.
3. The support system shall attach to the building structural elements or be wall mounted.
4. The supports shall be made of fire retardant and low smoke emission products, which meet UL 2034 requirements for air plenum spaces.
5. The support products shall have a minimum of a 1 inch wide platform for the cable to rest. Bridle rings or bridle rings with 1" inserts are not acceptable.
6. Individual supports shall be installed at intervals not greater than 60 inches.
7. Cable supports shall be installed a minimum of 6 inches above lay-in ceiling system. Cable sags shall not allow the cable to touch ceiling grid or tiles.
8. Minimum clearances from sources of EMI and RFI must be as specified in TIA/EIA-568C, TIA/EIA-569 and the latest version of the BICSI TDMM.
9. Approved Manufacturers:
   a. Caddy by Erico
   b. Siemon
   c. CPI
   d. Panduit
   e. Garvin Industries
   f. B-line

G. Cable Ties
1. Provide plenum rated cable ties for cables in/or above ceiling.
2. Cable ties shall be of appropriate length to loosely bundle and secure the low-voltage cables. Cable ties are not to be pulled so tight that they damage or distort the cables in the bundles. Trim cable tie loose ends.
3. Cable ties shall meet UL 94V-O.
4. Approved Manufacturers:
   a. Panduit
   b. Hubbell
   c. Leviton

H. Cable Hook and Loop Fasteners
1. Provide cable hook and loop fasteners to secure cable bundle at equipment cabinets, panels, and controllers.
2. Hook and loop fasteners may be used above ceiling if they are plenum rated.
3. UL listed.
4. Approved Manufacturers:
   a. Panduit
   b. Hubbell
   c. Leviton

I. Innerduct (Indoor)
1. Provide 1.0 inch I.D. plenum rated corrugated innerduct above ceiling for all non-armored fiber optic cable.

2. Innerduct shall be UL listed and plenum rated.
3. Approved Manufacturers:
    a. Endot-Endocor
    b. Carlon
    c. Pyramid Industries
    d. Eastern

J. Innerduct (Outdoor)
1. Provide 1.0 inch I.D. non-plenum polyethylene-type, ribbed inside tube, innerduct in the conduit as shown on the Drawings.
2. Innerduct shall be UL listed.
3. Provide a nylon pull string in all empty innerduct runs.
4. Approved Manufacturers:
    a. Enduct Ribbed (for outside applications)
    b. Carlon
    c. Pyramid Industries
    d. Eastern

K. Temperature Control Contractor shall refer to all Divisions 23 and 26 Project Manual sections for unique requirements for each piece of equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. DDC Global Control Panel for network control and building interface shall be located in the a room in the building to be chosen by the owner.

B. Control of the air handling units, VAV terminals, ceiling radiant panels, exhaust fans, chilled water system and heating water system shall be accomplished through DDC control. Controlled equipment shall be monitored, trend, alarmed, and controlled through the online-based BMS. The tablet specified shall interface with the BMS through applications.

C. Coordinate the installation of the refrigerant monitor with the specification section 283500, Refrigerant Detection and Alarm, Contractor for final power connections. The refrigerant monitors shall be installed per the manufacturers' recommendations. Coordinate with the Owner's representative for training on each of these devices. All wiring from these devices to the BMS System and wiring between the units and emergency ventilation systems shall be provided by the Temperature Control Contractor. Label each device per Specification Section 230553, Mechanical Identification.

D. The Temperature Control Contractor shall provide direct communication between the DDC/BAS System and the variable frequency drives. The data from the variable frequency drives on fans and pumps including drive power data such as minimum voltage, current and frequency shall be available for data collection and trending at the DDC/BAS System workstation.

E. Mount all wall mounted sensing devices at +4'-8" A.F.F. to the bottom of the device unless noted otherwise on the drawings.

F. Temperature Control Cabling
1. Cabling shall be supported by products that meet BICSI, EIA, TIA requirements or installed in cable tray.
2. Where denoted on the drawings, sleeves and cable trays shown on the Technology drawings may be used by the Temperature Control Contractor as detailed; however their use is strictly voluntary. Deviation from these pathways is acceptable but any additional sleeves, coring, supports etc are the responsibility of this contractor. Deviations must be clearly noted on the Record Drawings.

3. Materials installed under this Specification shall be attached to the building structure, independent of other pipe, duct, equipment, ceiling grid, or other installations. Cable supports are not to be attached to ceiling grid wires or fire sprinkler piping supports. Cables are not to rest on or be supported by masonry or other building structural members.
4. Cables in exposed ceiling areas such as auditorium, gymnasium, art rooms, classrooms, locker rooms, corridors, etc. shall be installed in conduit from the device to the nearest accessible lay-in ceiling or the nearest telecommunication room. The Temperature Control Contractor is responsible for coordinating these conduit installations to minimize cable distances.
5. Cables installed in rooms with architectural "clouds" may be installed without conduit but the cabling must be routed so that it cannot be seen from the floor.

3.2 SEQUENCE OF OPERATION

A. Refer to Specification Section 230993 for all equipment sequences of operation.

3.3 OCCUPIED/UNOCCUPIED ZONES

A. Zone control shall be based upon air handling unit service area. Zone control shall include all air handling units, variable air volume reheat terminals, fan powered terminals, radiant ceiling panels, and exhaust fans. All zones to include capabilities through the Building Automation System for override setting to full occupied cycle during unoccupied cycle.

B. Manual Overrides
1. Provide manual, push button overrides as a part of each room temperature sensor. Pressing of override button will place zone on which sensor is located into a programmed override that is adjustable through the software.
2. All zones shall include computer controlled overrides.

3.4 GUARANTEE

A. It is intended that the Temperature Control Contractor include as part of his bid one (1) year full service warranty. All labor and material shall be guaranteed against defects in workmanship for the one (1) year period from the date of Substantial Completion and acceptance by the Owner. Any material proving defective shall be repaired or replaced during that period. This shall not, however, apply to material that has been damaged due to willful negligence.

B. The Contractor will provide hardware and software support during the first year guarantee after the date of acceptance. Hardware support includes replacing of any major or minor components, relays, sensors, etc., that fail to operate properly. Software support includes upgrading of software during warranty period such that system is loaded with latest available revision at end of warranty period.

C. Support is also defined to include Owner personnel training needed to operate the system effectively as outlined in this Specification. Explicitly included is the training needed to analyze a building's operation with a view to minimizing energy costs.

3.5 TRAINING OF SCHOOL OPERATOR

A. The Temperature Control Contractor shall, during the one-year guarantee period, provide 3 (3) days of tuition-free schooling for one (1) Owner selected operator. This schooling shall be given at the Temperature Control Contractor's central training school, and shall consist of classroom instruction in basic control theory and operation of Direct Digital Controller System. In addition, no less than (5) 4-hour training sessions shall be held at the building site after system is in full operation. A total of two 4 hour training sessions shall be given quarterly during the first 12 months of operation to familiarize maintenance personnel on the operation of the mechanical and control systems through the host computer.

B. Travel expenses to and from the training school and living expenses shall be paid by the Owner.

3.6 COMPLETION

A. Prior to final inspection, this Contractor shall perform the following service work, including, but not limited to, the following items:
   1. Check and oil electric motors furnished under control system.
   2. Lubricate damper bearings as required.
   3. Check damper travel, adjust and tighten set screws.
   4. Lubricate valve stems, as required, check packing; repair as required.
   5. Calibration of instruments.
   6. Check and verify circuitry.
   7. Calibrate and checkout controllers, fusing, etc.
   8. Test and debug microprocessor and software.

B. When the work is completed, and at a time directed by the Owner or the Architect/Engineer, the Contractor shall carefully adjust all parts of the equipment and systems. This includes adjustment of automatic controls and safety devices, proper setting of adjustable devices, dampers and valves, and other necessary operations so the systems are fully operable and automatic in operation. Upon completion of the Work, notify the Owner, and/or Architect/Engineer that system is ready for final tests and inspection.
   1. At the time of final inspection, this Contractor shall be represented by a person with the proper authority, who shall demonstrate, as directed by the Architect/Engineer, that his Work fully complies with the purpose and intent of the Specifications and Drawings. Labor, services, instruments, and tools necessary for demonstrations and tests shall be provided by the Contractor.
   2. The Contractor shall test and adjust each instrument specialty and equipment furnished by him, prior to final acceptance. The Contractor shall demonstrate, for approval by the Architect/Engineer, that subsystems operate as a coordinated and properly functioning, integrated system.
   3. The Contractor shall furnish labor, provide adjustments and incidentals necessary to obtain the desired and intended results.
   4. The Contractor shall turn over a printed copy and electronic copy of the completed and debugged operating software to the Owner at the conclusion of the first year warranty.

END OF SECTION 23 09 00

SECTION 23 09 93 - HVAC SEQUENCE OF OPERATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Sections included under Division 1, General Requirements, and Section 23 05 00 of this Division are included as a part of this Section as though bound herein.

B. Refer to Division 01 Section “Alternates” that may affect the Work of this Section.

C. Refer to the details and schedules on the Drawings for additional requirements.

D. Refer to specifications for additional requirements.

1.2 SECTION INCLUDES

A. This Section includes the sequences of operation for the HVAC equipment and systems.

B. The Temperature Control Contractor shall read all other Drawings and Specifications, become familiar with requirements and scope of the Project, and include such coordination work as may be required.

C. Sequences of operation shall meet or exceed the requirements of ASHRAE standard 90.1.

1.3 SUBMITTALS

A. Submittals are required and shall include detailed descriptions of the proposed sequence of operations for all HVAC systems specific to the project.

1.4 BUILDING SET POINTS

A. All set points and other variables noted in the sequences are to be adjustable from the web accessible graphical user interface so that the owner does not have to go to the school or open any programming software to change the settings. Access to the adjustable settings shall be password protected and an audit log shall track who made what changes and when they were made.

B. Refer to sequence of operations of individual equipment for set points specific to each designated zone.

Winter Design:

Occupied Mode	**Unoccupied Mode**
70 deg. F	55 deg. F

Summer Design:

Occupied Mode	**Unoccupied Mode**
75 deg. F, 60 percent RH	85 deg. F, 60 percent RH

1.5 EXISTING SEQUENCE OF OPERATIONS

A. The Temperature Controls Contractor shall verify all existing sequence of operations for all equipment prior to removing existing controls. The following sequence of operations are intended to be adapted as required to accommodate existing conditions. The Temperature Controls Contractor shall prepare sequence of operations for all equipment and review those sequences with the Architect/Engineer and Owner. Sequence of Operations review meetings shall be scheduled a minimum of 10 days prior to the meeting to allow all required parties to participate.

1.6 SEQUENCE OF OPERATION

A. Constant Volume Air Handling Units:

1. Provide a microprocessor based direct digital control system that shall provide the following:
   a. Direct Digital Controller interface.
   b. Occupied-unoccupied control.
   c. Necessary operating interlocks.
2. Heating Warm-Up
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan shall run continuously.
   c. The outside air damper shall remain closed, the heating water control valve shall be open, the chilled water control valve shall be closed, the return air damper shall remain open until the return air temperature is within the heating mode of control (68 degrees F adj.).
   d. When the space air temperature reaches 68 degrees F, the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed. The unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper(s) shall be ramped open and the return air damper shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
3. Cooling Pull-Down
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan will run continuously.
   c. If the outside air can be used as determined through an enthalpy controlled economizer for cooling pull-down, the outside air damper(s) shall be modulated open and used during the pull-down cycle. If the outside air enthalpy is such that it cannot be used for cooling pull-down, the outside air damper(s) shall remain closed and the chilled water control valve shall be open until the return air temperature reaches 77 degrees F (adj.).
   d. When the room air temperature reaches 77 degrees F (adj.), the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed. The unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper(s) shall be ramped open and the return air damper shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
4. Occupied Cycle
   a. The supply fan shall run continuously.
   b. The controller shall measure the zone temperature(s) and shall modulate the heating water control valve, chilled water control valve, and outdoor air economizer damper to maintain zone temperature set point.
   c. Outside air enthalpy below return air enthalpy
      1) Upon a rise in space temperature, the outside air damper(s) shall modulate open, as required to maintain space temperature. Outside air damper(s) shall modulate open to maintain a unit leaving air temperature of 55 degrees F. (adj.) during economizer modes.
      2) On a continued rise in space temperature, with the outside air damper(s) 100 percent open, the chilled water control valves shall be modulated open as required to maintain space temperature.
      3) Upon a drop in space temperature, the chilled water control valve shall be modulated closed as required to maintain space temperature.
      4) Upon a continued drop in space temperature the outside air damper(s) shall modulate to its minimum position as required to maintain space temperature.

5) Upon a continued drop in space air temperature and outside air damper(s) at its minimum position, the heating water control valve shall modulate as required to maintain space air temperature.

6) Upon a rise in space humidity above 60 percent RH (adj.), and the outdoor air temperature above 50 degrees F. (adj.), the outside air damper(s) shall modulate open, the chilled water control valve modulated open full, and the heating water control valve shall be modulated to maintain space temperature.

d. Outside air enthalpy above return air enthalpy

1) Upon a rise in space temperature, the outside air damper(s) shall stay at its minimum position and the chilled water control valve shall be modulated open as required to maintain space temperature.

2) Upon a drop in space temperature the chilled water control valve shall modulate closed as required to maintain space temperature.

3) Upon a continued drop in space air temperature and chilled water control valve closed, the heating water control valve shall modulate as required to maintain space air temperature.

4) Upon a rise in space humidity above 60 percent RH (adj.), the outside air damper shall remain at its minimum position, the chilled water control valve shall be opened to maintain a unit leaving air temperature above 55 degrees F (adj.), and the terminal unit heating water control valves shall be modulated to maintain space temperature. The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.

e. The outside air damper(s) minimum position shall be modulated between zero and minimum positions as required to maintain the carbon dioxide levels in the space below 1000 PPM (adj.) .as determined by a unit mounted carbon dioxide sensor.

5. Unoccupied Cycle

a. The direct digital controller shall automatically program the unit to the unoccupied control mode.

b. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a pre-programmed period of time.

c. The controller shall measure the zone temperature and shall modulate the supply fan on, modulate the heating water control valve and chilled water control valve to maintain the room temperature set point.

d. To prevent short cycling, the unit shall run for a minimum adjustable time and shall be off for minimum adjustable time.

e. The outside air damper(s) shall be closed, the return air damper shall be open, and the supply fan shall cycle as required to maintain space set point of 55 degrees F. (adj.) in the winter and 78 degrees F. (adj)

f. A unit mounted humidity sensor shall enable the unit and place the unit into dehumidification mode anytime humidity rises above 60 percent RH (adj.) during unoccupied cycle. The supply fan shall run, the chilled water control valve shall modulate open and the heating water control valve shall be modulated to maintain reduced unoccupied space temperature. If the outside air enthalpy is below the return air enthalpy, outside air shall be used in conjunction with chilled water. If the outside air enthalpy is above the return air enthalpy, the outside air damper(s) shall remain closed. Once humidity level reaches set-point, the system shall return to unoccupied mode. The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.

6. Safeties
   a. Provide an automatic software reset safety low limit thermostat downstream of duct mounted heating coils set to close the outside air damper(s), open the heating coil control valve full, and stop the supply fan if the air temperature drops below 38 degrees (adj.). System shall automatically reset when freezing condition has been eliminated. Provide software to lock out the unit if the low limit trips and resets itself three times without being reset by an authorized operator through the web graphics.
   b. Provide a software reset safety high limit in the discharge air duct to stop the supply fan, if discharge static pressure goes above 5 inches W.C. (adj.). System shall be capable of being reset through software at the temperature control computer.
   c. Provide differential pressure sensing across air filters and send alarm to BAS panel requesting filter change. Include independent alarm for each filter bank at each air handling unit. Alarms and set points shall be capable of being reset through software at the temperature control computer.
   d. The system provided must be capable of manually positioning all damper operators, and heating valve actuators, if all levels of DDC control fail.
   e. A fan proving device will indicate the fan status for each fan and send an alarm to the central BAS panel indicating fan failure.
   f. Provide a manual reset differential pressure switch in return air and outside air mixing box section to stop supply fan, upon detection of outside air and/or return air control damper failure. Static set point to be adjustable.
   g. Monitor supply air temperature, return air temperature, heating coil leaving air temperature, outdoor air temperature, mixed air temperature, return air CO2, and humidity in addition to all sensors required to meet sequences.
   h. All safeties must be reset prior to fans operating in either automatic or Hand mode.
7. Provide a humidity sensor at the return air duct. Humidity reading shall be viewable as part of the AHU graphics. If a sensor detects humidity levels in excess of set-point, an alarm shall be sent to the BAS.
8. Provide a carbon dioxide (CO2) sensor in the main return air duct to the air handler. Carbon dioxide reading shall be viewable as part of the AHU graphics.
9. All unit dampers shall be factory installed.

B. Variable Air Volume Air Handling Units:
   1. Provide a microprocessor based direct digital control system that shall provide the following:
      a. Direct Digital Controller interface.
      b. Occupied-unoccupied control.
      c. Necessary operating interlocks.
   2. Heating Warm-Up
      a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
      b. The supply fan will run. The heating water valve shall be opened to provide 85 degrees F. (adj.) discharge air temperature.
      c. The outside air damper and outside air dampers shall remain closed until the return air temperature is within the heating mode of control (68 degrees F adj.). The return damper shall be full open.
      d. When the return air temperature reaches 68 degrees F, the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed. The unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper shall be ramped open and the return air damper shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
      e. Fan powered VAV terminals shall be started 5 minutes (adj.) prior to start of supply fan.

f. The VAV reheat controller assumes the occupied mode of operation, reverses the control action of the damper to modulate the air flow between maximum flow and reheat minimum flow values to maintain the zone temperature. The heating valve supplements the warm air available from the air handling unit. When the zone temperature reaches set-point, the system will automatically index to occupied cycle.

3. Cooling Pull-Down
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan will run
   c. If the outside air can be used as determined through an enthalpy controlled economizer for cooling pull-down, the outside air damper shall be open during the pull-down cycle. If the outside air enthalpy is such that it cannot be used for cooling pull-down, the outside air damper shall remain closed and the chilled water control valve open until the return air temperature reaches 77 degrees F (adj.). The return damper shall be full open. Chilled water control valve and outside air damper shall modulate to maintain a unit leaving air temperature above 55 degrees F (adj.).
   d. The VVR terminals shall be indexed to full airflow and the associated reheat coils shall be fully closed.
   e. When the return air temperature reaches 77 degrees F (adj.), the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed. The unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper shall be ramped open and the return air damper shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
4. Occupied Cycle
   a. The supply fan shall run continuously. The supply fan variable frequency controller shall be modulated via a signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFC accordingly.
   b. On an increase or decrease in required system air flow, the return air damper shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. An alarm shall be generated anytime the outside airflow is below the defined minimum outside airflow (adj.). The minimum variable frequency controller set point shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air damper shall be open and the return air damper shall be closed.
   c. Discharge air temperature shall be maintained by staging the cooling and heating water control valve in association with an enthalpy controlled economizer. Discharge air temperature reset shall be employed per the following schedule. The temperature control system to determine critical space via a calculation as follows:

$$CoolingDemand\% = \frac{(actual_flow_rate - minimum_flow_rate)}{(maximum_flow_rate - minimum_flow_rate)} * 100$$

      1) DAT is 55 deg F (adj.). When the critical zone cooling demand is 50%, the SAT is 62 deg F (adj.). When the critical zone cooling demand is 100%, supply air temperature (SAT)
      2) Control system to evaluate every 5 minutes (adj). If any zone is above 90% (adj.) cooling demand, decrease SAT by 1 deg F. If no zone is greater than 80% (adj.), increase SAT by 1 deg F.

d. A mixed air low limit sensor shall modulate the outside air damper and the return air damper through the DDC controller to maintain the minimum mixed air temperature at 45 deg F (adj.) to keep the unit from shutting down on low limit freeze protection. The sensor shall be installed in a serpentine manner to cover as much surface area as possible.

e. Outside air enthalpy below return air enthalpy
   1) Upon a rise in discharge air temperature, the outside air damper shall modulate open, as required to maintain discharge air temperature.
   2) On a continued rise in discharge air temperature, with the outside air damper 100 percent open, the chilled water coil shall modulate open as required to maintain discharge air temperature.
   3) Upon a drop in discharge air temperature, the chilled water control valve shall modulate closed as required to maintain discharge air temperature.
   4) Upon a continued drop in discharge air temperature, with the chilled water valve closed, the outside air damper shall modulate to its minimum position as required to maintain discharge air temperature.
   5) Upon a continued drop in discharge air temperature, with the chilled water valve closed, outside air damper at their minimum position , the heating water valve shall modulate as required to maintain discharge air temperature.
   6) Upon a rise in space humidity above 60 percent RH (adj.), and the outdoor air temperature below 50 degrees F. (adj.), the outside air damper shall modulate open, and the heating water control valve shall be modulated to maintain space temperature.

f. Outside air enthalpy above return air enthalpy
   1) Upon a rise in discharge air temperature, the chilled water control valve shall modulate as required to maintain discharge air temperature.
   2) Upon a drop in discharge air temperature, the chilled water control valve shall modulate closed as required to maintain discharge air temperature.
   3) Upon a rise in space humidity above 60 percent RH (adj.), the outside air damper shall remain at its minimum position, the chilled water control valve shall be opened to maintain a unit leaving air temperature above 55 degrees F (adj.), and the terminal unit heating water control valves shall be modulated to maintain space temperature. The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.

g. Static pressure shall be reset by modulating the supply fan variable frequency controller via a signal from the direct digital controller. Static pressure reset shall be employed based on the zone level VAV damper position. Static pressure reset shall be employed per the following schedule. All variables for the reset schedule shall be adjustable.
   1) The controller shall measure duct static pressure and modulate the supply fan VFC speed to maintain a duct static pressure set point. The speed shall not drop below 30% (adj.).
   2) The static pressure set point shall be reset based on VAV damper location. VAV damper position will be known by polling the terminal units every 10 minutes (adj.). All VAV damper position must be verified by BAS.
   3) The initial duct static pressure set point shall be 1.5 in. (adj.)
   4) If the most open terminal unit is more than 95% (adj.) open, the static pressure set point shall be increased by 0.1”.
   5) If the most open terminal unit is between 90% (adj.) and 95%, (adj.) no change is to occur.
   6) If the most open terminal unit is less than 90% (adj.) open, the static pressure set point shall be reduced by 0.1”.

7) The set point shall incrementally reset up to a maximum of 1.8 in. (adj.).
8) The set point shall incrementally reset down to a minimum of 1.3 in. (adj.).

5. Unoccupied Cycle
   a. The direct digital controller shall automatically program the unit to the unoccupied control mode.
   b. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a pre-programmed period of time (adj.).
   c. Upon entering the unoccupied mode, the outside air damper shall be closed, the fans and heat wheel shall not run, and the relief, outside air bypass, exhaust air bypass, and return air dampers shall be open.
   d. A space mounted humidity sensor(s) will enable the unit and shall place the unit into dehumidification mode anytime the space humidity rises above 60 percent RH (adj.) during unoccupied cycle. The supply fan shall run and the cooling coil control valve shall be opened to maintain a supply air temperature above 55 degrees (min.). The VAV terminals shall be indexed to occupied mode. The VAV terminals primary air dampers and heating water control valves shall be modulated to maintain reduced unoccupied space temperatures. If the outside air enthalpy is below the return air enthalpy, outside air shall be used in conjunction with the chilled water coil. If the outside air enthalpy is above the return air enthalpy, the outside air damper shall remain closed. Once the space humidity level reaches set-point, the system shall return to unoccupied mode. Minimum unit run-time of 30 min. (adj.) is required.
      1) The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.
   e. Should (2) or more VAV terminal unit space temperatures fall below the unoccupied heating set-point or one below 50 degrees (adj.), the BAS shall start the supply fan and modulate the VFC accordingly. Once enabled, the supply fan shall operate for a minimum of 30 minutes (adj.). The outside air damper shall remain closed with the return air damper open and the heat wheel off. The respective VAV terminal unit requiring heat shall modulate its primary air damper and heating water control valve to maintain the reduced unoccupied space temperature set –point.
   f. A night purge cycle shall be utilized during the cooling mode any time the outdoor air enthalpy is below the indoor air enthalpy. The system shall utilize 100 percent outside air economizer to purge the building and reduce the indoor air enthalpy. Duct static pressure set-point will be a .75”W.C. during this cycle. Night purge to be utilized from 4 hours before to 2 hours before scheduled occupancy (adj.). Maintain a unit leaving air temperature above 55 degrees F (adj.).
   g. When the outside air temperature is below 35 degrees F. (adj.), the heating water control valve shall be modulated to maintain 65 degrees F. (adj.) air handling unit cabinet temperature as determined by the mixed air temperature sensor.

6. Safeties
   a. Provide an automatic software reset safety high limit in the discharge air duct to stop the supply fan, exhaust fan, and heat wheel if discharge static pressure goes above 6 inches W.C. (adj.). System shall be capable of being reset through software at the temperature control computer.
   b. Provide an automatic software reset safety low limit thermostat upstream of cooling coils and downstream of heating coils set to close the outside air damper, open the heating coil valve full, stop the supply fan, exhaust fan and heat wheel if the air temperature drops below 38 degrees (adj.). System shall automatically reset when freezing condition has been eliminated. Provide software to lock out the unit if the low limit trips and resets itself three times without being reset by an authorized operator through the web graphics.

c. Provide individual differential pressure sensing across both pre-filters and primary air filters and send alarm to BAS panel requesting filter change. Include independent alarm for each filter bank at each air handling unit. Pre-filters and primary filters shall be monitored independently. Alarms and set-points shall be capable of being reset through software at the temperature control computer. A software adjustment is to be utilized to accurately represent the “dirtiness” of filters when airflow is below maximum.

d. The system provided must be capable of manually positioning all damper operators, and the cooling and heating valve actuators, if all levels of DDC control fail.

e. A fan proving device will indicate the fan status for each fan and send an alarm to the central BAS panel indicating fan failure.

f. Provide a manual reset differential pressure switch in return air and outside air mixing box section to stop supply fan, exhaust fan, and heat wheel upon detection of outside air and/or return air control damper failure. Static set point to be adjustable.

g. Monitor mixed air temperature, outdoor air inlet temperature, supply air temperature, return air temperature, heat wheel leaving air temperature (both exhaust and outside), return air humidity and CO2 in addition to all sensors required to meet sequences.

h. Monitor heating water and chilled water control valve location, in addition to all sensors required to meet sequences.

i. All safeties must be reset prior to fans operating in either automatic or Hand mode.

j. Maintain a unit leaving air temperature above 55 degrees F (adj.) in all modes.

7. Contractor shall provide a humidity sensor for each temperature control zone, as indicated in the control drawings. Humidity reading shall be viewable as part of the AHU graphics. If a sensor detects humidity levels in excess of set-point, an alarm shall be sent to the BAS.

8. Contractor shall provide a carbon dioxide (CO2) sensor in the main return air duct(s) to the air handler for each floor. Carbon dioxide reading shall be viewable as part of the AHU graphics. If a sensor detects CO2 levels in excess of 1500ppm (adj.), an alarm shall be sent to the BAS.

~~C. Variable Air Volume Heat Recovery Units:~~

~~1. Provide a microprocessor based direct digital control system that shall provide the following:~~

~~a. Direct Digital Controller interface.~~

~~b. Occupied-unoccupied control.~~

~~c. Necessary operating interlocks.~~

~~2. Heating Warm-Up~~

~~a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.~~

~~b. The supply fan will run, and the exhaust fan and heat wheel will not run. The heating water valve shall be opened to provide 80 degrees F. (adj.) discharge air temperature.~~

~~c. The outside air damper(s), exhaust air bypass, outside air bypass dampers, shall remain closed until the return air temperature is within the heating mode of control (68 degrees F adj.). The return damper(s) shall be full open.~~

~~d. When the room air temperatures reach 68 degrees F, the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed, and the heat wheel and exhaust fans remain off. During standby mode, the unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper(s) shall be ramped open and the return air damper(s) shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.~~

e. The VAV controller assumes the occupied mode of operation, reverses the control action of the damper to modulate the air flow between maximum flow and reheat minimum flow values to maintain the zone temperature. The heating valve supplements the warm air available from the air handling unit. When the zone temperature reaches set point. The terminal unit will maintain space temperature until the scheduled or occupied time. The system will automatically index to occupied cycle.

3. Cooling Pull Down
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan will run, and the exhaust fan and heat wheel will not run.
   c. If the outside air can be used as determined through an enthalpy controlled economizer for cooling pull-down, the outside air bypass damper shall be open, and outside air through the outside air damper(s) shall be used during the pull-down cycle. If the outside air enthalpy is such that it cannot be used for cooling pull-down, the outside air damper(s), and outside air bypass damper, shall remain closed and the chilled water control valve open until the all zones reach 77 degrees F (adj.). The return damper(s) shall be full open.
   d. The VAV terminals shall be indexed to modulate airflow and the associated reheat coils shall be fully closed.
   e. When all room temperatures reach 77 degrees F (adj.), the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed, and the heat wheel and exhaust fans remain off. During standby mode, the unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper(s) shall be ramped open and the return air damper(s) shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
4. Occupied Cycle
   a. The supply fan shall run continuously. The supply fan variable frequency controller shall be modulated via a signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFC accordingly.
   b. On an increase or decrease in required system air flow, the return air damper(s) shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. An alarm shall be generated anytime the outside airflow is below the defined minimum outside airflow (adj.). For more than 10 minutes (adj.), the minimum variable frequency controller set point shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air damper(s) shall be open and the return air damper(s) shall be closed.
   c. The exhaust fan shall run continuously. Air flow shall be measured using an air flow monitoring station. Provide multiple airflow monitoring stations where required by multiple exhaust air ducts.
   d. All exhaust fans shall be monitored via current switches. The actual balanced CFMs of the fans exhausting to the outdoors shall be entered into the BAS system. The BAS shall calculate the total CFM of exhaust for each air handler. The minimum outside air CFM setpoint should always be above the total calculated exhaust CFM by 10 percent (adjustable through the BAS).
   e. Discharge air temperature shall be maintained by modulating the chilled water valve, heating water control valve, heat wheel, and bypass dampers in association with an enthalpy controlled economizer. Discharge air temperature reset shall be employed per the following schedule. The temperature control system to determine critical space via a calculation as follows:

$$CoolingDemand\% = \frac{(actual_flow_rate - min\ imum_flow_rate)}{(max\ imum_flow_rate - min\ imum_flow_rate)} * 100$$

f. Control system to evaluate every 5 minutes (adj). If any zone is above 90% (adj.) cooling demand, decrease SAT by 1 deg F. If no zone is greater than 80% (adj.), increase SAT by 1 deg F.

g. A mixed air low limit sensor shall modulate the outside air damper and the return air damper through the DDC controller to maintain the minimum mixed air temperature at 45 degrees F. (adj.) to keep the unit from shutting down on low limit freeze protection. The sensor shall be a minimum of 12 feet long and be installed in a serpentine manner to cover as much surface area as possible.

h. The heat wheel outside air bypass damper shall be closed anytime the outside air temperature is below 35 degrees F. (adj.).

i. Outside air enthalpy below return air enthalpy

1) Upon a rise in discharge air temperature, the outside air damper(s) shall modulate open, as required to maintain discharge air temperature. The heat wheel shall be off, and the outside air bypass and exhaust air bypass dampers shall be open. Outside air damper(s) shall module open to maintain a unit leaving air temperature of 55 degrees F. (adj.) during economizer modes.

2) On a continued rise in discharge air temperature, with the outside air damper(s) 100 percent open, the chilled water coil shall modulate open as required to maintain discharge air temperature. The heat recovery wheel shall be off, and the outside air bypass and exhaust air bypass dampers shall be open.

3) Upon a drop in discharge air temperature, the chilled water control valve shall modulate closed as required to maintain discharge air temperature.

4) Upon a continued drop in discharge air temperature, with the chilled water valve closed, the outside air damper(s) shall modulate to its minimum position as required to maintain discharge air temperature.

5) Upon a further drop in discharge air temperature, the chilled water valve closed, and the outside air damper(s) at its minimum position, the heat wheel shall be energized. Upon a further drop in discharge air temperature, the heat wheel speed should be modulated as required to maintain discharge air temperature. If discharge air temperature continues to drop, with the heat wheel speed at maximum, the outside air bypass dampers shall modulate closed as required to maintain discharge air temperature.

6) Upon a further drop in discharge air temperature, with the heat wheel speed at maximum and the outside air bypass dampers modulated closed, the exhaust air bypass dampers shall modulate closed as required to maintain discharge air temperature. Upon a continued drop in discharge air temperature, with the chilled water valve closed, outside air damper(s) at their minimum position, the heat wheel speed at maximum, and the outside air and exhaust air bypass dampers closed, the heating water valve shall modulate as required to maintain discharge air temperature.

7) The exhaust air temperature shall not drop below the temperature scheduled in order to protect the wheel from frosting. The heat wheel shall be energized with both the outside air and exhaust air bypass dampers modulated to maintain scheduled exhaust air temperature set point to prevent frosting. If the exhaust air temperature set point cannot be maintained to prevent frosting, the air handling unit shall be put in full return mode temporarily (10 min. adj.) until the frosting condition is eliminated.

j. Outside air enthalpy above return air enthalpy

1) The heat wheel shall run, and the outside air bypass and exhaust air bypass dampers shall be closed. The outside air damper(s) shall be at its minimum position. The heat wheel speed shall be modulated to maintain discharge temperature.
2) Upon a rise in discharge air temperature, with the heat wheel speed at maximum, the chilled water control valve shall modulate as required to maintain discharge air temperature.
3) Upon a drop in discharge air temperature, the chilled water control valve shall modulate closed as required to maintain discharge air temperature.
4) Upon a continued drop in discharge air temperature, with the chilled water valve closed and outside air damper(s) at its minimum position, the heat wheel speed shall be modulated as required to maintain discharge air temperature.

k. Outside air temperature above 75 degrees F. (adj.)
1) The supply fan, exhaust fan, and heat wheel shall run continuously. The supply fan variable frequency drive shall be modulated via a 4-20 mA signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFD accordingly.
2) On an increase or decrease in required system air flow, the return air dampers shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. The minimum variable frequency drive setpoint shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air dampers shall be open and the return air dampers shall be closed.
3) The exhaust and outside air bypass dampers shall remain closed.
4) Heat wheel speed shall be modulated to maintain discharge air temperature. Upon a rise in discharge air temperature above set point with heat wheel speed at 100% the discharge air temperature shall be maintained by modulating the chilled water valve.
5) The exhaust system shall be a constant volume of air as indicated on the drawings through the exhaust duct.

l. Outside air temperature between 48 and 75 degrees F. (adj.)
1) The supply fan, and exhaust fan shall run continuously. The supply fan variable frequency drive shall be modulated via a 4-20 mA signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFD accordingly.
2) The heat wheel shall not run and the exhaust and outside air bypass dampers shall remain open.
3) On an increase or decrease in required system air flow, the return air dampers shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. The minimum variable frequency drive set point shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air dampers shall be open and the return air dampers shall be closed.
4) Discharge air temperature shall be maintained by modulating the chilled water valve.

5) The exhaust system shall be a constant volume of air as indicated on the drawings through the exhaust duct.

m. Outside air temperature between 32 and 48 degrees F. (adj.)

1) Mechanical cooling shall be locked out.

2) The supply fan, exhaust fan, and heat wheel shall run continuously. The supply fan variable frequency drive shall be modulated via a 4-20 mA signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFD accordingly.

3) The discharge air temperature shall be maintained at 55 degrees F. (adj.) as indicated by the Drawings. Upon a rise in discharge air temperature above 55 degrees F. (adj.), the heat wheel speed shall be modulated to maintain discharge air temperature. The heat wheel speed shall not be reduced below 25% (adj.) of maximum speed. Upon a continued rise in discharge air temperature above 55 degrees F. (adj.), the exhaust bypass damper shall be modulated open to maintain discharge air temperature. If the discharge air temperature continues to rise with exhaust bypass damper 100% open, the outside air bypass damper shall be modulated open to maintain discharge air temperature.

4) Heat wheel speed shall be modulated to maintain discharge air temperature. Upon a drop in discharge air temperature below setpoint with heat wheel speed at 100% the discharge air temperature shall be maintained by modulating the heating water valve

5) The heating water valve shall be modulated to maintain a minimum 55 degrees F. discharge air temperature.

6) On an increase or decrease in required system air flow, the return air dampers shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. The minimum variable frequency drive setpoint shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air dampers shall be open and the return air dampers shall be closed.

7) The exhaust system shall be a constant volume of air as indicated on the drawings through the exhaust duct.

n. Outside air temperature below 32 degrees F. (adj.)

1) Mechanical cooling shall be locked out.

2) The supply fan, exhaust fan, and heat wheel shall run continuously. The supply fan variable frequency drive shall be modulated via a 4-20 mA signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFD accordingly.

3) The discharge air temperature shall be maintained at 55 degrees F. (adj.) as indicated by the Drawings. Upon a rise in discharge air temperature above 55 degrees F. (adj.), the heat wheel speed shall be modulated to maintain discharge air temperature. The heat wheel speed shall not be reduced below 25% (adj.) of maximum speed. Upon a continued rise in discharge air temperature above 55 degrees F. (adj.), the exhaust bypass damper shall be modulated open to maintain discharge air temperature.

4) Heat wheel speed shall be modulated to maintain discharge air temperature. Upon a drop in discharge air temperature below setpoint with heat wheel speed at 100% the discharge air temperature shall be maintained by modulating the heating water valve

5) The outside air bypass dampers shall remain closed to prevent nuisance freezestat trips.
6) The exhaust leaving air temperature from the heat wheel shall be maintained at a minimum temperature as indicated on the Drawings. The exhaust air bypass damper shall modulate open to maintain an exhaust air discharge temperature as scheduled. If the leaving exhaust air temperature continues to drop below scheduled value, the outside air damper shall modulate closed to maintain an exhaust air discharge temperature as scheduled.
7) The heating water valve shall be modulated to maintain a minimum 55 degrees F. discharge air temperature.
8) On an increase or decrease in required system air flow, the return air dampers shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. The minimum variable frequency drive setpoint shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air dampers shall be open and the return air dampers shall be closed.
9) The exhaust system shall be a constant volume of air as indicated on the drawings through the exhaust duct.

o. A space mounted humidity sensor(s) will enable the unit and shall place the unit into dehumidification mode anytime the space humidity rises above 60 percent RH (adj.) during occupied cycle. The supply fan shall run and the cooling coil control valve shall be open 100 percent. The VAV terminals primary air dampers and heating water control valves shall be modulated to maintain occupied space temperatures. If the outside air enthalpy is below the return air enthalpy, outside air shall be used in conjunction with the chilled water coil. If the outside air enthalpy is above the return air enthalpy, the outside air damper(s) shall remain at minimum position. Once the space humidity level reaches set point, the system shall return to occupied mode. Minimum unit run time of 30 min. (adj.) is required.
1) The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the hot water system is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.

p. Static pressure shall be reset by modulating the supply fan variable frequency controller via a signal from the direct digital controller. Static pressure reset shall be employed based on the zone level VAV damper position. Static pressure reset shall be employed per the following schedule. All variables for the reset schedule shall be adjustable.
1) The controller shall measure duct static pressure and modulate the supply fan VFC speed to maintain a duct static pressure set point. The speed shall not drop below 20% (adj.).
2) The static pressure set point shall be reset based on VAV damper location. VAV damper position will be known by polling the terminal units every 10 minutes (adj.). All VAV damper position must be verified by BAS.
3) The initial duct static pressure set point shall be as determined by the balancing contractor.
4) If the most open terminal unit is more than 95% (adj.) open, the static pressure set point shall be increased by 0.1".
5) If the most open terminal unit is between 90% (adj.) and 95%, (adj.) no change is to occur.
6) If the most open terminal unit is less than 90% (adj.) open, the static pressure set point shall be reduced by 0.1".
7) The set point shall incrementally reset up to a maximum of 3.0 in. (adj.).

8) The set point shall incrementally reset down to a minimum of 1.5 in. (adj.).

5. Unoccupied Cycle
   a. The direct digital controller shall automatically program the unit to the unoccupied control mode.
   b. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a pre-programmed period of time (adj.).
   c. Upon entering the unoccupied mode, the outside air damper(s) shall be closed, the exhaust fans and heat wheel shall not run, outside air bypass damper(s) shall be closed, exhaust air bypass damper(s) shall be closed, and return air dampers shall be open.
   d. During unoccupied time periods, the supply fan shall cycle as required to maintain the space temperatures of 55 degrees F (adj.) in the winter and 78 degrees F (adj.) or 60 percent relative humidity (adj.) in the summer. The outside air damper(s) shall be closed, the exhaust fan and heat wheel shall not run, and the return damper(s) shall be open. The supply fan shall be off when the space temperature and humidity sensors are satisfied. When the unit is on for unoccupied heating, the cooling valve shall be closed and the heating water valve shall modulate to maintain a minimum 65 degrees F (adj.) discharge air temperature. When the unit is on for unoccupied cooling/dehumidification, the heating valve shall be closed and the cooling water valve shall modulate open to maintain a 55 degree F (adj.) discharge air temperature.
   e. A space mounted humidity sensor(s) will enable the unit and shall place the unit into dehumidification mode anytime the space humidity rises above 60 percent RH (adj.) during unoccupied cycle. The supply fan shall run and the cooling coil control valve shall be open 100 percent. The VAV terminals shall be indexed to occupied mode. The VAV terminals primary air dampers and heating water control valves shall be modulated to maintain reduced unoccupied space temperatures. If the outside air enthalpy is below the return air enthalpy, outside air shall be used in conjunction with the chilled water coil. If the outside air enthalpy is above the return air enthalpy, the outside air damper(s) shall remain closed. Once the space humidity level reaches set-point, the system shall return to unoccupied mode. Minimum unit run-time of 30 min. (adj.) is required.
      1) The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.
   f. Should (2) or more VAV terminal unit space temperatures fall below the unoccupied heating set-point or one below 50 degrees (adj.), the BAS shall start the supply fan and modulate the VFC accordingly. Once enabled, the supply fan shall operate for a minimum of 30 minutes (adj.). The outside air damper shall remain closed with the return air damper(s) open and the heat wheel off. The respective VAV terminal unit requiring heat shall modulate its primary air damper(s) and heating water control valve to maintain the reduced unoccupied space temperature set –point.
   g. A night purge cycle shall be utilized anytime the building temperature is above the outside air temperature and outdoor air enthalpy is below the indoor air enthalpy. The system shall utilize 100 percent outside air economizer to purge the building and reduce the indoor air temperature and enthalpy to occupied setpoints. The heat wheel outside air bypass damper shall be open. Night purge to be utilized from 4 hours before 2 hours before scheduled occupancy (adj.). Outside air damper(s) shall modulate open to maintain a unit leaving air temperature of 55 degrees F. (adj.).
   h. When the outside air temperature is below 35 degrees F. (adj.), the heating water control valve shall be modulated to maintain 65 degrees F. (adj.) air handling unit cabinet temperature as determined by the mixed air temperature sensor.

6. Safeties

a. Provide an automatic software reset safety high limit in the discharge air duct to stop the supply fan, exhaust fan, and heat wheel if discharge static pressure goes above 6 inches W.C. (adj.). System shall be capable of being reset through software at the temperature control computer.

b. Provide an automatic software reset safety low limit thermostat upstream of cooling coils and downstream of heating coils set to close the outside air damper(s), open the heating coil valve full, stop the supply fan, exhaust fan and heat wheel if the air temperature drops below 38 degrees (adj.). System shall automatically reset when freezing condition has been eliminated. Provide software to lock out the unit if the low limit trips and resets itself three times without being reset by an authorized operator through the web graphics.

c. Provide individual differential pressure sensing across both pre-filters and primary air filters and send alarm to BAS panel requesting filter change. Include independent alarm for each filter bank at each air handling unit. Pre-filters and primary filters shall be monitored independently. Alarms and set-points shall be capable of being reset through software at the temperature control computer.

d. The system provided must be capable of manually positioning all damper operators, and the cooling and heating valve actuators, if all levels of DDC control fail.

e. A fan proving device will indicate the fan status for each fan and send an alarm to the central BAS panel indicating fan failure.

f. Provide a manual reset differential pressure switch in return air and outside air mixing box section to stop supply fan, exhaust fan, and heat wheel upon detection of outside air and/or return air control damper failure. Static set point to be adjustable.

g. Monitor mixed air temperature, outdoor air inlet temperature, supply air temperature, return air temperature, heat wheel leaving air temperature (both exhaust and outside), return air humidity and CO2 in addition to all sensors required to meet sequences.

h. Monitor heating water and chilled water control valve location, in addition to all sensors required to meet sequences.

i. All safeties must be reset prior to fans operating in automatic or hand mode.

j. VAV terminal damper positions for all zones shall be modulated open as required to maintain minimum air handling unit supply fan(s) speed, as required by the unit manufacturer.

7. Monitor supply fan airflow and exhaust fan airflow.

8. Provide a humidity sensor for each temperature control zone, as indicated in the control drawings. Humidity reading shall be viewable as part of the AHU graphics. If a sensor detects humidity levels in excess of set-point, an alarm shall be sent to the BAS.

9. Provide a carbon dioxide (CO2) sensor in the main return air duct(s) to the air handler. Carbon dioxide reading shall be viewable as part of the AHU graphics. If a sensor detects CO2 levels in excess of 1000ppm (adj.), an alarm shall be sent to the BAS.

10. All ductwork mounted dampers shall be provided, controlled and installed by the contractor. Dampers internal to the air handling unit shall be factory installed. All damper operators shall be provided, installed and controlled by the contractor.

D. Air-Cooled Chillers (outdoor, air-cooled chillers)

1. The chillers shall be supplied complete with all operating and safety controls. The Contractor shall wire the flow switch supplied (or differential pressure sensor) by the chiller manufacturer. The conduit and wiring from the outdoor chiller control panel to the chiller interface panel located in the mechanical room shall be by the Contractor.

2. The chillers shall be provided with open protocol communication boards for full communication via BACnet. This contractor shall coordinate exact requirements with chiller manufacturer. If the existing chillers are not equipped with communication boards, the temperature control contractor shall provide new communication boards as required to communicate with the chiller. The chiller manufacturer must provide submittals to the Contractor of all wiring diagrams and points lists including override capability and scaling values. The chiller manufacturer shall provide all software CD's, licenses, and connections tools to the Contractor for setup and servicing, which is to be turned over to the owner at project completion.
3. The BAS shall enable the chiller control circuit and the chilled water pumps on a call for cooling anytime the outdoor air temperature is above 50 degrees (adj.). The chiller control panel shall prove flow through the chiller before allowing chiller to operate. Pressure transducers and interlock wiring shall be furnished and installed by the Contractor. Flow switch (or internal differential pressure sensor) provided by chiller manufacturer.
4. Once energized, the chiller shall automatically operate to maintain required water temperature, based on chilled water supply temperature set-point reset, down to 4~~2~~5 degrees F. (adj.).
5. Chilled Water Supply Temperature – Set-point Reset:
   The chilled water supply temperature set-point shall reset using a trim and respond algorithm based on cooling requirements. The chilled water supply temperature set-point shall reset to a lower value (4~~2~~5 degrees F – adj.) as the facility's chilled water valves open beyond a user definable threshold (90% open, adj.). Once the chilled water coils are satisfied (valves closing below 90% open, adj.) then the chilled water supply temperature set-point shall gradually rise over time to reduce cooling energy use. Maximum set-point to be 50 degrees F (adj.).
6. Lock out the chiller system below 50 degrees F (adj.). outside air temperature during occupied mode, and during "unoccupied" sequence from the BAS.
7. The mechanical cooling system shall be locked out in "unoccupied" sequence unless building zone temperature rises above 85 degrees F (adj.) or 60 percent relative humidity (adj.).
8. Provide sensors in the building chilled water supply and return for indication through the Global Control Panel.
9. Temperature Control Contractor shall install chiller interface panel, provide wiring between chiller and panel, and provide all wiring and programming required to communicate with the chiller interface panel. Chiller interface panel furnished by the chiller manufacturer. Provide a specific graphics screen on the BAS for all points provided through the chiller interface panel. Coordinate communications protocol with chiller manufacturer. The following chiller control functions shall be accessible through the central BAS:
   a. Chilled water inlet temperature
   b. Chilled water outlet temperature
   c. Chilled water flow
   d. Evaporator refrigerant pressure
   e. Evaporator refrigerant temperature
   f. Evaporator approach temperature
   g. Condenser refrigerant pressure
   h. Condenser refrigerant temperature
   i. Compressor refrigerant discharge temperature
   j. Percent RLA
   k. Compressor running status
   l. Manual reset alarm occurrence
   m. Communication status
   n. Chiller enable/disable
   o. Chiller water set-point
   p. Demand limit set-point
10. The BAS will enable the chiller upon either of the following conditions.
    a. The outside air temperature is above 50 degrees (adj.) and any HVAC zone is an occupied state.

b. The outside air temperature is above 80 degrees (adj.) all HVAC zones are in an unoccupied state, and the average HVAC zone temperature is above 85 degrees (adj.).

11. The BAS will enable the lead chilled water pump along with the chiller.

12. Once the chiller is enabled, it will prove flow via the interlocked flow switch and automatically operate chiller to maintain a leaving water temperature of chilled water supply temperature – set-point reset, down to 4~~2~~5 degrees F. (adj.).

13. Chilled Water Pumps

a. The BAS will enable the primary chilled water pumps, ~~either primary or~~ variable speed chilled water pumps, when there is a command for their associated chiller to be operational. The primary chilled water pumps shall remain enabled for a period of 5 minutes (adj.) after the chillers have been disabled.

b. Upon enable, the lead pump will start and be proven on. The DDC Controller will monitor differential pressure between the chilled water supply and return lines in locations as denoted on the Drawings. The DDC Controller will increase or decrease the pump speed to maintain the desired set-point at the lowest pressure point. Upon lead pump obtaining 100 percent speed for 10 minutes (adj.), the lag pump will start. The DDC Controller will increase or decrease the pump speeds so that each pump is providing 50 percent of the system flow. Should the pumps fall below 65 percent speed (adj.), for a minimum of 10 minutes (adj.), the lag pump will turn off and the lead pump speed will be controlled to maintain set-point.

c. The chilled water pumps shall modulate to maintain the minimum required chiller differential pressure required by unit manufacturer.

d. Provide automatic weekly alternating lead/lag operation through the BAS to maintain equal runtimes of the pumps. Provide a software lead/lag override switch in the graphics for the owner to use during pump service.

e. The minimum speed for the variable speed chilled water pumps shall be as required to maintain the minimum flow rate through the chiller as required by the unit manufacturer, or the minimum flow rate recommended by the pump manufacturer, whichever flow rate is larger. The rate of speed change on the chilled water pumps shall not exceed the requirements of the chiller manufacturer.

f. The Building Automation System shall automatically start/stop and alternate pumps with the “off” pump as a backup, should the lead pump fail.

~~J. Powered Terminal Units~~

~~1. Provide microprocessor based direct digital control system that shall provide the following:~~

~~a. Direct digital controller interface.~~

~~b. Occupied-unoccupied control.~~

~~c. Necessary operating interlocks.~~

~~2. Heating Warm-Up~~

~~a. The system shall be enabled with an optimum start schedule of 1 hour maximum (adj.) prior to the start of occupied mode.~~

~~b. The supply fan shall run continuously.~~

~~c. The outside air control damper (where equipped) shall remain closed.~~

~~d. The unit heating water control valve shall be modulated upon until the room temperature is within the heating model of control (68 degrees F adj.).~~

~~e. When room temperature reaches 68 degrees F., the unit shall index to occupied mode.~~

~~3. Cooling Pull-Down~~

~~a. The system shall be enabled with an optimum start schedule of 1 hour maximum (adj.) prior to the start of occupied mode.~~

~~b. The supply fan shall run continuously.~~

~~c. The outside air control damper (where equipped) shall remain closed.~~

~~d. The unit chilled water control valve shall be modulated open until the room temperature is within the cooling mode of control (77 degrees F. adj.).~~

~~e. When room temperature reaches 77 degrees F., the unit shall index to occupied mode.~~

4. Occupied Cycle
   a. The supply fan shall run continuously and outside air control damper (where equipped) shall open.
   b. Upon a rise in room temperature above set point, the chilled water control valve shall be modulated to maintain the room set point temperature.
   c. Upon a drop in room temperature below set point, the heating water control valve shall be modulated open to maintain room set point temperature.
   d. Upon a rise in the return air humidity above 60 percent RH (adj.), the chilled water control valve shall be modulated open full, and the heating water control valve shall be modulated to maintain space temperature. The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.
5. Unoccupied Cycle
   a. The direct digital controller shall automatically program the unit to unoccupied mode.
   b. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a preprogrammed period of time.
   c. The outside air control damper (where equipped) shall be closed.
   d. Upon a drop in room temperature, the unit supply fan shall cycle on and the heating water control valve shall modulate to maintain room temperature set point of 55 degrees F. (adj.).
   e. Upon a rise in room temperature, the unit supply fan shall cycle on and the direct expansion cooling shall cycle on to maintain room temperature set point of 78 degrees F. (adj.).
   f. Upon a rise in the return air humidity above 60 percent RH (adj.), the chilled water control valve shall be modulated open full, and the heating water control valve shall be modulated to maintain space temperature. The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS
6. Safeties
   a. To prevent short cycling, the unit shall run for a minimum adjustable time and shall be off for a minimum adjustable time.
   b. The system provided must be capable of manually positioning heating and chilled water control valve actuators, if all levels of DDC control fail.
   c. A fan proving device will indicate the fan status for each fan and send an alarm to the central BAS panel indicating fan failure.

K. Variable Air Volume Terminal Unit Controllers
1. Fan Powered VVF Terminal Units
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan shall be started 5 minutes (adj.) prior to the air handling unit supply fan.
   c. The VAV terminal fan shall run continuously during occupied cycle. During unoccupied cycle, the fan shall cycle to maintain a reduced night temperature setting.
   d. A wall-mount electronic temperature sensor shall modulate the terminal unit primary air damper in sequence with the heating coil control valve to maintain space temperature.
   e. When morning warm up is initiated by the Building Automation System, the VAV controller assumes the occupied mode of operation, enables the terminal fan, reverses the control action of the damper to modulate the air flow between maximum flow and reheat minimum flow values to maintain the zone temperature. The heating valve supplements the warm air available from the air handling unit. When the zone temperature reaches setpoint the system will automatically index to occupied cycle.

f. During occupied operation, the primary air damper shall be modulated to maintain space setpoint. Minimum setting of air damper shall be as scheduled on Drawings. On a continued drop in space temperature at minimum air, the heating water valve shall be modulated open to maintain desired space temperature. Occupied space setpoint shall be 75 (adj.) for cooling and 70 (adj.) degrees for heating.

g. If space temperature drops more than 5 degrees F below occupied setpoint during the occupied period, primary air damper shall close completely, heating water control valve shall open fully and fan shall run. When space setpoint is reached, terminal unit shall return to full occupied operation.

h. The Contractor shall provide and install a discharge air sensor in the discharge airstream of VAV terminals. The sensor valves shall be included on the graphic screen for the terminal.

i. During unoccupied cycle, the primary air damper shall be closed tight, the heating valve modulated and the fan cycled as required to maintain reduced space setpoint. Unoccupied space setpoint shall be 55 degrees (adj.) in winter and 85 degrees (adj.) in summer.

2. VVR Reheat Terminal Units

a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.

b. During occupied cycle, a wall-mount electronic temperature sensor shall modulate the primary air damper to maintain space temperature. On a drop in space temperature below set point, the primary air damper shall modulate to its 50% position and the heating coil control valve will modulate open as required to maintain space set point. On a continued drop in space temperature, the heating coil control valve shall remain open and the primary air valve shall modulate from 50% airflow to maximum airflow as required to maintain space temperature. Conversely, on a rise in space temperature, the heating coil control valve shall close and the primary air damper shall modulate as required to maintain set point.

c. During the unoccupied cycle, the primary air damper shall be closed. If space temperature is below unoccupied heating space set point, associated control zone(s) shall be energized and VVR terminals primary air damper shall be set to 50% open for all terminal units in zone. The heating coil control valve shall be modulated as required to maintain unoccupied set-point. If space temperature is above unoccupied cooling space set point, associated control zone(s) shall be energized and VVR terminals primary air damper shall be set to maximum airflow for all terminal units in zone. Once unoccupied set points have been achieved for 30 min. (adj.) associated air handling units shall shut down and VVR terminal primary air damper shall close.

d. When morning warm-up is initiated by the Building Automation System, the VVR controller assumes the occupied mode of operation, reverses the control action of the damper to modulate the air flow between maximum flow and reheat 50% flow values to maintain the zone temperature. The heating valve supplements the warm air available from the air handling unit. When the zone temperature reaches set-point, the system will automatically index to occupied cycle.

e. The Contractor shall provide and install a discharge air sensor in the discharge airstream of VAV terminals. The sensor value shall be included on the graphic screen for the terminal.

3. The Contractor shall graphically display variable air volume terminal information in a matrix format, for each terminal unit associated with a given air handling unit. Matrix to include(at a minimum):

a. VAV Box Description
b. Room Name (or space being served)
c. VAV Box Mode of operation
d. Space temperature
e. Space set-points (heating / cooling)
f. VAV airflow

g. VAV airflow set-point
h. VAV Box Damper position
i. VAV Box % cooling
j. VAV Box % heating
k. VAV Box entering air temperature (From associated AHU).
l. VAV Box leaving air temperature.

L. Cabinet Heaters
1. An electronic low voltage adjustable temperature sensor/controller shall open the heating water control valve and cycle the unit fan on a call for heating. BAS system shall have controls graphic.

M. Propeller Unit Heaters
1. An electronic low voltage adjustable temperature sensor/controller shall open the heating water control valve and cycle the unit fan on a call for heating. BAS system shall have controls graphic.

N. Electric Cabinet Unit Heaters
1. An electronic low voltage adjustable temperature sensor/controller shall enable the unit fan and electric heating coil on a call for heating. BAS system shall have controls graphic.

O. Electric Propeller Unit Heaters
1. An electronic low voltage adjustable temperature sensor/controller shall enable the unit fan and electric heating coil on a call for heating. BAS system shall have controls graphic.

P. Exhaust Fans
1. General exhaust fans serving toilet rooms, storage rooms, etc. as scheduled shall operate based on time of day schedule with associated temperature control zones.
2. Exhaust fans in spaces with heat producing equipment such as kilns, transformers, technology equipment, etc. as scheduled shall be energized on a rise in room temperature above 85 degrees F. (adj.) as determined by a wall mounted, reverse acting thermostat. Fans with line voltage temperature sensors shall include status monitoring.
3. Exhaust fans servicing custodial closets and other areas requiring continuous fume or odor control as scheduled shall run continuously 24 hours per day.
4. Exhaust fans providing temporary fume or odor control such as science or art room general exhaust, or are associated with kitchen hoods, dishwasher hoods, fume hoods, paint booths, etc. as scheduled shall be controlled by a timer switch. Fans shall include status monitoring.
5. See Exhaust Fan Schedules on the Drawings.
6. A motor current operated switch shall input fan status to a DDC panel for all exhaust fans.

Q. Mini-Split Systems
1. The Contractor shall mount and wire thermostat provided by unit manufacturer. Control sequence shall be part of unit mounted controls. Provide interconnecting wiring between indoor unit and outdoor unit. Monitor room temperature through the central BAS panel and alarm if room temperature rises above 85F (adj.) degrees.

R. Building Relief
1. Provide a wall mounted static pressure sensor in each zone. Relief air control dampers shall modulate open as required to maintain a slight positive pressure in the building. Refer to contract documents for quantity and locations of relief dampers in each zone. The BAS shall generate an alarm if building zone is reading negative pressure for 30 min. (adj.). Initial set-point to be 0.05” WC to open relief air dampers.

S. Variable Frequency Controller.

1. The Building Automation System shall monitor alarms and outputs from the VFC, via BACnet Communication Interface.

T. Kitchen Hoods
1. Provide necessary contacts to enable Kitchen make-up air unit(s) and associated temperature control zones when kitchen hood(s) and/or dishwasher fans are in operation.

U. Make-Up Water Monitoring
1. The contractor shall provide a water meter in the make-up water connection to the heating water system and condenser water system to monitor the make-up water usage through the BAS.

V. Kitchen Cooler(s) and Freezer(s)
1. The contractor shall install temperature sensors in the cooler(s) and freezer(s) to monitor temperatures through the BAS. Provide alarm if temperature rises above desired temperatures.

W. Carbon Monoxide Detector
1. Provide a carbon monoxide detector in rooms with gas fired equipment and monitor through the building automation system. Detector shall send an alarm signal to the building automation system any time the carbon monoxide level exceeds 35 ppm (adj.).

X. Boiler Room Emergency Shut-Down
1. Provide an emergency shut-down button switch in the boiler room to shut-down all gas-fired equipment upon activation.
2. Emergency shut-down button switch shall be located near the door in the path of egress from the boiler room.
3. Activation of the emergency shut-down switch shall send an alarm to the building automation system.
4. Coordinate shutdown of power to boilers with electrical contractor.

Y. Smoke Detection
1. Contractor shall wire between smoke detector and unit to shut-down unit on smoke detection.

Z. Carbon Dioxide Sensor
1. Install carbon dioxide sensor(s) as shown on the drawings and/or as required by the sequence of operations.
2. Install outside carbon dioxide sensor.
3. Carbon dioxide levels shall be monitored through the building automation system.

AA. Humidity Sensor
1. Install humidity sensor as shown on the drawings and/or as required by the sequence of operations.

BB. Fire Alarm
1. Coordinate with Division 26 Electrical Contractor and provide necessary contacts to shut down all mechanical equipment during a fire alarm. The system shall be capable of restarting equipment globally upon a “no alarm signal” from the fire alarm panel.

CC. Snow Day, 1 Hour Delay, 2 Hour Delay, 3 Hour Delay
1. Snow day, 1 hour delay, 2 hour delay, 3 hour delay routine shall be provided to return all systems to unoccupied mode upon indication by system operator.

DD. Unoccupied Set-point
1. The Building Automation System shall be setup to allow a global change to unoccupied mode set-points from the temperature control system.

EE. Emergency Shutdown

1. The Building Automation System shall shutdown all mechanical equipment. Shutdown shall be located on the Temperature Control System graphic home page and shutdown key switch to be located at each building. Coordinate shutdown key switch location with school district representative.

FF. Day/Night Zones

1. The following shall be the accepted zone control. Zone control shall include all air handling units, power terminal units, unit ventilators, fan coil units, blower coil units, variable-volume terminals, and exhaust fans. All zones to include capabilities through the direct digital controller for override setting to full occupied cycle during unoccupied cycle.
2. Zones: Refer to drawings for temperature control zone information. Each temperature control zone shall be included with independent schedules.

GG. Critical Alarms

1. Critical alarms shall dial or send text to personal cell telephones, personal home telephones, and send email messages to school district employees as determined by the school corporation. Alarms shall be setup and active prior to building occupancy. The following will be considered critical alarms:
   a. Any boiler alarm.
   b. Any air handling unit manual low-limit or freeze-stat alarm,
   c. Any air handling unit fan failure and/or heat wheel motor failure.
   ~~d. Any packaged rooftop unit alarm.~~
   ~~e. Any unit ventilator manual low-limit or freeze-stat alarm.~~
   ~~f. Any unit ventilator fan failure alarm~~
   g. Any circulation pump failure
   h. Any space temperature dropping below 45 degrees F. (adj.) or rising above 85 degree F (adj.).
   i. Kitchen freezer temperature rise above 30 degrees F (adj.)
   j. Cooler system temperature rise above 43 degrees (adj.)
   ~~k. Cooling tower failure.~~
   l. Make-up water high flow rate.
   ~~m. Any feed system low level alarm.~~
   n. Any technology room temperature above 85 degrees F.
   o. Any other alarm deemed critical by the school corporation and/or Architect/Engineer.
   p. Refer to all sequences of operation for additional alarms.

~~HH. Energy Monitoring/Demand Limiting~~

~~1. The BAS shall monitor the electrical consumption and demand. The temperature control contractor shall be responsible to provide a separate meter if communication can not be made at the switchgear.~~
~~2. The BAS shall monitor natural gas usage.~~
~~3. The BAS shall monitor water usage.~~
~~4. The building automation system shall be set up to accept a signal from the local electric utility provider do go into demand limiting mode. Upon receipt of that signal, the system shall reduce the electric demand by turning off, cycling, or limiting equipment operation as defined by the agreement between the utility provider and the Owner.~~
~~5. The BAS shall also be set up to have demand limiting capabilities, if the local utility provider is not capable of providing such signal. The BAS shall monitor the electrical demand, from the electrical switchgear. The temperature controls contractor is responsible to provide trended data to the district on a monthly basis, for the first year of building ownership. Trended data can be in the form of digital or hard copy reports, graphs, and hourly data concerning electrical demand. From this data, the district and temperature controls contractor will determine the electrical demand limit (adj.) to trigger demand limiting mode. All requirements from the electrical utility will over ride the school district values, or control strategies.~~

a. Until the electrical demand limit is determined from trended data, an initial electrical demand limit shall be equal to the largest demand value measured over the past 9 months through the electrical switchgear.

b. Once the electrical demand limit (adj.) is determined, the BAS shall utilize this value to trigger demand limiting mode:

1) Upon electrical demand approaching 85% (adj.) electrical demand limit (adj.), the BAS shall send an alarm, via email, to all personnel requested by the district, informing them that the electrical demand critical value (adj.) – as determined by district is approaching. At this point, corrective action is requested by the building occupants in order to reduce electrical demand. It will be the responsibility of the owner to receive email and request corrective action by building occupants.

2) Upon electrical demand reaching 95% (adj.) electrical demand limit, all cooling set-points are to be globally changed to a value of 75 degrees F (adj.) and all air handling units supply temperature setpoints shall be raised by 2 degrees F. (adj). An email is to be sent to all personnel requested by the district.

a) If the above corrective action reduces electrical demand below the electrical demand critical value for a period of one hour (adj.), all cooling set-points are to be globally reset to prior values.

3) Upon electrical demand continuing to meet or exceed electrical demand limit, for a period of 30 minutes (adj.), all cooling set-points are to be globally increased to a value of 76 degrees F (adj.) and all air handling units supply temperature setpoints shall be raised by 2 degrees F. (adj). An email is to be sent to all personnel requested by the district.

a) If the above corrective action reduces electrical demand below the electrical demand critical value for a period of one hour (adj.), all cooling set-points are to be globally reduced back to 75 degrees F. The set-points are to be restored to initial values, in the opposite sequence.

4) Upon electrical demand continuing to meet or exceed electrical demand limit, for a period of 30 minutes (adj.), all cooling set-points are to be globally increased to a value of 77 degrees F (adj.) and all air handling units supply temperature setpoints shall be raised by 2 degrees F. (adj). An email is to be send to all personnel requested by the district.

a) If the above corrective action reduces electrical demand below the electrical demand critical value for a period of one hour (adj.), all cooling set-points are to be globally reduced back to 76 degrees F. The set-points are to be restored to initial values, in the opposite sequence.

6. A graphics package dashboard shall be created to monitor the electric, gas and water usage in the building. A spreadsheet shall be developed to accumulate consumption based on monthly usage, and yearly usage for all (3) utilities. A kbtuh/SF amount shall also be tracked to allow the owner to compare the usage. The spreadsheet shall be set up to allow the owner to easily print out.

END OF SECTION 23 09 93

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Chilled-water piping.
   3. Makeup-water piping.
   4. Condensate-drain piping.
   5. Blowdown-drain piping.
   6. Balancing valves.
   7. Pressure reducing valves
   8. Safety valves

B. Related Sections include the following:
   1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
   ~~2. Division 23 Section “Polypropylene Hydronic Piping Option”~~
      ~~a. The polypropylene hydronic piping option can be bid as an option to copper and or black steel piping for heating and chilled water systems. Approved fittings and connectors shall be used to transition to all valves and accessories. Refer to Section 23 21 14.~~

1.2 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Hot-Water Heating Piping: 125 psig at 200 deg F.
   2. Chilled-Water Piping: 125 psig at 200 deg F.
   3. Makeup-Water Piping: 100 psig at 150 deg F.
   4. Condensate-Drain Piping: 150 deg F.
   5. Blowdown-Drain Piping: 200 deg F.
   6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air control devices.
   3. Chemical treatment.
   4. Hydronic specialties.
   5. Grooved fittings and joint couplings, provide applicable styles used.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped or identified for quality assurance and traceability.

E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.6 EXTRA MATERIALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Grooved-Copper Fittings option: ASME B16.22.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Tyco-Grinnell
b. Anvil Gruvlok.
c. Victaulic Company of America.
2. Grooved-End Copper Fittings: ASME B16.22 wrought copper and ASTM B 75, copper tube or ASME B16.18 and ASTM B 584, bronze casting, manufactured to copper tube dimensions. Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.
3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EHP gasket rated for maximum 250 deg F for use with housing, and electroplated steel bolts and nuts.

D. Copper or Bronze Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Stadler-Viega (Propress)
b. Nibco
c. Elkhart
2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.

5. Minimum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. T-DRILL Industries Inc.

F. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Tyco-Grinnell.
b. Anvil Gruvlok.
c. Victaulic Company of America.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Rigid pattern, unless otherwise indicated, ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
a. NPS 2 through NPS 12:
1) Rigid Type: Housings shall be cast with bolt pads to provide rigidity and system support and haning in accordance with ANSI B31.1 and B31.9.
a) NPS 2 through NPS 6: Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket rated to +230 deg. F.
b) Zero-Flex Style.
2) Flexible Type: For use in locations where vibration attenuation and stress relief air required. Three flexible couplings may be used in lieu of a flexible connector. The couplings shall be placed in close proximity to the source of the vibration.

3) Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components.

b. 14 inch through 24 inch with lead-in chamfer on housing key and wide width FlushSeal® gasket.
   1) Rigid Type: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.
   2) Flexible Type: Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular pipe movement.
   3) Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PVC PIPE AND FITTINGS

A. PVC Material: The material used in the manufacture of the pipe shall be a rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784. This compound shall be light gray in color.

B. Pipe Dimensions: All sizes of PVC Schedule 80 pipe shall be manufactured by and ISO 9001 certified manufacture in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to the standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785.

C. Pipe Markings: Product marking shall meet the requirements of ASTM D1785 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in PSI for water @ 73°F; the ASTM designation D1785.

D. Threaded metal to plastic connections are not permitted. Where transitions between plastic and metal pipe and fittings occur, compression style metal to plastic unions, flanges, or grooved connections shall be utilized.

E. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Tyco-Grinnell.
      b. Anvil Gruvlok.
      c. Victaulic Company of America.
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   3. Couplings: Rigid pattern, unless otherwise indicated, ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
      a. NPS 2 through NPS 12:
         1) Flexible Type: For use in locations where vibration attenuation and stress relief air required. Three flexible couplings may be used in lieu of a flexible connector. The couplings shall be placed in close proximity to the source of the vibration.

2.4 CPVC PIPE AND FITTINGS

A. CPVC Material: The material used in the manufacture of the pipe shall be a rigid polyvinyl chloride (PVC) compound, Type IV Grade I, with a Cell Classification of 23447 as defined in ASTM D1784. This compound shall be light gray in color.

B. Pipe Dimensions: All sizes of CPVC Schedule 80 pipe shall be manufactured in strict accordance to the requirements of ASTM F 441 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to the standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1784.

C. Pipe Markings: Product marking shall meet the requirements of ASTM F 441 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in PSI for water @ 73°F; the ASTM designation D1784.

~~2.5 POLYPROPYLENE RESIN (PP-R) PIPE AND FITTINGS~~

~~A. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in a three layer extrusion process. Hydronic hot water and heating piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11. Pipe shall be Aquatherm® Climatherm® as manufactured by Aquatherm, Inc.~~

~~B. Fittings shall be manufactured from a PP-R resin meeting the short term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11. Fittings shall be Aquatherm® Climatherm® as manufactured by Aquatherm, Inc.~~

~~C. Installation of polypropylene resin (PP-R) piping, fittings, and system components shall be in strict accordance with the manufacture written instructions.~~

2.6 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's recommendations with lubricant supplied by the coupling manufacturer that is suitable for the gasket elastomer and system media.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

H. PVC solvent Joints: Solvent-cemented joints should be utilized in a two step process with primer manufactured for thermoplastic piping systems conforming to ASTM F656 and solvent cement conforming to ASTM 2564. Primer shall be clear. Solvent-cement shall be clear, medium-bodied and medium-setting and formulated for PVC piping.

I. CPVC solvent joints: Solvent-cemented joints should be utilized in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM F493. Primer shall be clear. Solvent-cement shall be clear, medium-bodied and medium-setting and formulated for CPVC piping.

2.7 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

~~C. Dielectric Unions:~~
~~1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~
~~a. Capitol Manufacturing Company.~~
~~b. Central Plastics Company.~~
~~c. Hart Industries International, Inc.~~
~~d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.~~
~~e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.~~
~~2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.~~

~~D. Dielectric Flanges:~~
~~1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~
~~a. Capitol Manufacturing Company.~~
~~b. Central Plastics Company.~~
~~c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.~~
~~2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.~~

~~E. Dielectric Flange Kits:~~
~~1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~
~~a. Advance Products & Systems, Inc.~~
~~b. Calpico, Inc.~~
~~c. Central Plastics Company.~~
~~d. Pipeline Seal and Insulator, Inc.~~
~~2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.~~
~~3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.~~

~~F. Dielectric Couplings:~~
~~1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~
~~a. Calpico, Inc.~~
~~b. Lochinvar Corporation.~~

2. ~~Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.~~

G. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Tyco-Grinnell
   b. Anvil Gruvlok
   c. Perfection Corporation; a subsidiary of American Meter Company.
   d. Precision Plumbing Products, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Victaulic Company of America.
2. Electroplated steel nipple or ductile iron casing with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.8 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Griswold Controls.
   e. Taco.
   f. Nexus.
   g. Tour & Andersson.
   h. Tyco-Grinnell.
   i. Victaulic Company
2. Body: Bronze or a metal copper alloy, ball, globe, or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Disc: A metal copper-alloy.
5. Plug: Resin.
6. Seat: PTFE or EPDM.
7. End Connections: Threaded or socket.
8. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
9. Handle Style:
   a. Lever, with memory stop to retain set position.
   b. Hand wheel, with memory stop to retain set position.
10. CWP Rating: Minimum 300 psig.
11. Maximum Operating Temperature: 230 deg F.
12. Valve shall be selected between 2 and 6 feet water pressure drop. Verify optimal sizing with manufacturer.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Griswold Controls.
   e. Taco.
   f. Nexus.

g. Tour & Andersson; available through Victaulic Company of America.
h. Tyco-Grinnell.
i. Victaulic Company

2. Body: Cast-iron, ductile iron, or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: A metal copper-alloy or glass and carbon-filled PTFE.
6. Seat: PTFE or EPDM.
7. End Connections: Flanged or grooved.
8. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
9. Handle Style:
   a. Lever, with memory stop to retain set position.
   b. Hand wheel, with memory stop to retain set position.
10. CWP Rating: Minimum 250 psig.
11. Maximum Operating Temperature: 230 deg F.
12. Valve shall be selected between 2 and 6 feet water pressure drop. Verify optimal sizing with manufacturer.

E. Diaphragm-Operated, Pressure-Reducing 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 ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Sized for a maximum operating temperature 225 degrees F.
11. Sized for a maximum operating pressure of 125 psig.
12. Valve Size and Capacity: Selected to suit system in which installed. Refer to detail in Contract Documents.
13. Operating Pressure: Inlet pressure up to 300 psig. Outlet pressure field adjustable from 10 to 35 psig.

F. Diaphragm-Operated Safety 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 ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bell & Gossett Domestic Pump; a Division of ITT Industries.
   b. Flow Design Inc.
   c. Nexus
   d. Griswold Controls.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.
10. Valve size to be selected between 2 and 6 feet water pressure drop (WPD). Verify optimal sizing to minimize pressure drop with unit manufacturer.
11. Removable flow cartridge.

2.9 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.
5. Wessels.

B. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:
1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

~~D. Expansion Tanks:~~
~~1. Tank: Welded steel, rated for 125 psig working pressure and 240 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gauge glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.~~
~~2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125 psig working pressure and 250 deg F maximum operating temperature.~~

3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gauge Glass: Full height with dual manual shutoff valves, 3/4 inch diameter gauge glass, and slotted metal glass guard.

E. Diaphragm or Bladder-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm or Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

F. Tangential Type Air Separators:
1. Tank: Welded steel; ASME constructed and labeled for 125 psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

G. In-Line Air Separators:
1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

H. Combination Air Eliminator and Dirt Separator – Option in lieu of installing air separator and side loop filter.
1. Performance Requirements:
a. Air Separation: Removal of 99.6 percent of entrained air in the system.
b. Dirt Separation: Removal of 80 percent of all particles 30 micron and larger with 100 passes.
2. Coalescing type air eliminator and dirt separator equal to Spirovent by Spirotherm, or approved equal.
a. Air eliminator and dirt separator to be sized for schedule water flow and will replace the air separator only for chilled water system. The aluminum bag filter to be installed from drain outlet of air eliminator and dirt separator to downstream side to reintroduce clean glycol back into the chilled water system.
b. All details for the air separator will apply to air eliminator and dirt separator.
c. All cost and manufacturer requirements are to be included under base bid if option is to be pursued.

I. Performance Requirements
1. Air Separation:
a. 100 percent of free air.
b. 100 percent entrained air.
c. Removal of 99.6 percent of dissolved air in the system.
2. Dirt Separation:
a. Removal of 80 percent of all particles 30 micron and larger within 100 passes.
3. Coalescing medium to extend full length of shell filling the entire vessel with no open space or voids between them to suppress turbulence and provide high efficiency. Partial fill units are not acceptable.
a. Coalescing medium to be copper or stainless steel.
4. Combination air eliminator and dirt separator to be sized for schedule water flows.
5. Rated for 150 psig working pressure.
6. Maximum entering water velocity to be less than 10 feet per second.
7. Accessories:

a. Blow-down valve
b. Skim valve
c. Automatic air vent

J. Air Purgers:
1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.10 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 536, Grade 65-45-12, ductile iron with coupled cover or ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; grooved or flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent total free area.
4. CWP Rating: 300 psig.
5. Include blow down valve with cap and chain.

B. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.
6. Three flexible style couplings may be used in lieu of flexible connectors for vibration attenuation and stress relief for services to 230 deg. F. The couplings shall be placed in close proximity to the source of the vibration.

C. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.
6. Three flexible style couplings may be used in lieu of flexible connectors for vibration attenuation and stress relief for services to 230 deg. F. The couplings shall be placed in close proximity to the source of the vibration.

D. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure seal joints.

2. Type L, drawn-temper copper tubing, grooved, mechanical joint coupling and fittings, and grooved mechanical joints.
3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
4. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure seal joints.
2. Type L, drawn-temper copper tubing, grooved, mechanical joint coupling and fittings, and grooved, mechanical joints.
3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
4. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

~~E. Underground Piping System~~
~~1. Pipe shall be composed of integral sealed units of PVC plastic outer jacket, PVC plastic carrier pipe and insulated with polyurethane foam completely filling the annular space between the pipe and jacket.~~
~~2. Insulation shall be rigid 90 percent closed cell polyurethane. Density shall be 2.0 pounds per cubic foot. The coefficient of thermal conductivity (K) shall be .14 BTU/HR SR degrees F at 73 degrees F.~~
~~3. Installation per manufacturer's recommendations.~~

F. Non-potable/make-up water piping installed aboveground shall be the following:
1. Schedule 80 PVC or CPVC pipe with solvent-cement joints and/or grooved, flanged or threaded fittings connections. Pipe shall not bear the weight of installed equipment and flow control devices. Where pipe connections are used to bear the weight of equipment, equipment shall be independently supported, and if necessary copper or stainless spool pieces utilized to perform this function.
2. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure seal joints.

G. Makeup-water piping installed aboveground shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure seal joints.

~~H. Condensate Drain Piping:~~
~~1. Within non-plenum rated buildings areas:~~
~~a. Schedule 80 PVC or CPVC pipe with solvent cement joints and/or grooved, flanged or threaded fittings connections. Pipe shall not bear the weight of installed equipment and flow control devices. Where pipe connections are used to bear the weight of equipment, equipment shall be independently supported, and if necessary copper or stainless spool pieces utilized to perform this function.~~
~~b. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.~~
~~2. Within plenum rated buildings areas:~~
~~a. Schedule 80 CPVC pipe with solvent cement joints and/or grooved, flanged or threaded fittings connections. Pipe shall not bear the weight of installed equipment and flow control devices. Where pipe connections are used to bear the weight of equipment, equipment shall be independently supported, and if necessary copper or stainless spool pieces utilized to perform this function.~~
~~b. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.~~

I. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

~~J. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.~~

K. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

L. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

M. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Heating Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main as denoted on Drawings.

C. Install calibrated-orifice, balancing valves or automatic flow control valves in the return pipe of each heating or cooling terminal as denoted on Drawings.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

G. Insulation: Where insulation is indicated, install extended stem valves arranged in a proper manner to receive insulation.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap and chain, at low points in piping system mains and elsewhere as required for system drainage.

M. Reduce pipe sizes using eccentric reducer fitting installed with level side up for horizontal piping.

N. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

O. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
   1. Unions or flanges are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points).

Q. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2. All strainers shall contain blow down valve.

R. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
   1. For water systems, use adequate numbers of flexible style couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with coupler manufacturer instructions and as approved by the engineer.) Where expansion loops are required, use flexible style couplings on the loops.

S. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

T. Freeze Protection
   1. Do not install any hydronic piping which includes domestic cold and hot water, fire and sprinkler water, chilled water, heating water, condenser water piping, etc. within 12 feet of an exterior wall or roof opening utilized for fresh air intake or building relief air.
   2. Any piping installed closer than 12 feet of an exterior wall or roof opening shall be moved or rerouted around the perimeter of the opening in order to prevent possible freezing of hydronic piping.

U. Install dielectric fittings as specified between connections of all dissimilar metals.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Pipe attachments shall be located adjacent to fittings at each offset or change in direction, at ends of branches over 5 feet long, at riser pipes, and along piping where necessary to prevent sags, bends, or vibration. Piping risers shall be supported at each floor level.

D. Hanger rod must hang perpendicular before and after pipe covering or insulation is applied.
   1. Support piping from rolled steel beams or channels from any point on either top or bottom flanges.
   2. Support piping from open web steel joists from hangers connected to either top or bottom chords within 3 inches of center of chord panel points (intersection of diagonal or vertical chord with top or bottom chord). Joist reinforcement will be required if hangers are not installed at panel points. Refer to structural details.
   3. In addition to maximum spacing of hangers or supports specified below, the number and spacing of hangers and supports shall be such as to equally distribute loads to all structural members in the system.
   4. Connections to structural members shall be clamping devices which do not damage or deform structural elements. Welding to or drilling holes in structural members is not permitted unless specifically approved by Architect.
   5. Threaded rod shall not be bent. Provide swivel connection or other means to prevent stress on threaded rod.

E. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

F. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
   8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
   9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
   10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
   11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
   12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
   13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
   14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
   15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

G. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. NPS 1Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

I. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads, which permit support and hanging in accordance with ANSI B31.1, B31.3, and B31.9.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
   1. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions.
   2. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
   3. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer.
   4. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools and installation of grooved joint products.
      a. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor’s representative is not considered qualified to conduct the training of jobsite visit(s).)

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

K. Pressure-Sealed Joints: Use manufacturer-recommended PFT series tool and procedure. Leave insertion marks on pipe after assembly.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

~~D. Install tangential air separator in pump suction. Install blowdown piping with full-port ball valve; extend full size to nearest floor drain.~~

~~E. Install welded steel type expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.~~
~~1. Install tank fittings that are shipped loose.~~
~~2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.~~

F. Install bladder or diaphragm type expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gauges and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gauges for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens. All piping in the entire building is to be flushed, regardless of installation method.
    a. Clean water shall be water that has been through the permanent project softener and permanent project domestic water filtration, or from an approved public water supply, by A/E.
    b. All rooms, branch piping, and equipment will be isolated prior to initiating flush/clean/fill.
    c. The main piping will be filled with clean water and mild cleaning agents.
    d. A water quality sample will be taken by the chemical treatment company.
    e. The drain valve(s) at the end of each pipe run will be opened, with a hose routed outside the building.
    f. Utilizing the main circulating pumps, this water will be re-circulated for a minimum of 48 hours.
    g. After initial flush, this water will be removed and the process repeated until water sample is deemed acceptable by F/H and CxA.
    h. Once the main piping is approved clean, the drain valves to each room or branch will be opened individually until clean water is flowing from the drain valve.
    i. The individual strainers will be removed, cleaned, and reinstalled. Multiple strainer cleanings may be required during the flush/clean/fill procedure.
    j. At that point, the isolation valves to each room will be opened and the total system will be filled.
    k. Utilizing the main circulating pumps, this water will be re-circulated for a minimum of 48 hours.

l. The drain valves to each room or branch will be opened individually until clean water is flowing from the drain valve.
m. The individual strainers will be removed, cleaned, and reinstalled. Multiple strainer cleanings may be required during the flush/clean/fill procedure.
n. The process is to be repeated until water sample is deemed acceptable by F/H and/or CxA.

4. Isolate all equipment and all equipment coils from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
6. Corrosion inhibitor to be applied after flushing and before filling the piping system.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.9 PREPARATION AND CLEANING PROCEDURES

A. Preparation
1. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
2. Place terminal control valves in open position during cleaning.

B. Cleaning Sequence
1. Add cleaner to closed systems at concentration recommended by manufacturer. Hot Water Heating Systems: Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.
2. Chilled Water Systems: Circulate for 48 hours, then drain systems as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed.
3. Use neutralizer agents on recommendation of system cleaner supplier and approval of A/E.

4. Remove, clean, and replace strainer screens.
5. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

C. Closed System Treatment and Cleaning
1. Provide one shot feeder on each system. Install isolating and drain valves and necessary piping. Install around circulating pumps unless indicated otherwise.

D. Refer to Division 23 Section 232500 – HVAC Water Treatment for additional requirements.

END OF SECTION 23 21 13

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:
   1. Bypass chemical-feed equipment and controls.
   2. ~~Biocide chemical-feed equipment and controls.~~
   3. Glycol feed equipment and controls.
   4. Chemical treatment test equipment.
   5. HVAC water-treatment chemicals.
   6. Water filtration units for HVAC makeup water.

1.2 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.3 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
   1. Bypass feeders.
   2. Automatic glycol feeders.
   3. Side-loop filters.
   4. ~~Water meters.~~
   5. ~~Inhibitor injection timers.~~
   6. ~~pH controllers.~~
   7. ~~TDS controllers.~~
   8. ~~Biocide feeder timers.~~
   9. ~~Chemical solution tanks.~~
   10. ~~Injection pumps.~~
   11. ~~Chemical test equipment.~~
   12. ~~Multimedia filters.~~
   13. ~~Self-cleaning strainers.~~
   14. ~~Bag- or cartridge-type filters.~~
   15. ~~Centrifugal separators.~~

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power and control wiring.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. ~~Manufacturer Seismic Qualification Certification: Submit certification that components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:~~
   1. ~~Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.~~
      a. ~~The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."~~
      b. ~~The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."~~
   2. ~~Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.~~
   3. ~~Detailed description of equipment anchorage devices on which the certification is based and their installation requirements~~.

B. Other Informational Submittals:
   1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
   2. Water Analysis: Illustrate water quality available at Project site.
   3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.6 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

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.

1.8 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, biological growth, and glycol concentration for cooling chilled-water piping, heating-hot-water piping, heating, steam and condensate piping, condenser-water piping, and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
   1. Initial water analysis and HVAC water-treatment recommendations.
   2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
   3. Periodic field service and consultation. Test systems every 2 months, unless noted otherwise.
   4. Customer report charts and log sheets.
   5. Laboratory technical analysis.
   6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. WSG/Chardon Labs

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 2 gal. 5 gal.
2. Minimum Working Pressure: 175 psig.

~~2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT~~

~~A. Water Meter:~~
~~1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.~~
~~2. Body: Bronze.~~
~~3. Minimum Working-Pressure Rating: 150 psig.~~
~~4. Maximum Pressure Loss at Design Flow: 3 psig.~~
~~5. Registration: Gallons or cubic feet.~~
~~6. End Connections: Threaded.~~
~~7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250 V ac; and that will close at adjustable increments of total flow.~~

~~B. Water Meter:~~
~~1. AWWA C701, turbine-type, totalization meter.~~
~~2. Body: Bronze.~~
~~3. Minimum Working-Pressure Rating: 100 psig.~~
~~4. Maximum Pressure Loss at Design Flow: 3 psig.~~
~~5. Registration: Gallons or cubic feet.~~
~~6. End Connections: Threaded.~~
~~7. Control: Low-voltage signal capable of transmitting 1000 feet.~~

~~C. Water Meter:~~
~~1. AWWA C701, turbine-type, totalization meter.~~
~~2. Body: Bronze.~~
~~3. Minimum Working-Pressure Rating: 150 psig.~~
~~4. Maximum Pressure Loss at Design Flow: 3 psig.~~
~~5. Registration: Gallons or cubic feet.~~
~~6. End Connections: Flanged.~~
~~7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250 V ac; and that will close at adjustable increments of total flow.~~

~~D. Inhibitor Injection Timers:~~
~~1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."~~
~~2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.~~
~~3. Test switch.~~
~~4. Hand-off-auto switch for chemical pump.~~
~~5. Illuminated legend to indicate feed when pump is activated.~~
~~6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.~~

7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

E. pH Controller:
1. Microprocessor based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal pH indication.
5. High or low pH alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for acid pump.
7. Internal adjustable hysteresis or deadband.

F. TDS Controller:
1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High or low conductance alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves:
   a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.
   b. Steam Boilers: Motorized ball valve, steel body, and TFE seats and seals.

G. Biocide Feeder Timer:
1. Microprocessor based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
3. Precision, solid state, bleed-off lockout timer and clock controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two different formulations.
5. 24-hour display of time of day.
6. 14-day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

H. Chemical Solution Tanks:
1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 30 gal.

I. Chemical Solution Injection Pumps:
1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.

5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

J. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

K. Injection Assembly:
1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Two-piece, stainless steel as described in "Stainless Steel Pipes and Fittings" Article below; and selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.4 GLYCOL FEED SYSTEM

A. Glycol feed system shall include one 55 gallon polyethylene dilution tank with tank level markings, welded tank support frame, tank drain fitting, low level alarm switch, removable polyethylene cover, pre-piped discharge piping with shutoff valve, check valve, pressure switch, system tee, pressure relief valve, pressure relief tubing return to the dilution tank, and suction tubing with strainer.

B. Provide a NEMA 1 rated control panel complete with 0-30 psig pressure gauge, alarm circuit, temperature control system interlock for low liquid level, visual low level alarm light, automatic start/stop switch activated by pressure switch, hand-off-auto selector switch, disconnect switch. Control panel shall be factory mounted on the dilution tank support frame. Low level alarm shall notify temperature control system through dry contacts, light the visual alarm on the panel, and shut down the feed pump. System shall be designed to maintain a consistent operating pressure in the closed loop and automatically feed a diluted glycol/water mixture to the system expansion tank as required by the system demand.

C. Provide a rotary gear type direct drive glycol feed pump with flexible coupler. Pump construction shall consist of bronze body, stainless steel shaft, positive spring loaded lip seal with temperature rating of 250 degrees F, self lubricating carbon bearings and built-in relief valve. Pump shall be self priming form a dry start and shall be capable of 20 feet w.g. on the suction side with a capacity of 1.5 GPM at 100 psi discharge pressure. Motor shall be open dripproof 115 volt, single phase of horsepower as denoted on the drawings.

D. System shall be Venture VI Model GF-P-1-1 or equipment product as manufactured by Armstrong or Wessels.

2.5 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

2.6 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

2.7 ETHYLENE GLYCOL-BASED PRODUCT

A. The heat transfer fluid shall be an inhibited ethylene glycol-based industrial heat transfer fluid specifically formulated for use in HVAC and ICE BANK SYSTEMS. The fluid must contain corrosion inhibitors and buffers and an antifoam agent, necessary for long fluid and system life.

B. The 30 percent solution of heat transfer fluid and deionized water, premixed by the chemical manufacturer, shall have a freezing point of 3 degrees F, a burst point of -12 degrees F, a pH between 8.0 and 9.0, a reserve alkalinity of 6.6ml HCl/10ml, a specific gravity of 1.047 at 20/20 degrees C, no flash point, no silicates, and fluorescent orange color.

C. The weight per gallon of premixed fluid shall be 8.71 lbs./gal. at 68 degrees F. The specific heat shall be 0.858 BTU/lb. degrees F at 25 degrees F and 0.875 BTU/lb. degrees F at 68 degrees F.

D. Field or distributor mixed fluid, automotive antifreeze, uninhibited glycol, or field or distributor inhibited glycol is not acceptable.

E. Acceptable Manufacturers: Subject to compliance with requirements, provide premixed 30 percent ethylene glycol by one of the following:
1. Dow Chemical Co. - Dowtherm SR-1
2. Union Carbide Corp. - Ucartherm - IBS-30
3. Interstate: Intercool NFE

2.8 PROPYLENE GLYCOL-BASED PRODUCT

A. The heat transfer fluid shall be an inhibited ethylene glycol-based individual heat transfer fluid specifically formulated for use in HVAC and ICE BANK SYSTEMS. The fluid must contain corrosion inhibitors and buffers and an antifoam agent, necessary for long fluid and system life.

B. The 30 percent solution of heat transfer fluid and deionized water, premixed by the chemical manufacturer, shall have a freezing point of 9 degrees F., a burst point of -11 degrees F., a specific gravity of 1.061 at 20/20 degrees C., no flash point, no silicates, and fluorescent orange color.

C. The weight per gallon of premixed fluid shall be 8.78 lbs./gal. at 68 degrees F. The specific heat shall be 0.935 BTU/lb. degrees F. at 25 degrees F. and 0.941 BTU/lb. degrees F. at 68 degrees F.

D. Field or distributor mixed fluid, automotive anitfreeze, uninhibited glycol, or field or distributor inhibited glycol is not acceptable.

E. Acceptable Manufacturers: Subject to compliance with requirements, provide premixed 30 percent propylene glycol by one of the following:
1. Dow Chemical Co.: Dowfrost HD.
2. Union Carbide Corp.: Ucar Protherm - 30.
3. Interstate: Intercool NFP.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.

C. Install water testing equipment on wall near water chemical application equipment.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and glycol cooling, and equipped with the following:
   1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
   2. Install water meter in makeup water supply.
   3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
   4. Install full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
   5. Install a swing check on inlet after the isolation valve.

~~G. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:~~
   ~~1. Install water meter in makeup water supply.~~
   ~~2. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.~~
      ~~a. Pumps shall operate for timed interval when contacts close at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.~~
   ~~3. Install test equipment and furnish test-kit to Owner.~~

~~H. Install automatic chemical-feed equipment for condenser water and include the following:~~
   ~~1. Install water meter in makeup water supply.~~
   ~~2. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.~~
      ~~a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.~~
   ~~3. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.~~
   ~~4. Install TDS controller with sensor and bleed valves.~~
      ~~a. Bleed valves shall cycle to maintain maximum TDS concentration.~~
   ~~5. Install pH sensor and controller with injection pumps and solution tanks.~~
      ~~a. Injector pumps shall operate to maintain required pH.~~
   ~~6. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.~~
      ~~a. Injection pumps shall operate to feed biocide on an alternating basis.~~

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
   2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
   3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
   4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
   5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
   8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at eight-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At eight-week intervals following Substantial Completion and during warranty period, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:
   1. Silica: ASTM D 859.
   2. Steam System: ASTM D 1066.
   3. Acidity and Alkalinity: ASTM D 1067.
   4. Iron: ASTM D 1068.
   5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 25 00

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
   1. Rectangular ducts and fittings.
   2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
   3. Duct liner.

B. Related Sections include the following:
   1. Division 07 Section "Penetration Firestopping."
   2. Division 09 Section "Interior Painting."
   3. ~~Division 23 Section "Nonmetal Ducts" for fibrous glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.~~
   4. ~~Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.~~
   5. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 DEFINITIONS

A. NUSIG: National Uniform Seismic Installation Guidelines.

1.3 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by A/E. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Duct accessories, including access doors and panels.
   11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.

2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. In general, the piping and ductwork shown on the drawings shall be considered as diagrammatic for clearness in indicating the general run and connections required, and may not be shown in its true position. The piping and ductwork equipment may have to be offset, lowered, or raised as required to accommodate field conditions.

~~1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS~~

~~A. LEED Submittals: See Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.~~
~~1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 – "Systems and Equipment."~~
~~2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 – "HVAC System Construction and Insulation."~~
~~3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 – "Duct Leakage Tests."~~
~~4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4. – Ventilation System Start-Up."~~
~~5. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.~~
~~6. IEQ Credit 4.1 ("Low-Emitting Materials – Adhesives and Sealants"): Submit Product Data for adhesives, sealants, and sealant primers installed inside of the weatherproofing system and applied on-site, indicating compliance 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 Chamber, including 2004 Addenda. Alternatively:~~
~~a. Submit Product Data indicating that it satisfies the requirements of an alternate compliance path by meeting the requirements of the South Coast Air Quality Management District (SCAQMD) Rule 1168 corresponding to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.~~

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports, AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members, and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 – Systems and Equipment" and Section 7 – "Construction and System Start-up."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 – "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having ~~G60~~ G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653 and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 2 mils thick on opposite surfaces.

D. Carbon-Steel Sheets: ASTM A 366, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

E. Stainless Steel: ASTM A480, Type 304 and having a No. 20 finish for concealed ducts, and a finish to match kitchen or dishwasher hoods for exposed ducts.

F. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
   1. Manufacturers:
      a. CertainTeed Corp.; Insulation Group.
      b. Johns Manville International, Inc.
      c. Knauf Fiber Glass GmbH.
      d. Owens Corning.
   2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
      a. Thickness: 1 inch.
      b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
      c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
      d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

1) 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).
2) Adhesive shall comply with the testing and product requirements of the California Department of Health Services' Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

e. 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 duct.
1) Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.
2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.4 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
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*.

B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

D. Contractor may use load rated cable suspension system. Suspension system shall have a specified manufacturers safe working load and supplemental safety factor of at least five times the safe working load.
   1. Suspension system shall be verified by SMACNA Testing and Research Institute to be in compliance with SMACNA Duct Construction Standards Guidelines (1995 CH.4).

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
   2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
   ~~1. Manufacturers:~~
      ~~a. Ductmate Industries, Inc.~~
      ~~b. Nexus Inc.~~
      ~~c. Ward Industries, Inc.~~

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
   ~~1. Manufacturers:~~
      ~~a. Ductmate Industries, Inc.~~
      ~~b. Lockformer.~~
   2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
   3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.7 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. The net free area of the duct dimensions on the Contract Documents shall be maintained. Increase metal duct dimensions as necessary to compensate for addition of the liner.

B. 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.

C. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

D. Butt transverse joints without gaps and coat joint with adhesive.

E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

F. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

G. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm

H. 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.

I. 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:
1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

J. 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; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

D. Duct Joints:
1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
~~a. Manufacturers:~~
~~1) Ductmate Industries, Inc.~~
~~2) Lindab Inc.~~
5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
~~a. Manufacturers:~~
~~1) Ductmate Industries, Inc.~~
~~2) McGill AirFlow Corporation.~~
~~3) SEMCO Incorporated.~~

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
   a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
   b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
   c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
   d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
   a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
   b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
   c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
   d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

H. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction, riveted and bonded.
4. Other Fittings: Riveted and bonded joints.
5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

~~2.9 DOUBLE-WALL DUCT AND FITTING FABRICATION~~

~~A. Manufacturers:~~
~~1. Lindab Inc.~~
~~2. McGill AirFlow Corporation.~~
~~3. SEMCO Incorporated.~~

~~B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.~~
~~1. Outer Shell: Base metal thickness on outer shell dimensions. Fabricate outer shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.~~
~~2. Insulation: 1-inch thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.~~
~~a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.~~
~~3. Solid Outer Ducts: Use the following sheet metal thicknesses and seam construction:~~

a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.

4. Perforated Inner Ducts: Fabricate with 0.028-inch thick sheet metal having 3/32-inch diameter perforations, with overall open area of 23 percent.
5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

C. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Outer Ducts: Use the following sheet metal thicknesses:
a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
2. Perforated Inner Ducts: Fabricate with 0.028-inch thick sheet metal having 3/32-inch diameter perforations, with overall open area of 23 percent.

D. Flat Oval Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
2. Insulation: 1 inch thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
3. Solid Outer Ducts: Use the following sheet metal thicknesses and seam construction.
a. Duct width up to 22 inches: 0.024 inch with standard spiral-seam construction.
b. Duct widths 23 to 46 inches: 0.030 inch with single-rib spiral-seam construction.
c. Duct widths 47 to 68 inches: 0.036 inch with single-rib spiral-seam construction.
d. Duct widths 69 inches and up: 0.047 inch with standard spiral-seam construction.
4. Perforated Inner Ducts: Fabricate with 0.028 inch thick sheet metal having 3/32 inch diameter perforations, with overall open area of 23 percent.
5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

E. Flat Oval Duct Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Outer Ducts: Use the following sheet metal thicknesses:
a. Ducts 3 to 34 inches in diameter: 0.028 inch.
b. Ducts 35 to 58 inches in diameter: 0.034 inch.
c. Ducts 60 to 88 inches in diameter: 0.040 inch.
2. Perforated Inner Ducts: Fabricate with 0.028 inch thick sheet metal having 3/32 inch diameter perforations, with overall open area of 23 percent.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
1. Supply Ducts: 2-inch wg.
2. Supply Ducts (before Air Terminal Units): 3-inch wg.
3. Supply Ducts (after Air Terminal Units): 2-inch wg.
4. Return Ducts (Negative Pressure): 1-inch wg.
5. Exhaust Ducts (Negative Pressure): 2-inch wg.

B. All ducts shall be galvanized steel except as follows:

1. Range Hood Exhaust Ducts: Comply with NFPA 96.
    a. Concealed: Carbon-steel sheet.
    b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
    c. Weld and flange seams and joints.
2. Kitchen Hood Exhaust Ducts
    a. The exhaust duct shall be sized to have a minimum velocity of 1500 FPM and a maximum velocity of 2200 FPM and shall be constructed of 16 gauge, carbon steel, welded liquid tight to comply with NFPA 96. Ductwork shall slope as required by the local building code with sealed access panels as required and at the required intervals. Ductwork shall be protected with fire resistance insulation in accordance with ASTM E814 and “F” and “T” rating.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

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. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" or NUSIG.

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

R. 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."

3.3 PVC-COATED DUCT, SPECIAL INSTALLATION REQUIREMENTS

A. Repair damage to PVC coating with manufacturer's recommended materials.

3.4 UNDERSLAB DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Verify undamaged condition of ducts before enclosure with fill or encasement.

B. Protect ducts from damage by equipment used in placing fill materials and concrete on or around ducts.

C. Protect duct openings from damage and prevent entrance of foreign materials.

3.5 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

3.6 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated and in compliance with ASHRAE/IESNA 90.1.
1. For pressure classes lower than 2-inch wg, seal transverse joints.

B. Seal ducts before external insulation is applied.

3.7 HANGING AND SUPPORTING

A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 5, "Hangers and Supports," unless otherwise noted.

B. Support horizontal ductwork runs on 6 foot centers and within 24 inches of each elbow and within 48 inches of each branch intersection. Where duct weight for the 6 foot length is less than 40 pounds, support hangers may be on 8 foot centers.

C. Support vertical ducts at maximum intervals of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

3.8 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.9 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports. Leak testing is required for all medium pressure ductwork rated with a static-pressure class that exceeds 2-inch wg. Low-pressure ductwork rated below 2-inch wg will not require pressure testing.
   1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
   4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.10 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
   2. Disconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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, and actuators 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.

E. 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.
   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.

F. Cleanliness Verification:
   1. Visually inspect metal ducts for contaminants.
   2. Where contaminants are discovered, re-clean and reinspect ducts.

~~3.11 CLEANING EXISTING SYSTEMS~~

~~A. Use service openings, as required, for physical and mechanical entry and for inspection.~~
   ~~1. Use existing service openings where possible.~~
   ~~2. Create other openings to comply with duct standards.~~
   ~~3. Disconnect flexible ducts as needed for cleaning and inspection.~~
   ~~4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.~~
   ~~5. Remove and reinstall ceiling sections to gain access during the cleaning process.~~

~~B. Mark position of dampers and air directional mechanical devices before cleaning, and restore to their marked position on completion.~~

~~C. 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 the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.~~

~~D. Clean the following metal duct systems 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, and actuators 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.~~

~~E. 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 operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:
1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

G. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

H. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 23 31 13

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. ~~Utility set fans.~~
2. Centrifugal roof ventilators.
3. ~~Axial roof ventilators.~~
4. ~~Upblast propeller roof exhaust fans.~~
5. ~~Centrifugal wall ventilators.~~
6. ~~Ceiling-mounting ventilators.~~
7. In-line centrifugal fans.
8. ~~Propeller fans.~~
9. ~~Dryer exhaust duct power ventilators~~

1.2 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

~~B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.~~

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

~~1.8 EXTRA MATERIALS~~

~~A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.~~
~~1. Belts: One set(s) for each belt-driven unit.~~

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck.
2. Loren Cook Company.
3. Acme Engineering & Mfg. Corp.
4. Aerovent; a Twin City Fan Company
~~5. American Coolair Corp.~~
~~6. Ammerman; General Resource Corp.~~
~~7. Breidert Air Products.~~
8. Broan Mfg. Co., Inc.
9. Carnes Company HVAC.
~~10. Central Blower Co.~~
~~11. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.~~
~~12. Delhi Industries Inc.~~
~~13. Hartzell Fan, Inc.~~
~~14. JencoFan; Div. of Breidert Air Products.~~
~~15. NuTone Inc.~~
16. Penn Ventilation.
~~17. Quietaire Corporation.~~
18. Twin City Fans

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

~~E. Belt Driven Drive Assembly: Resiliently mounted to housing, with the following features:~~
~~1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.~~
~~2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.~~
~~3. Pulleys: Cast iron, adjustable-pitch motor pulley.~~
~~4. Fan and motor isolated from exhaust airstream.~~

F. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent. Speed controller is to be factory mounted and wired.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.
3. Pitch Mounting: Manufacture curb for roof slope.

H. Finish
1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
a. Color and Gloss: Standard color as selected from manufacturer chart.

2.2 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck.
2. Loren Cook Company.
3. Acme Engineering & Mfg. Corp.
~~4. American Coolair Corp.~~
~~5. Ammerman; General Resource Corp.~~
~~6. Bayley Fans; a division of Lau Industries, Inc.~~
~~7. Breidert Air Products.~~
8. Carnes Company HVAC.
~~9. FloAire.~~
~~10. Hartzell Fan, Inc.~~
~~11. JencoFan; Div. of Breidert Air Products.~~
~~12. Madison Manufacturing.~~
13. Penn Ventilation.
~~14. Quietaire Corporation.~~

B. Description: In-line, direct or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

~~E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.~~

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
5. Disconnect switch, non-fusible type, with thermal overload protection.

2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

~~B. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."~~

~~C. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."~~

D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 23 34 23

SECTION 23 34 33 - AIR CURTAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air curtains for pedestrian entrances.

~~B. Air curtains for vehicular enatrances.~~

C. Air curtains for large loading dock doors.

1.2 RELATED SECTIONS

A. Section 05 50 00 – Metal Fabrications: Concealed steel support members.

B. Section 06 10 00 – Rough Carpentry.

C. Section 05 41 00 – Structural Metal Studs.

D. Section 07 62 00 – Sheet metal flashing.

E. Section 07 92 00 – Joint Sealants.

F. Section 08 10 00 – Metal Doors and Frames.

G. Section 08 33 00 – Overhead Coiling Doors.

H. Section 08 42 00 – Entrance Doors.

I. Section 22 10 00 – Plumbing Piping:

J. Section 23 21 00 – Hydronic Piping: Hot water heating piping to units.

K. Section 23 22 13- Steam and Condensate Piping: Steam heating piping to units.

L. Section 26 05 00 – Equipment Wiring: Connections to building power distribution.

1.3 REFERENCES

A. ASTM A240 / A240M -10 – Standard Specification for Chromium and Chromium.

B. ASTM A879 / A879M -06 – Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Application Requiring Designation of the Coating Mass on Each Surface.

C. ASTM A653 / A653M -09a – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. UL 507 – UL Standard for Safety Electric Fans – Intertek Testing Services Listed for US and Canada.

E. UL508A – Standard for Industrial Control Panels

F. UL 1995/CSA 22.2 – UL Standard for Safety Heating and Cooling Equipment – Intertek Testing Services Listed for US and Canada.

G. UL 2021/CSA 22,.2 – Standard for Fixed and Location-Dedicated Electric Room Heaters – Intertek Testing Services Listed for US and Canada.

H. AHRI 410-2001 – Standard for Forced-Circulation Air-cooling and Air-Heating Coils.

I. NSF/ANSI 37 – Air Curtains for entranceways in food and food service establishments – ETL Sanitation.

J. AMCA 211 (Air Movement & Control Association International, Inc.) – Certified Ratings Program – Product Rating Manual for Fan Air Performance.

K. CEC – Approved Elec heating Coils

L. Electrical components UL/CUL listed.

M. NEC – National Electric Code.

N. U.S. Green Building Council, LEED Building Design and Construction (BD+C) Version 4.0 Rating System. (LEED v4.0).

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Include plans, elevations, sections, and details, indicating dimensions, tolerances, materials, fasteners, hardware, finish, piping, electrical wiring diagrams, options, and accessories.

~~D. LEED Submittals: Provide documentation of how the requirements of Credit will be met:~~
~~1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.~~
~~2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.~~

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6.25 inches (160 mm) square, representing actual product, color, and patterns.

G. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

H. Operation and Maintenance Manual: Submit manufacturer's operation and maintenance manual, including operation, maintenance, adjustment, and cleaning instructions, trouble shooting guide, parts list, and electrical wiring diagrams.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum ten years documented experience producing the products specified in this Section

B. Installer Qualifications: Minimum five years documented experience installing products specified in this Section

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store in a dry, heated storage area until installation of products.

C. Protect materials and finish from damage during handling and installation.

1.7 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Coordinate the installation of wiring and control switches for air curtains with the openings and the hardware provided for such openings.

C. Install after doors, walls, ceilings, and other adjacent surfaces are finished and painted.

1.8 WARRANTY

A. Standard five-year limited parts warranty for unheated units against defects in workmanship and material.

B. Standard 18-month limited parts warranty for heated units against defects in workmanship and materials.

PART 2 PRODUCTS

2.1 MANUFACTURER

~~A. Acceptable Manufacturer: Mars Air Systems, LLC; 14716 South Broadway St., Gardena, CA 90248. Tel: (310) 532-1555 or (800) 421-1266. Fax: (310) 324-3030. Email: info@marsair.com. Web: www.marsair.com.~~

B. Manufacturers:
1. Mars Air Systems
2. Powered Aire, Inc.
3. Berner Air Curtains

~~C. Delete one of the following two paragraphs: coordinate with requirements of Division 1 section on product options and substitutions.~~

D. Requests for substitutions will be considered in accordance with provisions of Section 01 33 00.

2.2 AIR CURTAIN ASSEMBLIES

A. Motor Fan Assembly: Design for easy removal, assembly, repair, and maintenance.
   1. Motor: Totally enclosed air over (TEAO) cooled motor with sealed lifetime pre-lubricated ball bearings, motor starter and thermal overload protection.
      a. Wired for single speed operation.
      b. Wired for two speed operation. (Not Applicable for Fly Insect Control Unit)
      c. Wired for three speed operation. (Not applicable for Fly Insect Control Unit)
      d. Provide wash down type motors, NEC IP-54 for the locations indicated.
      e. Provide explosion proof type motors, NEC Class 1, Division 1, Group D for the locations indicated.
      f. Electrical Characteristics: 115V AC, single phase; 5.1 Amp full load per motor/fan.
      g. Electrical Characteristics: 208/230V AC, single phase; 2.5 Amp full load per motor/fan.
      h. Electrical Characteristics: 208/230V AC, three-phase; 1.8/1.6 Amp full load per motor/fan.
      i. Electrical Characteristics: 460V AC, three-phase; 0.8 Amp full load per motor/fan.
      j. Electrical Characteristics: 575V AC, three-phase; 0.65 Amp full load per motor/fan.
      k. Meets NEC. ETL Listed to conform to UL 507 (US) and CSA22.2 (Canada) Standards. AMCA 211 Certified.
   2. Fans: Forward curved centrifugal type, double width, and double inlet design, directly driven to an electric motor.
      a. Provide resilient isolation dampening mountings between motor frame and motor mounting pan.
      b. Factory balanced blower wheel assembly statically and dynamically.

B. Housing: Self-contained one-piece type with sufficient strength for mounting from pre-punched mounting holes at both ends to adjacent walls or ceiling without intermediate support.
   1. Size:
      ~~a. Unheated: 12-3/4 inches deep by 10-5/8 inches high (including discharge nozzle) by width of unit.~~
      b. Electric Heated: 17-3/8 inches deep by 10-5/8 inches high (including discharge nozzle) by width of unit.
      ~~c. Hot Water/Steam Heated: Depth 17-3/8 inches single row and double row by 10-5/8 inches high including discharge nozzle by width of unit plus 10 inches for manifolds.~~
   2. Mounting:
      ~~a. Unheated Inside Mount.~~
      b. Heated Inside Mount.
      ~~c. Unheated Outside Mount.~~
      ~~d. Mount Location Indicated.~~
   3. Material:
      a. Provide 18- and 20-gauge electro or hot dipped galvanized steel sheet housing conforming to ASTM A 879 and/or ASTM A 653.
      b. Provide type 304 stainless steel housing with brushed finish. ASTM A 240/A 240M.
   4. Air Inlet Grille and/or Filters: Provide air inlet grille and/or filters specified.
   5. Discharge: Provide integral discharge nozzle specified.
   6. Finish and Color: Provide with, no VOC, corrosion resistant polyurethane powder coated finish for sheet metal housings.
      ~~a. Obsidian Black.~~

b. Pearl White.
c. Titanium Silver.
d. Stainless Steel.
e. Standard color selected by A/E

C. Environmental Air Curtains: Models for Heights to 12 feet (3656 mm) for Environmental Separation and Temperature Control and up to 10 feet (3048 mm) for Flying Insect Control (STD2 series)
1. Discharge Nozzle: Wedge-shaped discharge outlet nozzle with adjustable air foil vanes with a plus/minus 40-degree sweep front to back.
2. Air Velocity at Nozzle:
a. STD236-1: 36 Inch (915 mm) Wide Units: 2206 feet/min (11.2 m/s) single 1/2HP motor/fan assembly.
b. STD242-1: 42 Inch (1065 mm) Wide Units: 1945 feet/min (9.9 m/s) single 1/2HP motor/fan assembly.
c. STD248-1: 48 Inch (1220 mm) Wide Units: 1730 feet/min (8.8 m/s) single 1/2HP motor/fan assembly.
d. STD260-2: 60 Inch (1524 mm) Wide Units: 2592 feet/min (13.2 m/s) single 1/2HP motor/fan assembly.
e. STD272-2: 72 Inch (1830 mm) Wide Units: 2206 feet/min (11.2 m/s) two 1/2HP motor/fan assemblies.
f. STD284-2: 84 Inch (2133 mm) Wide Units: 1945 feet/min (9.9 m/s) two 1/2HP motor/fan assemblies.
g. STD296-2: 96 Inch (2440 mm) Wide Units: 1730 feet/min (8.8 m/s) two 1/2HP motor/fan assemblies.
h. STD2108-3: 108 Inch (2743 mm) Wide Units: 2206 feet/min (11.2 m/s) two 1/2HP motor/fan assemblies.
i. STD2120-3: 120 Inch (3050 mm) Wide Units: 2084 feet/min (10.6 m/s) three 1/2HP motor/fan assemblies.
j. STD2144-3: 144 Inch (3660 mm) Wide Units: 1730 feet/min (8.8 m/s) three 1/2HP motor/fan assemblies.
3. Air Speed at Floor: Minimum of 300 fpm (1.53 m/s) at 3 feet (914 mm) from the floor.
4. Air Inlet Grille and Filters:
a. Location: Front.
b. Type: Fixed air intake grille.
1) Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable.
c. Type: Filter Only as follows:
1) Filter: Flat bank 1-inch, disposable.
2) Filter: Flat bank 2-inch, disposable.
3) Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable.
4) Filter: HEPA filtration, 12” HEPAC section with disposable filters
d. Type: UV Only as follows
1) UV: UVC & UVV germicidal and odor elimination, 5-1/2” UV section with disposable UV bulbs
e. Speed: 2550 cu ft/min (1200 L/s), minimum, per motor/fan assembly.
5. Sound Pressure Level At 10 feet (3 m) From Nozzle:
a. Single Motor/Fan Units: 66 dBA.
b. Two Motor/Fan Units: 68 dBA.
c. Three Motor/Fan Units: 71 dBA.
d. Four Motor/Fan Units: 73 dBA.

D. Insect Control Air Curtains: Models for Heights up to 7 feet (3048 mm) for Flying Insect Control. Certified to NSF/ANSI Standard 37. (N2 Series)
1. Discharge Nozzle: Wedge-shaped discharge outlet nozzle with adjustable air foil vanes with a plus/minus 40-degree sweep front to back.
2. Air Velocity at Nozzle:

a. N236-1: 36 Inch (915 mm) Wide Units: 2206 feet/min (11.2 m/s) single 1/2HP motor/fan assembly.
b. N242-1: 42 Inch (1065 mm) Wide Units: 1945 feet/min (9.9 m/s) single 1/2HP motor/fan assembly.
c. N248-1: 48 Inch (1220 mm) Wide Units: 1730 feet/min (8.8 m/s) single 1/2HP motor/fan assembly.
d. N260-2: 60 Inch (1524 mm) Wide Units: 2592 feet/min (13.2 m/s) single 1/2HP motor/fan assembly.
e. N272-2: 72 Inch (1830 mm) Wide Units: 2206 feet/min (11.2 m/s) two 1/2HP motor/fan assemblies.
f. N284-2: 84 Inch (1830 mm) Wide Units: 1945 feet/min (9.9 m/s) two 1/2HP motor/fan assemblies.
g. N296-2: 96 Inch (2440 mm) Wide Units: 1730 feet/min (8.8 m/s) two 1/2HP motor/fan assemblies.
h. N2108-3: 108 Inch (2743 mm) Wide Units: 2206 feet/min (11.2 m/s) two 1/2HP motor/fan assemblies.
i. N2120-3: 120 Inch (3050 mm) Wide Units: 2084 feet/min (10.6 m/s) two 1/2HP motor/fan assemblies.
j. N2144-3: 144 Inch (3600 mm) Wide Units: 1730 feet/min (8.8 m/s) two 1/2HP motor/fan assemblies.

3. Air Speed at Floor:
   a. Customer entry doors require a minimum of 600 fpm (3.05 m/s) at 3 feet (914 mm) from floor.
4. Air Inlet Grille and Filters:
   a. Location: Front.
   b. Speed: 2550 cu ft/min (1200 L/s), minimum, per motor/fan assembly.
      1) Type: Fixed air intake grille.
5. Sound Pressure Level At 10 feet (3 m) From Nozzle:
   a. Single Motor/Fan Units: 66 dBA.
   b. Two Motor/Fan Units: 68 dBA.
   c. Three Motor/Fan Units: 71 dBA.
   d. Four Motor/Fan Units: 73 dBA

2.3 COMPONENTS

A. Electric Heaters: Provide complete with motor control panel factory mounted to air curtain housing, and thermostat to be field installed
   1. Temperature limit controller.
   2. Thermostat: Wall-mounted, 24-Volt operation, with heater on/off selection.
   3. Heating Coils: ETL approved as part of unit. Meets NEC and CEC tested by ETL Certified to conform to UL2021(US) and CSA22.2 (Canada) Standards. Factory mounted on the discharge end of the motor fan assembly and located within the nozzle outlet.

~~B. Steam Heaters: Provide finned tube steam coils for field mounting on air intake side of the air curtain cabinet with opposite end connections.~~
   ~~1. Meets NEC and CEC tested by ETL Certified to conform to UL1995(US) and CSA22.2 (Canada) Standards.~~
   ~~2. Output: Air curtain manufacturer's standard, one-row coils.~~
   ~~3. Coils: Certified in accordance with AHRI 410.~~
   ~~4. Connections: Opposite end.~~
   ~~5. Connections: Same end, right hand.~~
   ~~6. Connections: Same end, left hand.~~
   ~~7. Casing: One-piece unpainted galvanized steel, bolted to air curtain housing.~~
   ~~8. Supply and return fittings on ends of casing.~~
   ~~9. Steam Distributing coil required for 8 feet and above for same end coils. Dual supply, Single returns.~~

10. Thermostat: Wall-mounted, 110-Volt operation, with heater on/off selection.
11. Thermostat: Wall-mounted, 208/230-Volt operation, with heater on/off selection.

C. Hot Water Heaters: Provide finned tube water coils for field mounting on air intake side of the air curtain cabinet with opposite end connections.
1. Meets NEC and CEC tested by ETL Certified to conform to UL1995(US) and CSA22.2 (Canada) Standards.
2. Output: Air curtain manufacturer's standard, one-row coils.
3. Output: Air curtain manufacturer's standard, two-row coils.
4. Coils: Certified in accordance with AHRI 410.
5. Connections: Opposite end.
6. Connections: Same end, right hand.
7. Connections: Same end, left hand.
8. Casing: One-piece unpainted galvanized steel, bolted to air curtain housing.
9. Supply and return fittings on top of casing.
10. Thermostat: Wall-mounted, 110-Volt operation, with heater on/off selection.
11. Thermostat: Wall-mounted, 208/230-Volt operation, with heater on/off selection.

D. Motor Control Panels for Unheated Units: Recommended for all three-phase units and single phase units with combined motor capacities of more than 1 HP whenever a door limit switch is used to automatically start and stop the air curtain. Provide motor control panels as follows:
1. Mounting: Shipped loose to be field mounted.
2. Mounting: Factory mounted on right hand side of air curtain housing.
3. Mounting: Factory mounted on left hand side of air curtain housing.
4. Electrical components UL/CUL listed.
5. Panels UL 508A listed.
6. Optional Digital Programmable Controller:
   a. WiFi enabled controller for wireless interface with field supplied smartphone, tablet or computer
   b. No download or app required for wireless interface
   c. Wireless control range up to minimum of 50 feet from controller
   d. Fully factory assembled and wired inside the air curtain for easy field installation
   e. Optional remote mounted high resolution 7” Color LCD Display with resistive touchscreen technology
   f. Fully programmable controller
   g. Pre-set and fully customizable programs
   h. Time delay (Passive & Adaptive)
   i. 24/7/365 timer
   j. Maintenance schedule alerts
   k. Password protected
   l. Low voltage control signal for door activation
   m. Multispeed fan control
   n. Optional VFD compatible with 0-10VDC output
   o. Optional Integrated BMS controls
   p. Optional BACnet MS/TP
   q. Optional BACnet IP
   r. Optional adaptive fan speed control based on existing field conditions. Field mounted outdoor temperature sensors required.

E. Motor Control Panels for Electric HeateSd Units: Motor Control Panel is included for all electric heated units. Thermostat is provided for field installation. Provide motor control panels as follows:
1. Mounting: Factory mounted on the inside of air curtain housing.
2. Mounting: Factory mounted on right hand side of air curtain housing.
3. Mounting: Factory mounted on left hand side of air curtain housing.

4. Electrical components UL/CUL listed.
5. Optional Digital Programmable Controller:
    a. WiFi enabled controller for wireless interface with field supplied smartphone, tablet or computer
    b. No download or app required for wireless interface
    c. Wireless control range up to minimum of 50 feet from controller
    d. Fully factory assembled and wired inside the air curtain for easy field installation
    e. Optional remote mounted high resolution 7" Color LCD Display with resistive touchscreen technology
    f. Fully programmable controller
    g. Pre-set and fully customizable programs
    h. Time delay (Passive & Adaptive)
    i. Factory Integrated temperature control sensors. No external thermostat required.
    j. Heat on Demand Mode to regulate the space temperature
    k. Summer-Winter modes
    l. 24/7/365 timer
    m. Maintenance schedule alerts
    n. Password protected
    o. High temperature lock from fan failure
    p. Low voltage control signal for door activation
    q. Multispeed fan control
    r. Optional VFD compatible with 0-10VDC output
    s. Optional Integrated BMS controls
    t. Optional BACnet MS/TP
    u. Optional BACnet IP
    v. Optional adaptive fan speed control and heat control based on existing field conditions. Field mounted outdoor temperature sensors required.

F. Motor Control Panels For Hot Water and Steam Heated Units: Recommended for all three-phase units and single phase units with combined motor capacities of more than 1HP whenever a door limit switch is used to automatically start and stop the air curtain. Provide motor control panels as follows:
1. Mounting: Shipped loose to be field mounted.
2. Mounting: Factory mounted on right hand side of air curtain housing.
3. Mounting: Factory mounted on left hand side of air curtain housing.
4. Provide with remote mount thermostat for field installation.
5. Electrical components UL/CUL listed.
6. Panels UL 508A listed.
7. Optional Digital Programmable Controller:
    a. WiFi enabled controller for wireless interface with field supplied smartphone, tablet or computer
    b. No download or app required for wireless interface
    c. Wireless control range up to minimum of 50 feet from controller
    d. Fully factory assembled and wired inside the air curtain for easy field installation
    e. Optional remote mounted high resolution 7" Color LCD Display with resistive touchscreen technology
    f. Fully programmable controller
    g. Connect and control via any web browser
    h. Factory built wireless router with over 50 feet range
    i. Pre-set and fully customizable programs
    j. Time delay (Passive & Adaptive)
    k. Factory Integrated temperature control sensors. No external thermostat required.
    l. Heat on Demand Mode to regulate the space temperature

m. Summer-Winter modes
n. 24/7/365 timer
o. Maintenance schedule alerts
p. Password protected
q. High temperature lock from fan failure
r. Low voltage control signal for door activation
s. Multispeed fan control
t. Optional VFD compatible with 0-10VDC output
u. Optional Integrated BMS controls
v. Optional BACnet MS/TP
w. Optional BACnet IP
x. Optional adaptive fan speed control and heat control based on existing field conditions. Field mounted outdoor temperature sensors required.

G. Door-Activated Limit switch(s): Provide, field installed 250-Volts, 20 amps limit switch to control air curtain(s) as follows; Automatic on/off control, activates air curtain when door is opened and turns off when door is closed. Provide limit switch for direct control one 1 HP or up to two 1/2 HP single phase motors without a separate control panel. Provide a separate control panel for three-phase motors controlled by a limit switch.
1. Type: Combination plunger/roller switch for swing and sliding doors.
   a. Provide limit switches with NEMA 1 (20 amps) ratings in locations indicated.
   b. Provide limit switches with NEMA 4X (10 amps) ratings in locations indicated.
   c. Provide limit switches with NEMA 4X (15 amps) ratings in locations indicated.
   d. Provide limit switches with NEMA 7 (10 amps) ratings in locations indicated.
2. Type: Magnetic reed switch and actuator for swing and sliding doors. Industrial floor mounted or surface mounted switches for roll up doors.
3. Operation for Unheated Units: Automatic on/off control, on when door is opened, off when door is closed.
4. Operation for Heated Units: Automatic on when door is opened, off after time delay period after door is closed, maintaining heat in the event door is opened within time delay period. Field adjustable from 1 to 17 minutes.

H. Provide mounting hardware as required for the opening.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that required utilities are in correct location and are of correct capacities for specified products.

B. Verify openings to receive air curtains are plumb, level, square, accurately aligned, correctly located, and in tolerance.

C. Examine surfaces to receive air curtains. If surface preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install air curtains in accordance with approved shop drawings and manufacturer's printed installation instructions.

B. Install air curtains plumb, level, square, true to line, and weathertight, without warp or rack.

C. Anchor air curtains securely in place to supports.

D. Coordinate with sheet metal flashing as specified in Section 07 62 00.

E. Install joint sealants as specified in Section 07 92 00.

F. Coordinate with electrical power as specified in Section 26 05 00.

G. Install door limit switches and adjust for correct operation.

H. Provide connection to piped services and utilities as specified in Section 22 10 00 and 23 21 00.

3.3 FIELD QUALITY CONTROL

A. Adjust air curtains to function properly.

B. Adjust air foil vanes located within the discharge nozzle as required for prevailing conditions at each opening.

C. Check heated air curtain performance on a calm day by measuring air temperature 6 inches off the floor. Optimal reading is halfway between the temperature inside and outside the building.

3.4 CLEANING

A. Clean air curtains promptly after installation in accordance with manufacturer's instructions.

B. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

C. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.5 PROTECTION

A. Protect materials and finish from damage until substantial completion.

3.6 SCHEDULES

A. Refer to Air Curtain Schedule appended to this section.

END OF SECTION

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Fan-powered air terminal units.
   2. VAV Reheat Terminal Units

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.3 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
      a. Instructions for resetting minimum and maximum air volumes.
      b. Instructions for adjusting software set points.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 COORDINATION

A. Coordinate layout and installation of air terminal units 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.

PART 2 - PRODUCTS

2.1 FAN-POWERED AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat; a Mestek Company.
   2. Carnes.
   3. Environmental Technologies, Inc.;/Johnson Controls.
   4. Krueger.
   5. METALAIRE, Inc.; Metal Industries Inc.
   6. Nailor Industries of Texas Inc.
   7. Price Industries.
   8. Trane Co. (The); Worldwide Applied Systems Group.
   9. Tuttle & Bailey.

B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch steel.
   1. Casing Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
   2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
   3. Air Outlet: S-slip and drive connections.
   4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
   2. Damper Position: Normally closed.

E. Damper Actuator
   1. DDC electronic damper actuator for fixing air flow on terminal shall be supplied by temperature control contractor and shipped for factory installation by terminal unit manufacturer.

F. Velocity Sensor
   1. Velocity sensor shall be averaging multi-point flow cross or ring type provided as an integral part of box by terminal unit manufacturer. Control of terminal unit velocity sensor shall be by unitary controller provided by Temperature Control Contractor.

G. Fan Section: Galvanized-steel plenum, with direct-drive, forward-curved fan with air filter and backdraft damper.
   1. Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
   2. Motor: Multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
      a. Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.
      b. Fan-Motor Assembly Isolation: Rubber isolators.
   3. Air Filter: 1-inch thick, fiberglass throwaway.

H. Attenuator Section: 0.034-inch steel sheet metal (factory provided or field fabricated).
   1. Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
   2. Line as a minimum the first four feet after the heating coil unless indicated otherwise on Contract Documents.

I. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

J. Multioutlet Attenuator Section: With collars of size and quantity denoted on Drawings; each with locking butterfly balancing damper.

K. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

L. Factory-Mounted and -Wired Controls: Electrical components shall be mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
2. Wiring Terminations: Fan, relay, and controls to terminal strip, and terminal lugs shall match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
3. Disconnect Switch: Factory-mounted, fused type.
4. For DDC control, a multi-port averaging type velocity sensor shall be provided as an integral part of box by terminal unit manufacturer. Velocity controller shall be furnished by Temperature Control Contractor and factory installed by terminal unit manufacturer at cost to the terminal unit manufacturer.
5. DDC electronic damper actuator for fixing air flow on terminal shall be supplied by temperature control contractor and shipped for factory installation by terminal unit manufacturer.
6. Solid state fan speed control as specified in Article 2.3, G.2.a. above.
7. Temperature Control Contractor shall provide DDC unitary controller to terminal unit manufacturer complete with wiring diagram for factory installation by terminal unit manufacturer.
8. All testing and calibration of control system shall be by Temperature Control Contractor.

M. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."

2.2 VAV REHEAT TERMINAL BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.;/Johnson Controls.
4. Krueger.
5. METALAIRE, Inc.; Metal Industries Inc.
6. Nailor Industries of Texas Inc.
7. Price Industries.
8. Trane Co. (The); Worldwide Applied Systems Group.
9. Tuttle & Bailey.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch steel.
1. Casing Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Normally closed.

E. Damper Actuator
1. DDC electronic damper actuator for fixing air flow on terminal shall be supplied by temperature control contractor and shipped for factory installation by terminal unit manufacturer.

F. Velocity Sensor
1. Velocity sensor shall be averaging multi-point flow cross or ring type provided as an integral part of box by terminal unit manufacturer. Control of terminal unit velocity sensor shall be by unitary controller provided by Temperature Control Contractor.

G. Attenuator Section: 0.034-inch steel sheet metal (factory provided or field fabricated).
1. Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
2. Line as a minimum the first four feet after the heating coil unless indicated otherwise on Contract Documents.

H. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

I. Multioutlet Attenuator Section: With collars of size and quantity denoted on Drawings; each with locking butterfly balancing damper.

J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

K. Factory-Mounted and -Wired Controls: Electrical components shall be mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
2. Wiring Terminations: Fan, relay, and controls to terminal strip, and terminal lugs shall match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
3. Disconnect Switch: Factory-mounted, fused type.
4. For DDC control, a multi-port averaging type velocity sensor shall be provided as an integral part of box by terminal unit manufacturer. Velocity controller shall be furnished by Temperature Control Contractor and factory installed by terminal unit manufacturer at cost to the terminal unit manufacturer.
5. DDC electronic damper actuator for fixing air flow on terminal shall be supplied by temperature control contractor and shipped for factory installation by terminal unit manufacturer.
6. Solid state fan speed control as specified in Article 2.3, G.2.a. above.
7. Temperature Control Contractor shall provide DDC unitary controller to terminal unit manufacturer complete with wiring diagram for factory installation by terminal unit manufacturer.
8. All testing and calibration of control system shall be by Temperature Control Contractor.

L. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."

2.3 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve or automatic flow control valve and union or flange.

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Ground units with electric heating coils according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
2. Verify that controls and control enclosure are accessible.
3. Verify that control connections are complete.
4. Verify that nameplate and identification tag are visible.
5. Verify that controls respond to inputs as specified.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:
1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. A model number is indicated for each product as an example of the device required.
a. A-J Manufacturing Co., Inc.
b. Anemostat; a Mestek Company.
c. Carnes.
d. Dayus Register & Grille.
e. Hart & Cooley, Inc.; Hart & Cooley Div.
f. Krueger.
g. METALAIRE, Inc.; Metal Industries Inc.
h. Nailor Industries of Texas Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

2.2 SQUARE PANEL CEILING DIFFUSER (Type A)

A. All 18 gauge steel diffuser.

B. Round neck connection, dimension as scheduled on Drawings.

C. Solid face panel with curved back pan designed for VAV usage. Face panel shall be easily removed.

D. Back pan shall be one-piece die-formed with smooth surfaces and no corner joints.

E. Baked white enamel finished unless otherwise denoted on Drawings.

F. Provide blank-off plates to convert diffuser to 2-way or 3-way blow where indicated on Drawings.

G. Equivalent to Titus “Omni.”

2.3 SQUARE ALUMINUM LOUVERED RETURN GRILLE (Type B)

A. ¾” BLADE SPACING

B. Aluminum border, if required.

C. Size as scheduled on the Drawings.

D. Surface mount or lay-in border as required by installation.

E. Baked white enamel or powder paint white finish.

F. Equivalent to Titus “350FL”

2.4 EGGCRATE GRILLE (TYPE C)

A. 1/2 inch by 1/2 inch by 1/2 inch aluminum grid.

B. Aluminum border, if required.

C. Size as scheduled on the Drawings.

D. Surface mount or lay-in border as required by installation.

E. Baked white enamel or powder paint white finish.

F. Equivalent to Titus “Model 50.”

2.5 SIDEWALL SUPPLY GRILLE (TYPE D1)

A. All steel construction, 20 gauge border.

B. Double deflection blades, 3/4 inch blade spacing.

C. Front and rear blades, individually adjustable. Blades shall have steel friction pivots on both ends; plastic blade pivots are not acceptable.

D. Front blades parallel to long dimension.

E. Surface mounted.

F. Baked white enamel finish.

G. Size of grille as indicated on Drawings.

H. Equivalent to Titus “300RS.”

2.6 LONG THROW, HIGH CAPACITY ALUMINUM SUPPLY GRILLE (TYPE D2)

A. All steel construction, 20 gauge border.

B. Dimension as scheduled on Drawings.

C. Blades to be individually adjustable. Blades shall have steel friction pivots on both ends; plastic blade pivots are not acceptable.

D. Front blades parallel to short dimension.

E. Duct mounted.

F. Baked white enamel finish.

G. Size of grille as indicated on Drawings.

H. Equivalent to Titus “S-DL & S-DL-SV.”

2.17 LINEAR SLOT DIFFUSER (TYPE F)

A. Pattern controllers shall be one piece extruded aluminum, 24 inches long maximum, positioned between spring loaded spacers. Pattern controllers shall allow the airstream to be directed flat against the ceiling in either direction or downward, as well as allowing throw reduction every two feet along the entire length of the linear slot diffusers. The airstream shall be maintained at the ceiling plane and shall not dump when volume is reduced. Pattern controllers shall be field adjustable from the face of the diffuser.

B. Material shall be minimum wall thickness 0.062 extruded aluminum. Spring steel retainers shall be used under the spacers to hold the slot diffusers assembly tightly together.

C. Factory mounted plenums shall be minimum 24 gauge galvanized steel and lined inside with black matte fiberglass insulation.

D. Flanges exposed to view shall be painted factory standard white. All other surfaces shall be painted flat.

E. For lay-in ceiling, provide hanger wire support clips that are integral with the linear slot diffusers allowing the linear slot diffusers to be supported from the building structure with ceiling wire.

F. Slot width, number of slots, diffuser length and inlet collar size shall be as scheduled on the Drawings.

G. Equivalent to Titus FlowBar-FlowTee “FTI-15-HT and “FTI-20-HT.”

2.7 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
   1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
      a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
      b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.

~~1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS~~

~~A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:~~
   ~~1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.~~
      ~~a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."~~
      ~~b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."~~
   ~~2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.~~
   ~~3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.~~

1.5 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

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.

1.8 WARRANTY

A. Special Warranty
1. The pressure vessel/heat exchanger shall have a 5 year warranty against failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
2. The control panel shall have a 2 year warranty against failure due to defective materials or workmanships.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fulton Boiler Works, Inc.
2. ~~Gasmaster Industries Incorporated.~~
3. Hydrotherm, Inc.; a division of Mestek, Inc.
4. AERCO International.
5. Heat Transfer Products, Inc.
6. Laars Heating Systems; a division of Waterpik Technologies, Inc.
7. Lochinvar Corporation.
8. Viessmann Manufacturing Co. (US) Inc.

2.2 PULSE-COMBUSTION CONDENSING BOILERS.

A. Description: Factory-fabricated, -assembled, and -tested, pulse-combustion 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.

B. Heat Exchanger: Type 316L, stainless-steel primary and secondary combustion chamber.

C. Pressure Vessel: Carbon steel with welded heads and tube connections.

D. Exhaust Decoupler: Fiberglass composite material in a corrosion-resistant steel box.

E. Burner: Natural gas, self-aspirating and self-venting after initial start.

F. Blower: Centrifugal fan to operate only during start of each burner sequence.
1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC 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.

G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

I. Casing:
1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosure: NEMA 250, Type 1A.
3. Finish: Baked-enamel or powder-coated protective finish.
4. Insulation: Minimum 2-inch thick, mineral-fiber insulation surrounding the heat exchanger.
5. Draft Hood: Integral or external.
6. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
7. Mounting base to secure boiler to concrete base.
   a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when mounting base is anchored to building structure.

J. Mufflers: Carbon-steel intake muffler and stainless-steel exhaust.

K. Condensate Trap: Cast-iron body with stainless-steel internal parts.

2.3 CAST IRON CONDENSING BOILERS

A. Combustion Chamber: The combustion chamber shall be constructed of cast-iron. It shall be a down-fired design utilizing lightweight refractory around the burner housing.

B. Heat Exchanger: Boilers shall be a cast iron sectional unit designed for pressure firing and shall be constructed and tested for 100 P.S.I water working pressure, in accordance with the A.S.M.E. Section IV Rules for the Construction of Heating Boilers. Individual sections will have been subjected to a hydrostatic pressure test of 250 PSIG at the factory before shipment and they shall be marked, stamped or cast with the A.S.M.E. Code symbol. Boilers with less than 250-psi pressure test will not be acceptable for this project. The sections shall be of a down fired counter flow single-pass design. Water ports will be sealed with graphite port connectors. The sections will be fully machined for metal to metal sealing of the gas side surfaces. The design will provide for equal temperature rise through all sections. The heat exchanger shall be designed to prevent fluid boiling. The iron shall have a minimum thickness of ¼". The heat exchanger design should have no limitations on temperature rise or restrictions to inlet water temperature and a Cv of 60.

C. Jackets: Stainless Steel.

D. Gas Burner: The burner shall be metal fiber mesh construction, allowing high turndown of the fuel-air mixture. The burner flame shall burn horizontally and be of the pre-mix type with a forced draft fan. Burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for maintenance without the disruption of any other major component of the boiler. A window view port shall be provided for visual inspection of the boiler during firing. The gas distribution components and burner shall be enclosed with a cast-aluminum housing.

E. Ignition components: The ignition hardware shall consist of Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.

F. Rated Capacity: The boiler shall be capable of operating at rated capacity with pressures as low as 2” W.C. at the inlet to the burner pressure regulator.

G. The burner shall be capable of 99% efficiency without exceeding a Nox reading above 11ppm.

H. The burner and gas train shall be provided with the following trim and features:
   1. Burner Firing: Full modulation with 5:1 turndown @ Continuous CO2
   2. Burner Ignition: Interrupted spark
   3. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
   4. Flue-Gas Collector: Enclosed combustion chamber with integral combustion-air blower and single venting connection.
   5. Gas Train: Manual gas valves (2), main gas valve (solenoid), manual test and check valves, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted and CSD-1 compliant.
   6. Safety Devices: Low gas pressure switch, air-flow switch, and blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset. All safeties to be factory mounted.
   7. Individual gas regulator provided by factory, shipped loose for field installation, one per boiler.

2.4 FIRE-TUBE CONDENSING BOILERS.

A. 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. Water heating service only.

B. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.

C. Pressure Vessel: Carbon steel with welded heads and tube connections.

D. Burner: Natural gas, forced draft.

E. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
   1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC 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.

F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

G. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

H. Casing:
   1. Jacket: Sheet metal or plastic, with snap-in or interlocking closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   3. Finish: Baked-enamel or powder-coated protective finish.
   4. Insulation: Minimum 2-inch thick, mineral-fiber insulation surrounding the heat exchanger.
   5. Combustion-Air Connections: Inlet and vent duct collars.
   6. Mounting base to secure boiler.
      a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when mounting base is anchored to building structure.

2.5 WATER-TUBE CONDENSING BOILERS

A. Description: Factory-fabricated, -assembled, and -tested, water-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. Water heating service only.

B. Heat Exchanger: Finned-copper primary and stainless-steel secondary heat exchangers.

C. Combustion Chamber: Stainless steel, sealed.

D. Burner: Natural gas, forced draft drawing from gas premixing valve.

E. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
   1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC 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.

F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

G. Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.

H. Integral Circulator: Cast-iron body and stainless-steel impeller sized for minimum flow required in heat exchanger.

I. Casing:
   1. Jacket: Sheet metal, with snap-in or interlocking closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   3. Finish: Textured epoxy.
   4. Insulation: Minimum 1-inch thick, mineral-fiber insulation surrounding the heat exchanger.
   5. Combustion-Air Connections: Inlet and vent duct collars.
   6. Mounting base to secure boiler.
      a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when mounting base is anchored to building structure.

2.6 WATER-JACKETED CONDENSING BOILERS

A. Description: Factory-fabricated, -assembled, and -tested, water-jacketed condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; water supply, return, and condensate drain connections; and controls. Water heating service only.

B. Heat Exchanger: Stainless-steel primary and secondary combustion chamber.

C. Pressure Vessel: Carbon steel with welded heads and tube connections where not in contact with combustion or flue gases.

D. Burner: Natural gas, forced draft; swing-open front and burner observation port.

E. Blower: Centrifugal fan, forced draft. Include prepurge and postpurge of the combustion chamber.
   1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC 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.

F. Gas Train: Combination gas valve with manual shutoff and pressure regulator. Include 100 percent safety shutoff with electronic flame supervision.

G. Ignition: Electric-spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

H. Casing:
1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Powder-coated protective finish.
4. Insulation: Minimum 4-inch thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.
6. Mounting base to secure boiler.
a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when mounting base is anchored to building structure.

2.7 TRIM

A. Aquastat Controllers: Operating, firing rate, and high limit.

B. Safety Relief Valve: ASME rated.

C. Pressure and Temperature Gauge: Minimum 3-1/2-inch diameter, combination water-pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

D. Boiler Air Vent: Automatic.

E. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

F. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.8 CONTROLS

A. Refer to Division 23 Section "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. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 200 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.
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: Automatic reset stops burner if operating conditions rise above maximum boiler design.

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 field 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 Management System Interface: Factory install hardware and software to enable building management 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 communication interface with building management system shall enable building management system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building management system. Communication protocol shall be coordinated with the temperature control contractor for correct communication. BACnet, Lon, or TCP/IP are acceptable as selected by Temperature Control Contractor.

2.9 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 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 wire lugs.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

C. Division 26 shall provide a fused disconnect to each boiler. Control voltage transformer shall be provided by unit manufacturer.

2.10 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.11 SOURCE QUALITY CONTROL

A. 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.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, 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 boiler performance, maintenance, and operations.
   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. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

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 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. 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 Division 23 Section "Common Work Results for HVAC."

E. 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.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:
   1. Install flue venting kit and combustion-air intake.
   2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."

I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform 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. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 52 16

SECTION 23 64 23 - SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Packaged, water-cooled, electric-motor-driven, scroll water chillers.
   2. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

B. Related Sections:
   1. Division 28 Section "Refrigerant Detection and Alarm" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

C. Related Work by Others
   1. Division 26 shall supply main power wiring to single point connection at unit. Provide primary and secondary fused control power transformer and a separate internal 115 volt single phase connection for evaporator heater.
   2. Temperature Control Contractor shall provide interconnecting wiring required to communications with the temperature control system.

1.2 DEFINITIONS

A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
   1. Performance at ARI standard conditions and at conditions indicated.
   2. Performance at ARI standard unloading conditions.
   3. Minimum evaporator flow rate.
   4. Refrigerant capacity of water chiller.
   5. Oil capacity of water chiller.
   6. Fluid capacity of evaporator.
   7. Fluid capacity of condenser.
   8. Characteristics of safety relief valves.

9. Minimum entering condenser-water temperature.
10. Minimum entering condenser-air temperature

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.
6. Refrigerant piping layout for remote evaporator barrel.

C. Coordination Drawings: Floor 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. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Seismic Qualification Certificates: For water chillers, accessories, and components from manufacturers.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control test reports.

C. Startup service reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 590 certification program.

B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. ASHRAE Compliance:
1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE Guideline 3 for refrigerant leaks, recovery, and handling and storage requirements.
3. ASHRAE/IESNA 90.1 for energy efficiency.

D. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

E. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.
   1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED AIR-COOLED WATER CHILLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carrier Corporation; a United Technologies company.
   2. Trane.
   3. York International Corporation.

B. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.

C. Fabricate base, frame, and attachment to water chiller components strong enough to resist movement during a seismic event when water chiller base is anchored to field support structure.

D. Cabinet:
   1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
   2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
   3. Casing: Galvanized steel.
   4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
   5. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

E. Compressors:
   1. Description: Positive-displacement direct drive with hermetically sealed casing.
   2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
   3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
   4. Capacity Control: On-off compressor cycling
   5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
   6. Vibration Isolation: Mount individual compressors on vibration isolators.

F. Compressor Motors:
   1. Hermetically sealed and cooled by refrigerant suction gas.
   2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

G. Compressor Motor Controllers:
   1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

H. Refrigeration:
   1. Refrigerant: R454B. Classified as Safety Group A1 according to ASHRAE 34.
   2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
   3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
   4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

I. Evaporator
   1. Brazed Plate:
      a. Direct-expansion, single-pass, brazed-plate design.
      b. Type 316 stainless-steel construction.
      c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
      d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.
   2. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.

J. Air-Cooled Condenser:
   1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
      a. Construct coils of copper tubes mechanically bonded to aluminum fins.
   2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
   3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
   4. Fan Guards: Steel safety guards with corrosion-resistant coating.

K. Electrical Power:
   1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
   2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
   3. Wiring shall be numbered and color-coded to match wiring diagram.
   4. Install factory wiring outside of an enclosure in a raceway.
   5. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
   6. Provide branch power circuit to each motor and to controls with the following disconnecting means:
      a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
      b. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
   7. Provide each motor with overcurrent protection.
   8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
   9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.

10. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
    a. Power unit-mounted controls where indicated.
11. Control Relays: Auxiliary and adjustable time-delay relays.
12. Indicate the following for water chiller electrical power supply:
    a. Current, phase to phase, for all three phases.
    b. Voltage, phase to phase and phase to neutral for all three phases.
    c. Three-phase real power (kilowatts).
    d. Three-phase reactive power (kilovolt amperes reactive).
    e. Power factor.
    f. Running log of total power versus time (kilowatt hours).
    g. Fault log, with time and date of each.

L. Controls:
1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
    a. Date and time.
    b. Operating or alarm status.
    c. Operating hours.
    d. Outside-air temperature if required for chilled-water reset.
    e. Temperature and pressure of operating set points.
    f. Entering and leaving temperatures of chilled water.
    g. Refrigerant pressures in evaporator and condenser.
    h. Saturation temperature in evaporator and condenser.
    i. No cooling load condition.
    j. Elapsed time meter (compressor run status).
    k. Pump status.
    l. Antirecycling timer status.
    m. Percent of maximum motor amperage.
    n. Current-limit set point.
    o. Number of compressor starts.
4. Control Functions:
    a. Manual or automatic startup and shutdown time schedule.
    b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water or outside-air temperature.
    c. Current limit and demand limit.
    d. External water chiller emergency stop.
    e. Antirecycling timer.
    f. Automatic lead-lag switching.
5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
    a. Low evaporator pressure or high condenser pressure.
    b. Low chilled-water temperature.
    c. Refrigerant high pressure.
    d. High or low oil pressure.
    e. High oil temperature.
    f. Loss of chilled-water flow.
    g. Control device failure.
6. Building Management System Interface: Factory-installed hardware and software to enable building management system to monitor, control, and display water chiller status and alarms.
    a. Hardwired Points:
        1) Monitoring: On/off status, common trouble alarm, electrical power demand (kilowatts), electrical power consumption (kilowatt hours).
        2) Control: On/off operation, chilled-water discharge temperature set-point adjustment, electrical power demand limit.

b. ASHRAE 135 BACnet, TCP/IP or Industry-accepted open-protocol communication interface with building management system shall enable building management system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building management system. Communication protocol shall be coordinated with the Temperature Control Contractor prior to shop drawing approval.

M. Insulation:
1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: 3/4 inch.
3. Factory-applied insulation over cold surfaces of water chiller components.
a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
4. Apply protective coating to exposed surfaces of insulation.

N. Accessories:
1. Factory-furnished, chilled-water flow switches for field installation.
2. Individual compressor suction and discharge pressure gauges with shutoff valves for each refrigeration circuit.

2.2 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory test and inspect evaporator and water-cooled condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

C. For water chillers located indoors, rate sound power level according to ARI 575 procedure.

D. For water chillers located outdoors, rate sound power level according to ARI 370 procedure.

2.3 REFRIGERANT MONITORS

A. The refrigerant monitoring system shall be a microprocessor based refrigerant leak detector monitor, complying with ASHRAE 15. The system shall include an LCD display indicating refrigerant concentration in parts per million (PPM). The system shall be selected as required based on the refrigerant present.

B. The refrigerant monitoring system shall interface and engage the refrigerant purge exhaust fan and dampers as required for a complete and operational system.

C. The refrigerant monitoring system shall include indicators for normal operation, warning, and alarm conditions.

D. The refrigerant monitoring system shall include contacts as required for monitoring through the BAS.

E. Install refrigerant monitoring systems per manufacturer's requirements.
1. The refrigerant monitor may be mounted inside or outside of the mechanical room.
2. The leak detection element shall be mounted in the mechanical room near the chiller(s).
3. The system shall include visual and audible alarm inside and outside of the mechanical room.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
   1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Install water chillers on support structure indicated.

B. Equipment Mounting: Install water chiller on concrete bases using elastomeric pads. Comply with requirements in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
   1. Minimum Deflection: 1/4 inch.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Equipment Mounting: Install water chiller using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
   1. Minimum Deflection: 1/4 inch.

D. Equipment Mounting: Install water chiller on vibration isolation inertia bases. Comply with requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Equipment Mounting: Install water chiller on concrete bases. Comply with requirements in Division 03 Section "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Maintain manufacturer's recommended clearances for service and maintenance.

G. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

H. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements in Division 23 Section "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Division 23 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to chiller to allow service and maintenance.

D. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gauge, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.

E. Condenser Fluid Connections: Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gauge, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.

F. Refrigerant Pressure Relief Valve Connections: For water chillers installed indoors, extend vent piping to the outside without valves or restrictions. Comply with ASHRAE 15.

G. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gauges are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled- and condenser-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers.

END OF SECTION 23 64 23

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 23 Section “Common Motor Requirements for HVAC Equipment”.

1.2 SUMMARY

A. Section Includes:
   1. Variable-air-volume, single-zone air-handling units.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

~~B. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.~~
   ~~1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."~~

1.4 ACTION SUBMITTALS

A. Product Data: For each air-handling unit indicated.
   1. Unit dimensions and weight.
   2. Cabinet material, metal thickness, finishes, insulation, and accessories.
   3. Fans:
      a. Certified fan-performance curves with system operating conditions indicated.
      b. Certified fan-sound power ratings.
      c. Fan construction and accessories.
      d. Motor ratings, electrical characteristics, and motor accessories.
   4. Certified coil-performance ratings with system operating conditions indicated.
   5. Dampers, including housings, linkages, and operators.
   6. Filters with performance characteristics.

B. Coordination Drawings: Floor 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. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
   2. Support location, type, and weight.
   3. Field measurements.

~~1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS~~

~~A. Seismic Qualification Certificates: For air-handling units, accessories, and components, from manufacturer.~~
   ~~1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.~~
   ~~2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.~~
   ~~3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.~~

1.6 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

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. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) for each air-handling unit.
   2. Fan Belts: One set(s) for each air-handling unit fan.

1.10 RELATED WORK BY OTHERS

~~A. Supply and exhaust fans shall be controlled by variable frequency controllers (VFC). VFC shall be specified in Section 23 29 23. Division 26 shall wire to the VFC complete with disconnect from remote mounted VFC to the fan motor.~~

~~B. Division 26 shall provide power connection with a combination starter/disconnect for supply and exhaust fans and energy recovery wheel motors.~~

~~C. The energy recovery motor shall be controlled by a variable frequency controller (VFC). VFC shall be specified in Section 23 29 23. Division 26 shall wire to the VFC complete with disconnect from remote mounted VFC to the motor.~~

D. Division 26 Contractor shall provide 115/1/60 single point power connection to junction box(es) factory installed by unit manufacturer for convenience lighting and receptacles.

E. Temperature Control Contractor shall provide interconnecting wiring required for proper wire control.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ~~Air Enterprises, Inc.~~
2. ~~Airtherm; a Mestek company.~~
3. ~~Buffalo Air Handling.~~
4. Carrier Corporation; a member of the United Technologies Corporation Family.
5. ~~Coil Company, LLC.~~
6. Engineered Air.
7. ~~Mammoth Inc.~~
8. ~~Scott Springfield Mfg. Inc.~~
9. Trane; American Standard Inc.
10. ~~USA Coil & Air.~~
11. ~~YORK International Corporation.~~ Johnson Controls Incorporated
12. ~~Energy Labs~~

2.2 UNIT CASINGS

A. General Fabrication Requirements for Casings:
1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws.
3. Sealing: Seal all joints with water-resistant sealant.
4. Factory Finish for Galvanized-Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.
5. Casing Coating: Hot-dip galvanized.
6. The entire unit shall be double wall construction. The minimum thickness shall be 2 inches thick of 22 gauge solid plate galvanized steel in all interior panel sections. Exterior panels shall be constructed of 18 gauge solid plate galvanized steel.
7. Leakage rate shall be no move than 1 percent of design airflow at plus/minus 8 inch wg.
8. Panels and access doors deflection shall not exceed L/240 ratio of design static pressure.

B. Casing Insulation and Adhesive:
1. Materials: ASTM C 1071, Type I or Type II.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
   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. Insulation shall be 2 inch thick, 3 pound per cu.ft. density or foam injection insulation minimum R-value of 12.
   d. Insulation and adhesive shall conform to NFPA.
3. Location and Application: Encased between outside and inside casing.

C. Inspection and Access Panels and Access Doors:
1. Panel and Door Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
   a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
   b. Gasket: Neoprene, applied around entire perimeters of panel frames.
   c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
   a. Hinges: A minimum of two ball-bearing hinges and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
   b. Gasket: Neoprene, applied around entire perimeters of panel frames.

c. Size: At least 24 by 60 inches.
d. The hinge shall provide a method of releasing cabinet operating pressure while maintaining a safety catch to the door for fan sections.

4. Locations and Applications:
   a. Fan Section: Doors and inspection window.
   b. Access Section: Doors.
   c. Coil Section: Inspection and access panel.
   d. Damper Section: Doors and inspection window.
   e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
5. Lighting and convenience outlet circuit
   a. Service Light: 100W vaporproof fixture in each section accessed with a door. A minimum of one light switch and convenience outlet shall be factory mounted on outside of unit.
   b. Lights and receptacles in the entire unit shall be factory wired to one junction box for final connection by Division 26.

D. Condensate Drain Pans:
1. Fabricated with slopes in at least 2 planes to collect condensate from cooling coils (including coil piping connections, coil headers and return bends, and a minimum of 6 inches downstream from cooling-coil face) and from humidifiers.
2. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
3. A minimum of 2 inches deep, and complying with requirements in ASHRAE 62.1.
4. Drain Connections: Drain connection located as denoted on Drawings.
5. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to air-handling unit sections, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when air-handling unit frame is anchored to building structure.

2.3 ACCESS DOORS AND PANELS

A. Access doors or plug panel doors will be provided as indicated on the drawings. Doors shall be rigid double wall construction and shall use heavy-duty hinges with lockable latches on each door. Doors shall be a minimum of 15 inch in width. Doors shall be of the same construction as panels. Door latches shall be capable of being fully tightened against gasket surfaces. All major components such as coils, filters, blowers, etc., within the air handling structure shall be easily removable through access panels without dismantling plenums or distributing ductwork. Equipment that requires disassembly of components rather than access through removable or hinged panels shall not be acceptable. The unit casing shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. Panels without gaskets shall not be acceptable.

2.4 LIGHTING AND CONVENIENCE OUTLET CIRCUIT

A. Vapor-proof service lights shall be provided in all sections requiring access for the use of service personnel.
1. Lights and receptacles shall be factory wired to junction box.
2. 115/1/60 power shall be field wired to the junction box so that the lights and receptacles remain operable when the main service disconnect has been opened to allow unit internal access.

B. Lighting fixtures selected shall be vapor-proof.
1. Light fixture operation shall not be affected by moisture.

2. Construction shall consist of shockproof threaded gasketed bodies, clear glass threaded globe.

C. A convenience outlet shall be mounted on exterior of unit and shall be a combination switch and outlet, UL listed rated for outdoors.

2.5 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontal-Flanged, Split Housing: Bolted construction.
3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
4. Flexible Connector: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized-steel sheet or 0.032-inch thick aluminum sheets; select metal compatible with casing.
a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
1) Fabric Minimum Weight: 26 oz./sq. yd.
2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3) Fabric Service Temperature: Minus 40 to plus 200 deg F.

C. Plug Fans Housings: Steel cabinet; fabricated without fan scroll and volute housing.

D. Backward-Inclined, Centrifugal Fan Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

E. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

F. Airfoil, Centrifugal Fan Wheels: Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

G. Axial Fans: Fan wheel and housing, straightening-vane section, factory-mounted motor with belt drive or direct drive, an inlet cone section, and accessories.
1. Variable-Pitch Fans: Internally mounted electronic actuator, externally mounted positive positioner, and mechanical-blade-pitch indicator.
2. Housings: Galvanized steel.
a. Inlet and Outlet Connections: Flanges.
b. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.

H. Fan Shaft Bearings:

1. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ABMA II.

I. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

J. Fan Motors
1. Motors shall be heavy duty, open drip-proof, premium efficiency type. Motors designated using a variable frequency drive (where denoted on the drawings or schedules) shall be inverter-duty type, meeting the requirements of NEMA MG1 Part 31. Motors shall be mounted to the fan assembly. Belt drive fan motors shall have an adjustable base to permit drive belt tensioning.
2. Motors shall be standard NEMA frame.
3. Motors for direct drive fans shall be suited for direct drive applications, with motor speed matched to the fan wheel RPM.
4. All motors driven by a variable frequency controller shall include a maintenance free, circumferential, conductive microfiber shaft grounding ring (AEGIS-SGR) to discharge shaft currents to ground.

K. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 1 inch.
1. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounting frame and air-handling-unit mounting frame are anchored to building structure.
2. Enclosure Type: Totally enclosed, fan cooled.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
5. Mount unit-mounted disconnect switches on exterior of unit.

2.6 COIL SECTION

A. General Requirements for Coil Section:
1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
4. Coils shall not act as structural component of unit.
5. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when coil-mounting frame and air-handling-unit mounting frame are anchored to building structure.

B. Heating and Chilled Water Coils

1. Aluminum fin and seamless copper tube in steel casing.
2. Minimum tube wall thickness of 0.020 inches.
3. Headers, coil, and coil return bends shall be enclosed inside unit.
4. Test complete coil assembly at 300 psi air under water.

2.7 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:
1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide 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. Disposable Panel Filters:
1. Factory-fabricated, viscous-coated, flat-panel type.
2. Thickness: 2 inches.
3. Arrestance (ASHRAE 52.1): 80.
4. Merv (ASHRAE 52.2): 13.
5. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
6. Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.8 DAMPERS

A. Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC."

~~C. Zone Dampers: Two single-blade, galvanized-steel or aluminum dampers offset 90 degrees from each other onsteel operating rod rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel or aluminum frame. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.~~

D. Face-and-Bypass Dampers: Opposed-blade, galvanized-steel or aluminum dampers withsteel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel or aluminum frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.

E. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel or aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in parallel-blade arrangement withsteel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel or aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

F. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.

G. Combination Filter and Mixing Section:
1. Cabinet support members shall hold 2-inch thick, pleated, flat, permanent or throwaway filters.
2. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

2.9 AIR-TO-AIR ENERGY RECOVERY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Airxchange.
   2. American Energy Exchange, Inc.
   3. Engineered Air
   4. Novel Aire
   5. Rotorsource
   6. SEMCO Incorporated.
   7. Trane; American Standard Inc.
   8. Venmar

B. Casing:
   1. Steel, with manufacturer's standard paint coating.
   2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
   3. Casing seals on periphery of rotor, on duct divider, and on purge section.
   4. Support rotor on grease-lubricated ball bearings with extended grease fittings. Mount horizontal wheels on tapered roller bearing.

C. Rotor: Aluminum, segmented wheel, strengthened with radial spokes, with nontoxic, noncorrosive, silica-gel desiccant coating.

D. Rotor: Aluminum, glass-fiber, or polymer segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, molecular-sieve desiccant coating.

E. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable frequency controller, and self-adjusting multilink belt around outside of rotor.

F. All motors driven by a variable frequency controller shall include a maintenance free, circumferential, conductive microfiber shaft grounding ring (AEGIS-SGR) to discharge shaft currents to ground.

2.10 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

~~D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.~~

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 casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for ~~steam~~, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting: Install air-handling units on concrete bases. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

~~B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."~~

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

~~F. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.~~

G. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

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. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan 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.

D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. After startup service, clean air-handling units internally on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems, clean filter housings and install new, clean filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13

SECTION 23 82 39 - UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cabinet unit heaters with centrifugal fans and hot-water or electric-resistance heating coils.
2. Propeller unit heaters with hot-water or electric-resistance heating coils.
3. ~~Wall and ceiling heaters with propeller fans and electric-resistance heating coils.~~

1.2 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
6. Perimeter moldings for exposed or partially exposed cabinets.

~~B. Manufacturer Seismic Qualification Certification: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:~~
~~1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.~~
~~a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."~~
~~b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."~~
~~2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.~~
~~3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.~~

1.5 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Cabinet Unit Heater Filters: Furnish one spare filter for each unit.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Airtherm; a Mestek Company.
   2. Berko Electric Heating; a division of Marley Engineered Products.
   3. Carrier Corporation.
   4. Chromalox, Inc.; a division of Emerson Electric Company.
   5. Engineered Air Ltd.
   6. Indeeco.
   7. International Environmental Corporation.
   8. Markel Products; a division of TPI Corporation.
   9. Marley Electric Heating; a division of Marley Engineered Products.
   10. Modine
   11. Ouellet Canada Inc.
   12. QMark Electric Heating; a division of Marley Engineered Products.
   13. Sterling
   14. Raywall
   15. Rittling
   16. Rosemex Products.
   17. Trane.
   18. USA Coil & Air.

B. Description: A factory-assembled and -tested unit complying with ARI 440.
   1. Electric cabinet unit heaters shall comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing or erosion-resistant coating to prevent erosion of glass fibers.
   1. Thickness: 1/2 inch.
   2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
   1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
3. Recessing Flanges: Steel, finished to match cabinet.
4. Control Access Door: Key operated.
5. Base: Minimum 0.0528-inch thick steel, finished to match cabinet, 4 inches high with leveling bolts.
6. Extended Piping Compartment: 8-inch wide piping end pocket.
7. False Back: Minimum 0.0428-inch thick steel, finished to match cabinet.

E. 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.

~~F. Steam Coil: Copper distributing tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 75 psig.~~

G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

H. Fan and Motor Board: Removable.
1. Fan: Forward curved, high static, 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 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

I. Electrical Connection: Factory wire motors and controls for a single field connection.
1. Disconnect switch.
2. Motor speed controller.

2.2 PROPELLER UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airtherm; a Mestek Company.
2. Engineered Air Ltd.
~~3. McQuay International.~~
4. Modine.
5. Sterling.
6. Raywall.
7. Rittling.
8. Rosemex Products.
9. Ruffneck Heaters; a division of Lexa Corporation.
10. Trane.

B. Description: An assembly including casing, coil, fan, and motor in vertical or horizontal discharge configuration with adjustable discharge louvers.

C. Electric unit heaters shall comply with UL 2021.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

G. General Coil Requirements: Test and rate hot-water or steam propeller unit heater coils according to ASHRAE 33.

H. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

~~I. Steam Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 75 psig.~~

J. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

K. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

L. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Type: Permanently lubricated, multispeed.

~~2.3 WALL AND CEILING HEATERS~~

~~A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~
~~1. Berko Electric Heating; a division of Marley Engineered Products.~~
~~2. Chromalox, Inc.; a division of Emerson Electric Company.~~
~~3. Indeeco.~~
~~4. Markel Products; a division of TPI Corporation.~~
~~5. Marley Electric Heating; a division of Marley Engineered Products.~~
~~6. Ouellet Canada Inc.~~
~~7. QMark Electric Heating; a division of Marley Engineered Products.~~
~~8. Raywall.~~
~~9. Trane.~~

~~B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.~~

~~C. Cabinet:~~
~~1. Front Panel: Stamped steel louver or extruded aluminum bar grille, with removable panels fastened with tamperproof fasteners.~~
~~2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory assembled and tested wall and ceiling heaters before shipping.~~

~~D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.~~

~~E. Electric Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.~~

~~F. Fan: Aluminum propeller directly connected to motor.~~
~~1. Motor: Permanently lubricated. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."~~

~~G. Controls: Unit-mounted thermostat.~~

~~H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.~~

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend cabinet unit heaters from structure with elastomeric hangers ~~and seismic restraints~~. Vibration isolators ~~and seismic restraints~~ are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric or spring hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

F. ~~Unless otherwise indicated, install union and gate or ball valve on steam supply connection and union, strainer, steam trap, and gate or ball valve on condensate return connection of unit heater. Steam specialties are specified in Division 23 Section "Steam and Condensate Heating Piping."~~

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 82 39

SECTION 27 41 33 – INTEGRATED A/V EQUIPMENT

(VIDEO PROJECTORS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes, but is not limited to the following:
   1. Video projectors
   2. Projector support
   3. Projector mounts

B. Related section includes the following:
   1. Division 01 – All Sections
   2. Division 27 – Communications Sections
   3. Division 28 – Electronic Safety and Security

1.3 DESCRIPTION OF WORK

A. Provide labor, material, project management, start-up, testing and service necessary for the installation and the operation of a video projector system, as indicated on the drawings and/or described herein.

B. The contractor shall install the software on all the provided projectors.

1.4 SUBMITTALS

A. Furnish to the Architect/Engineer complete sets of submittals for approval.

B. Complete and comprehensive Equipment Catalog Specification Sheets of each component provided.

C. See front end submittals section for more information.

D. See Common Work Results For Communications section 270500 for more submittal requirements.

1.5 CONTRACTOR QUALIFICATIONS

A. The Contractor or his subcontractor shall meet the minimum requirements as outlined in Section 270500 – "Common Work Results for Communications".

1.6 QUALITY ASSURANCE

A. All equipment shall be UL listed.

B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.

C. All equipment Installation Practices shall comply with the Local Electric Code.

D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standards.

E. All equipment and Installation Practices shall comply with the latest BICSI Telecommunications Distribution Methods Manuals Manual (TDMM).

F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862 standards.

G. Provide labeling per ANSI/EIA/TIA-606 requirement and in accordance with the Owner and Technology Consultant.

H. All equipment and installation shall comply with the latest InfoComm International Installation Handbook.

1.7 TRAINING

A. Provide training per Section – "Demonstration and Training of Communications Systems".

B. Provide training clock hours as specified in Section – "Demonstration and Training of Communications Systems".

C. The Contractor shall clean all the video projector filters in front of the Owner 6 months after the Certificate of Substantial Completion is issued.

1.8 PRECEDENCE

A. The Contractor shall review these specifications very carefully and shall provide the best quality equipment that meets or exceeds the bid specifications.

B. If the product specified is NO longer available, the contractor shall provide the replacement products and equipment that meets or exceeds the absolute products with NO exceptions.

C. If the Contractor provides the replacement products on his own that does not meet the specification, then he shall be responsible to provide the new products/equipment at NO cost to the Owner.

1.9 WARRANTY

A. The audio video distribution system shall carry as specified in Section – Demonstration and Training of Communications Systems". The warranty shall include all labor and material to replace all components that fail and or do not comply with the performance specifications.

1.10 RECORD DRAWINGS / OPERATION AND MAINTENANCE MANUALS

A. Provide record drawings and operation and maintenance manuals, as described in Sections – "Operation and Maintenance of Communications Systems" and Common Work Results for Communications Systems".

PART 2 - PRODUCTS

2.1 PROJECTORS

A. The projectors shall be capable of reproducing video and RGB computer generated images on screen sizes up to 125 inches diagonal with a 3LCD system with a laser light source.
   1. Multiple Frequencies: Projector shall automatically lock onto video and data inputs from 15 - 35 kHz horizontal. Step scan systems will not be considered.
   2. Bandwidth: All system components, including projector, video cables and related video switch devices (if any) shall have a minimum of 30 Mhz (-3dB) bandpass.

3. Resolution: Native resolution HD 1920 X 1080, WXGA (1920 X 1200) – see projector schedule for specific requirements.
4. The projector shall have a lamp free laser light source with a lifespan rating of at least 20,000 hours.

B. Remote Control
1. The projectors shall feature infrared wireless.
2. The projectors shall have a computer controlled RS-232 or RS-422 serial interface to control source switching and general operation.

C. Safety Standards: The projectors shall comply with FCC Class A, CSA 950, IEC 950, and DHHS regulations. The projector system must also have approval from UL.

D. Power Requirements: The projector shall accept power sources of 120 VAC at 60 Hz.

E. Temperature
1. Operating Temperature: 0 to 40 degrees C.
2. Storage: -10 to 50 degrees C.

F. The Contractor shall be responsible for the projector ceiling opening, housing, steel supports, panel and the rework of the ceiling grid, etc. Coordinate with the Ceiling Contractor.

G. The Contractor shall tie the projector to the sound system equipment in the space. (Coordinate with the Sound System Contractor, provide cabling as needed).

H. Provide projector users and application software and coordinate with owner.

I. Provide projector universal plate with lift as required.

J. Provide ceiling-mounted projectors. or wall mounted projectors that meet the following minimum requirements:

K. The projector fan shall be quiet, and the vendor shall demonstrate the dB noise to Owner and Architect/Engineer.

L. Provide heavy duty security cable for each multi-media projector.

M. Provide 10 percent spare remote control for each projector but the minimum shall be one spare unit for each type of projector.

N. The projectors shall be submitted with the lens for the room application, see Part 3 for more info.

O. Provide wire guard in Gyms, and other spaces as needed, submit wire guard with shop drawings for approval.

P. Projectors shall be Extended Display Identification Data (EDID) Capable.

Q. Projectors shall be High-bandwidth Digital Content Protection (HDCP) Compliant.

R. CLASSROOM TYPE VIDEO PROJECTOR
1. The classroom video projectors shall be capable of reproducing video and RGB computer generated image on screen sizes up to 100-inch diagonal or on an interactive board 4’X6’. The projector shall have a native resolution of 1280x800
2. The projector shall have the following:
   a. 4,500 lumens
   b. 1.6x Optical zoom
   c. ±30 degrees of vertical & horizontal keystone correction

d. Throw ratio 1.41 to 2.26:1
e. Aspect ratio 16:10 supported

3. Video and audio input/output capabilities:
   a. 2x HDMI Audio, Video Input
   b. 1x DE-15/DB-15 (VGA) Video Input
   c. 1x DE-15/DB-15 (VGA) Video Output
   d. 1x RCA (Composite) Audio, Video Input
   e. 2x 1/8" / 3.5 mm Mini Audio Input
   f. 1x 1/8" / 3.5 mm Mini Audio Output
   g. 1x 1/8" / 3.5 mm Mini Microphone Input
   h. 1x DE-9/DB-9 (RS-232) Control Input
   i. 1x USB-A, Power
   j. 1x USB-B
   k. 1x RJ45 (Ethernet)
4. Projector shall be 3 LCD type projector.
5. Projectors shall be Extended Display Identification Data (EDID) Capable.
6. Projectors shall be High-bandwidth Digital Content Protection (HDCP) Compliant.
7. The Contractor shall coordinate the exact location of the video projector with the ceiling grid, lighting, HVAC, sprinkler lines, and other equipment.
8. Provide projector application software to owner.
9. Warranty shall be 3 years
10. Provide 10% spare remote controls.
11. Basis of design:
    a. Epson L210W WXGA Model: V11HA70020 laser

S. MULTIPURPOSE ROOM TYPE VIDEO PROJECTOR

1. The multipurpose room video projectors shall be capable of reproducing video and RGB computer generated image on screen sizes up to 165-inch diagonal. The projector shall have a native resolution of 1920 x 1200.
2. The projector shall have the following:
   a. 6,500 lumens
   b. Manual focus
   c. ±50% vertical lens shift
   d. Throw distance 7.8 to 47.7'
   e. Throw ratio 1.35 to 2.2:1
   f. Aspect ratio 16:10 supported
3. Video and audio input/output capabilities:
   a. 2x HDMI Audio, Video Input
   b. 1x HDMI Video Output
   c. 2x DE-15/DB-15 (VESA 3D Sync) Video Input
   d. 2x RJ45 (HDBaseT) Audio, Video Input
   e. 2x 1/8" / 3.5 mm Mini Audio Output
   f. 1x USB-B Video Input
   g. 1x DE-9/DB-9 (RS-232) Control Input
4. Projector shall be 3 LCD or DLP type projector.
5. Projectors shall be Extended Display Identification Data (EDID) Capable.
6. Projectors shall be High-bandwidth Digital Content Protection (HDCP) Compliant.
7. The Contractor shall coordinate the exact location of the video projector with the ceiling grid, lighting, HVAC, sprinkler lines, and other equipment.
8. Provide projector application software to owner.
9. Warranty shall be 3 years
10. Provide 10% spare remote controls.
11. Basis of design:
    a. Epson PowerLite L690U 6500-Lumen WUXGA Laser 3LCD Projector

PART 3 - EXECUTION

3.1 INSTALLATION

A. This work shall be performed in accordance with acknowledged industry standards and professional practices.

B. The contractor shall provide a mockup room for the owner, CM and architect to review and approve, NO work can be done unless the contractor have written approval from the CM.

C. The contractor shall install the video projector software and coordinate the work with owner.

D. Install all video projectors as shown on the drawings and as described herein. Coordinate location with other trades and adjust installations as needed to fit the video screen, or the electronic whiteboard.

E. The video contractor shall clean all the projector's filters in front of the Owner 6 months after the certificate of the Substantial Completion is issued.

F. Mount video projectors on the same horizontal plane as the viewing surfaces or as follows (unless otherwise noted):
   1. 8' – 2" to 8' – 6" in classrooms with video projection screen
   2. Verify screen mounting height, projector location and lens requirements for Multipurpose Room projectors.
   3. The Contractor shall provide a mock-up room for approval.

G. Provide stem length as needed.

H. Install all projector mounts, per the manufacturer's recommendations.

I. If the video projector was installed and the Architect/Engineer discovered that the unit shakes, the contractor shall correct the problem at no cost to the Owner.

J. The Contractor shall verify the locations of the existing mount location and shall adjust the location to fit the interactive whiteboard and/or the projection screen.

K. The Contractor shall verify that the receptacle is installed in the existing ceiling behind the stem, if not, and then this Contractor shall relocate the receptacle behind the stem.

3.2 TESTING

A. Upon completion of the installation, the system shall be tested by the manufacturer's representative and all necessary modifications and/or adjustments shall be made to assure compliance with this specification.

B. Each video projector shall be tested with a DVD and PC for proper signal, picture, picture size, etc.

C. All testing shall be logged in on the spreadsheet. See Section - "Operation and Maintenance for Communications Systems" for more information.

3.3 WARRANTY

A. The Contractor shall warrant all components for a period as specified in Section – "Demonstration and Training of Communications Systems" after the date of final acceptance by the owner. The warranty shall include labor and material to replace all components that fails or do not comply with the performance specifications.

B. Response time shall be (2) hours for major failures and 24 hours for minor failures. A major failure shall be defined as a malfunction resulting in the loss of two or more video outlets.

C. The Contractor shall employ factory trained technical service personnel for service and maintenance of the system. The Contractor shall also instruct the owner's technical personnel in the operation, care and maintenance of the system.

3.4 CERTIFICATION

As a condition of final acceptance by the owner, the Contractor shall issue to the owner a letter of certification that the system is in compliance with the specifications and that final testing and adjustment has been completed.

3.5 VIDEO PROJECTOR

A. Provide projectors and controls as follows:
1. Typical Classrooms: Provide Classroom Type projector with the following:
   a. Provide a remote control.
   b. Provide HDMI patch cords and audio cables as indicated on the drawings. Verify length.
   c. Provide special lens as required, lens shall be submitted with the shop drawings.
   d. Verify distance from projection screen to video projector location.
   e. Verify projection screen size. Owner standard screen - Draper, Luma2 16:10 109" 57" x 92" Manual Projection Screen.
   f. Provide software.
   g. The contractor shall provide lens calculations showing screen size and type of lens required, image shall fit +95 % of the screen.

2. Multipurpose Room (Cafeteria C100): Provide Multipurpose Room Type projector with the following:
   a. Provide all equipment listed within division 27 specifications, as indicated on the drawings and as required for a complete system.
   b. Provide video projector mount, extension pole, vibration absorber, escutcheon ring and other hardware and accessories as required.
   c. Provide special lens as required, lens shall be submitted with the shop drawings.
   d. Verify distance from projection screen to video projector location.
   e. Verify projection screen size.
   f. Provide software.
   g. The contractor shall provide lens calculations showing screen size and type of lens required, image shall fit +95 % of the screen.
   h. Provide wire guard.

END OF SECTION 27 41 33

SECTION 27 51 17 – SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes, but is not limited to:
   1. Channel receiver/amplifier
   2. Speakers
   3. Miscellaneous items such as cables, brackets, connectors, etc.

B. Related sections include the following:
   1. Division 01, General Requirements
   2. Division 27, Communications

1.3 QUALITY ASSURANCE

A. The Projector Audio System Contractor shall have minimum of 2 years experience in the installation of this type of system.

B. Provide labeling per ANSI/EIA/TIA-606 requirement and in accordance with the Owner and Technology Consultant.

1.4 CODE

A. Must meet Federal Communications standards.

B. Must meet National Fire Protection Association standards.

C. Must meet National Electrical Code.

D. Must be UL listed.

E. Americans with Disabilities Act.

F. Latest edition of the Telecommunications Distribution Methods Manual (TDMM).

1.5 WARRANTY

A. Components, parts, and assemblies supplied by the Projector Audio System Contractor/manufacturer shall be warranted against defects in materials and workmanship for a period as specified in Section "Demonstration and Training for Communications Systems" from date of acceptance by the Owner.

B. All repairs must be completed by a Factory-Trained Certified Service Technician.

1.6 SUBMITTALS

A. Provide complete shop drawings for the following:
   1. System receivers/amplifiers
   2. Speakers
   3. Cabling layout – actual drawings

B. See front end submittals section for more information.

C. See Common Work Results For Communications section 270500 for more submittal requirements.

1.7 OWNER INSTRUCTION

A. Provide training on the projector audio system per Section – "Demonstration and Training of Communications Systems".

1.8 RECORD/OPERATION AND MAINTENANCE MANUAL

A. Provide record drawings and operation and maintenance manuals, as described in Sections – "Operation and Maintenance of Communications Systems" and Common Work Results for Communications Systems".

PART 2 - PRODUCTS

2.1 MIXER/AMPLIFIER (Provide as indicated on drawings)

A. The mixer/amplifier shall be rated to deliver minimum 40 watts at 70-volt output with microphone line mic output.

B. The unit shall be capable of delivering rated power from 50 Hz to 20 KHz plus/minus dB into 4 ohm.

C. The unit shall be plenum rated.

D. The unit shall be installed above ceiling.

E. Approved Manufacturer:
1. Extron MPA 601 - Mono 70/100 V Amplifier - 60 Watts

2.2 NOT USED

2.3 CEILING LOUDSPEAKERS WITH MATCHING TRANSFORMERS AND BAFFLE – 2X2

A. Provide 2'x2', recessed lay-in speaker assembly as described herein and as shown on the drawings
1. Speaker Size: 8 inch.
2. Power rating: 25 Watt Peak, 15 Watt RMS.
3. Sensitivity: 97 dB average.
4. Impedance: 8 ohms nominal.
5. Frequency Response: 45Hz-19 kHz Nominal, 50Hz- 8kHz + 5dB.
6. Minimum Dispersion Angle: 100-105 degrees, minus 6 dB at 2 kHz octave band.
7. Magnetic weight: 10 oz Nominal (260g)
8. Comply with TIA/EIA SE-103 and TIA/EIA-160
9. Line Transformer: frequency response 100Hz-10 kHz (+1.5dB): maximum insertion loss of 1.5 dB; secondary impedance 8 Ohms; power rating 4-5 Watts; primary terminals with 6 inch com. Lead color coded cables and dual voltage 25 V/70.7 V.
10. Multi taps at 4/5,2,1,1/2 and 1/8 watts.(45 ohm speakers will NOT be allowed)
11. Enclosures: Metal protective enclosure, acoustically dampened, with front face of at least 0.0478-inch steel. The whole assembly shall be rust proofed and factory primed. Provide mounting assembly and hardware suitable for ceiling, flush mounting with relief of back pressure.
12. Grills/Baffle: Provide each loudspeaker with flush mounted baffle, minimum thickness of 0.032-inch aluminum, with textured white finish.

B. Approved Manufacturers:

1. Quam SYSTEM 12 - 24"x24" Tile Replacement Loudspeaker System, 25V / 70V

2.4 CABLES

A. Speaker cable shall be a conductor number 20 AWG, unshielded, UL listed for plenum return, ASTM bare copper, polymer alloy insulation, flexible plenum jacket.

B. Approved Manufacturer:
1. West Penn Model 25226B
2. Belden
3. Ortronic
4. Berktek

2.5 NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. The projector audio system shall be installed by a manufacturer trained technician.

B. The projector audio system shall be installed in accordance with the manufacturer's installation instructions.

C. The projector audio system shall be connected to the video projector in the classroom with patch cords furnished by this contractor.

D. Tap the speakers as recommended by the manufacturer.

E. Provide boxes, fittings, patch cords, conduits, etc.

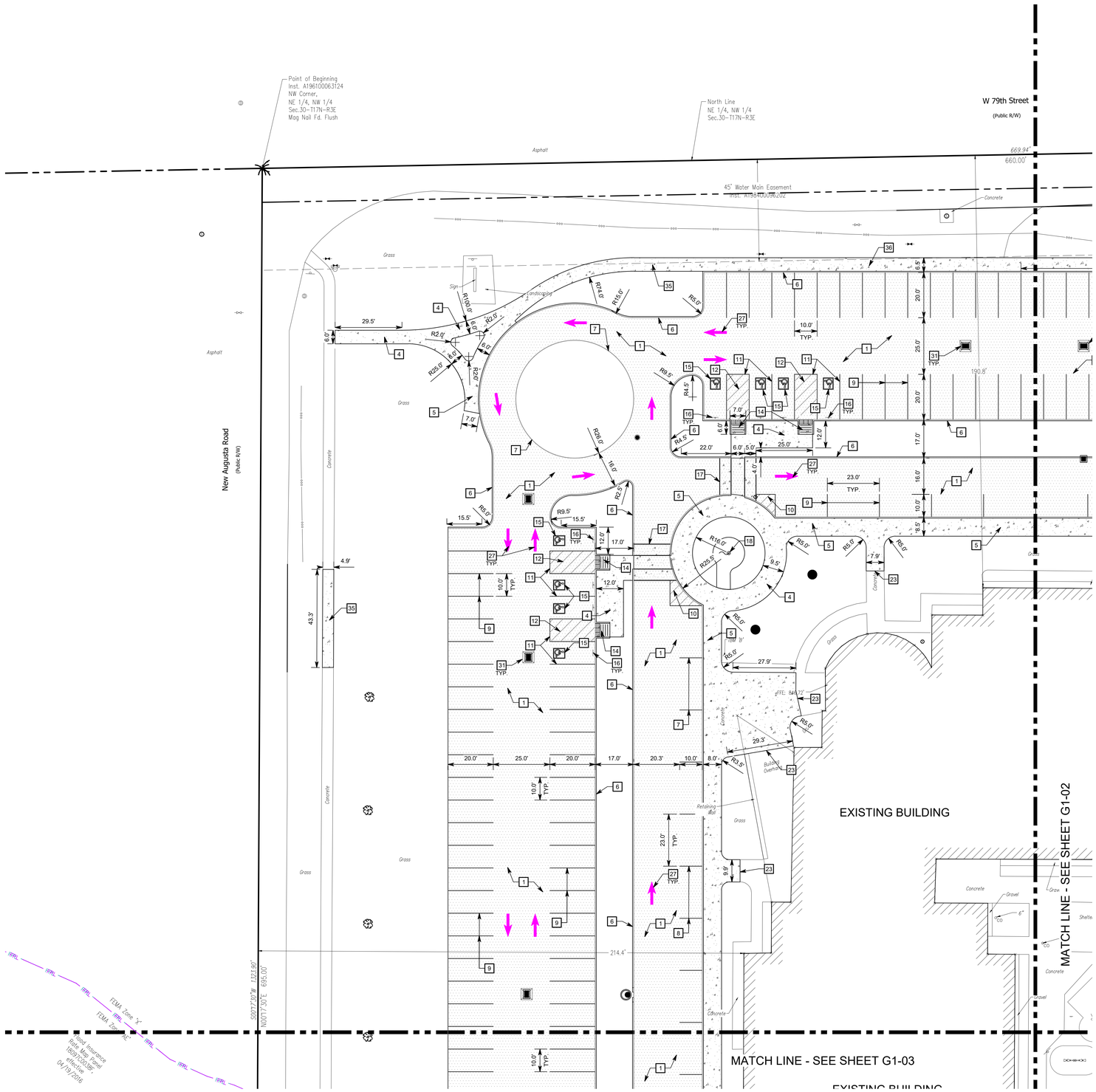
F. This Contractor shall be responsible for cutting the ceiling tile to install speakers. Coordinate with the Ceiling Contractor.

G. Provide projector audio system in all educational spaces as shown on the drawings.

3.2 CLEANUP

A. After the projector audio system is installed and tested, all the unused material and debris must be removed from the area.

END OF SECTION 27 51 21



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NORTH

20 0 20 40 60

GENERAL NOTES

1. SEE DRAWING GD0-0 FOR GENERAL NOTES AND ADDITIONAL LEGEND.
2. TOPOGRAPHIC CONDITIONS AND EXISTING UTILITIES SHOWN WERE PROVIDED BY SCHNEIDER GEOMATICS. THE ENGINEER MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED.
3. CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS IN THE PROJECT AREA INCLUDING UNDERGROUND UTILITY CONDITIONS, LOCATION AND DEPTH PRIOR TO ANY OTHER SITE CONSTRUCTION. REPORT ANY DISCREPANCIES TO THE ENGINEER.

☐ SITE KEYNOTES

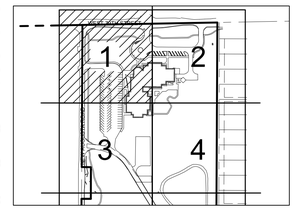
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3. 6" DEEP LAYER OF 2" DIA WASHED RIVER ROCK WITH SOIL SEPARATOR GEOTEXTILE BETWEEN STONE AND COMPACTED SUBGRADE.
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8. 4" WIDE WHITE PAINTED LINE
9. 4" WIDE YELLOW PAINTED LINE (BUS PARKING)
10. 4" WIDE DIAGONAL YELLOW PAINTED LINE @ 2'-0" O.C
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16. ADA PARKING SIGN - SEE DETAIL L ON SHEET G1-07
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19. 6' HIGH BLACK PVC COATED CHAIN LINK FENCE WITH BLACK PRIVACY SLATS - SEE DETAIL A ON SHEET G1-08
20. NEW PLAYGROUND EQUIPMENT - REFER TO LANDSCAPE PLANS
21. SEED DISTURBED AREAS - REFER TO LANDSCAPE PLANS
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24. CONTROL JOINT - SEE DETAIL I ON SHEET G1-07
25. CONCRETE EQUIPMENT PAD - SEE DETAIL E ON SHEET G1-08
26. 6" CONCRETE PIPE BOLLARD - SEE DETAIL J ON SHEET G1-07
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28. STOP SIGN, R1-1, TO BE MOUNTED ON INSTALLED 3LB/FT GALV U-POST PAINTED GREEN PER INDOT AND INDIANA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.
29. CONCRETE STOOP - SEE STRUCTURAL PLANS
30. CONCRETE APRON - SEE DETAIL I ON SHEET 61-08
31. CONCRETE COLLAR - SEE DETAIL N ON SHEET G1-07
32. RIGHT-OF-WAY ASPHALT PAVEMENT - FULL DEPTH, SEE CITY OF INDIANAPOLIS DETAIL 101.20 ON SHEET G1-08
33. RIGHT-OF-WAY ASPHALT PAVEMENT - 1.5" SURFACE, SEE CITY OF INDIANAPOLIS DETAIL 101.20 ON SHEET G1-08
34. DRIVE GEOMETRICS AND STRIPING - SEE CITY OF INDIANAPOLIS DETAIL 701.01 ON SHEET G1-08
35. RIGHT-OF-WAY SIDEWALK - SEE CITY OF INDIANAPOLIS DETAIL 101.16 ON SHEET G1-08

1
36. RIGHT-OF WAY MONOLITHIC CURB AND SIDEWALK - SEE CITY OF INDIANAPOLIS DETAIL 101.13 ON SHEET G1-08
37. 4' HIGH BLACK PVC COATED CHAIN LINK FENCE WITH BLACK PRIVACY SLATS - SEE DETAIL A ON SHEET G1-08
38. 6' ORNAMENTAL FENCING. SEE SITE PLAYGROUND/LANDSCAPE DETAILS DRAWINGS
39. THICKENED CONCRETE EDGE INTERFACE. SEE SITE PLAYGROUND/LANDSCAPE DETAIL DRAWINGS

PARKING SUMMARY	
EXISTING PARKING	
STANDARD PARKING SPACES	70
ADA PARKING SPACES	4
TOTAL EXISTING PARKING SPACES	74
EXISTING BUS PARKING SPACES	12
PROPOSED PARKING	
STANDARD PARKING SPACES	163
ADA PARKING SPACES	8
TOTAL PROPOSED PARKING SPACES	171
PROPOSED BUS PARKING SPACES	7

1
PROPOSED SITE LEGEND

- BUILDING
- CONCRETE SIDEWALK/PAVEMENT
- HEAVY DUTY ASPHALT PAVEMENT
- MEDIUM DUTY ASPHALT PAVEMENT
- RIGHT-OF-WAY FULL DEPTH ASPHALT PAVEMENT
- RIGHT-OF-WAY SURFACE ASPHALT PAVEMENT
- STONE



KEY MAP

NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

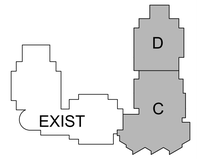
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CIVIL ENGINEER

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Indianapolis, IN 46268
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www.tlf-engineers.com
TLF Job No: 2024-452



KEY PLAN

N

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID
REGISTERED
No. 11300453
STATE OF INDIANA
PROFESSIONAL ENGINEER

PROJECT MANAGER: CNK
DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.1	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

SITE PLAN

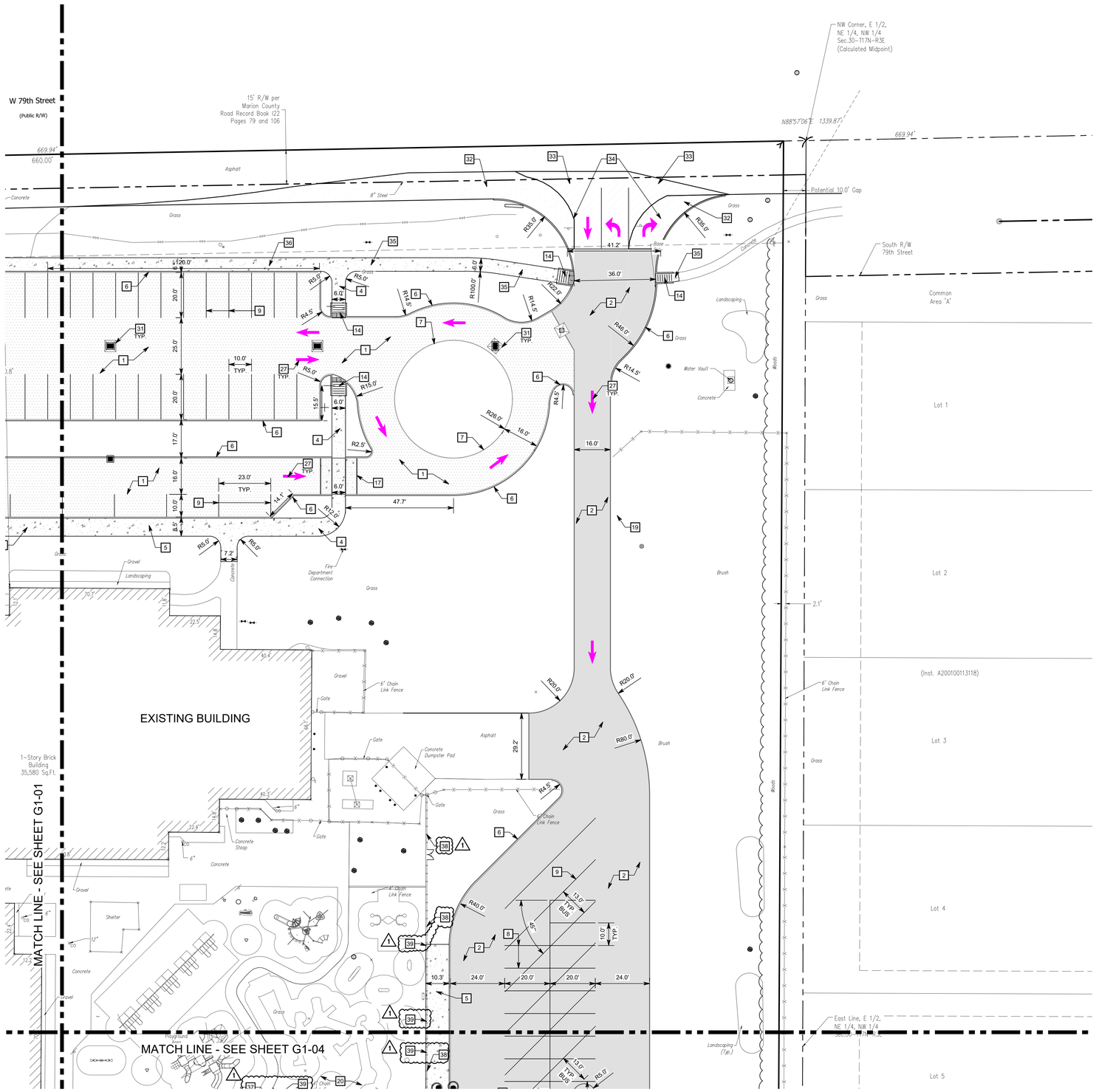
G1-01

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CAUTION !!

THE LOCATIONS OF ALL EXISTING UNDERGROUND UTILITIES SHOWN ON THE PLAN ARE BASED UPON ABOVE GROUND EVIDENCE (INCLUDING, BUT NOT LIMITED TO, MANHOLES, INLETS, VALVES, AND MARKS MADE UPON THE GROUND BY OTHERS) AND ARE SPECULATIVE IN NATURE. THERE MAY ALSO BE OTHER EXISTING UNDERGROUND UTILITIES FOR WHICH THERE IS NO ABOVE GROUND EVIDENCE OR FOR WHICH NO ABOVE GROUND EVIDENCE WAS OBSERVED. THE EXACT LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHALL BE VERIFIED BY CONTRACTOR PRIOR TO ANY AND ALL CONSTRUCTION.

Drawing Path: P:\2024\400\453\CAD\Civil\Active\5-2024-452_G1-01- 06_ Site Plan.dwg
Plotted By: jlaureano Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 2:02pm



NORTH

20 0 20 40 60

GENERAL NOTES

1. SEE DRAWING GD0-0 FOR GENERAL NOTES AND ADDITIONAL LEGEND.
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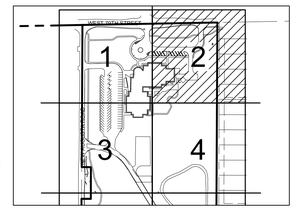
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1

PROPOSED SITE LEGEND

- BUILDING
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- HEAVY DUTY ASPHALT PAVEMENT
- MEDIUM DUTY ASPHALT PAVEMENT
- RIGHT-OF-WAY FULL DEPTH ASPHALT PAVEMENT
- RIGHT-OF-WAY SURFACE ASPHALT PAVEMENT
- STONE



KEY MAP

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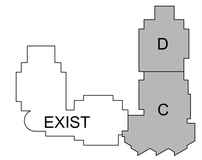
NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

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MSD OF PIKE TOWNSHIP

CIVIL ENGINEER

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Phone: (317) 334-1500
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TLF Job No: 2024-452



KEY PLAN N

CONSTRUCTION DOCUMENTS

CHAD N. KINGAID REGISTERED No. 11300453 STATE OF INDIANA PROFESSIONAL ENGINEER

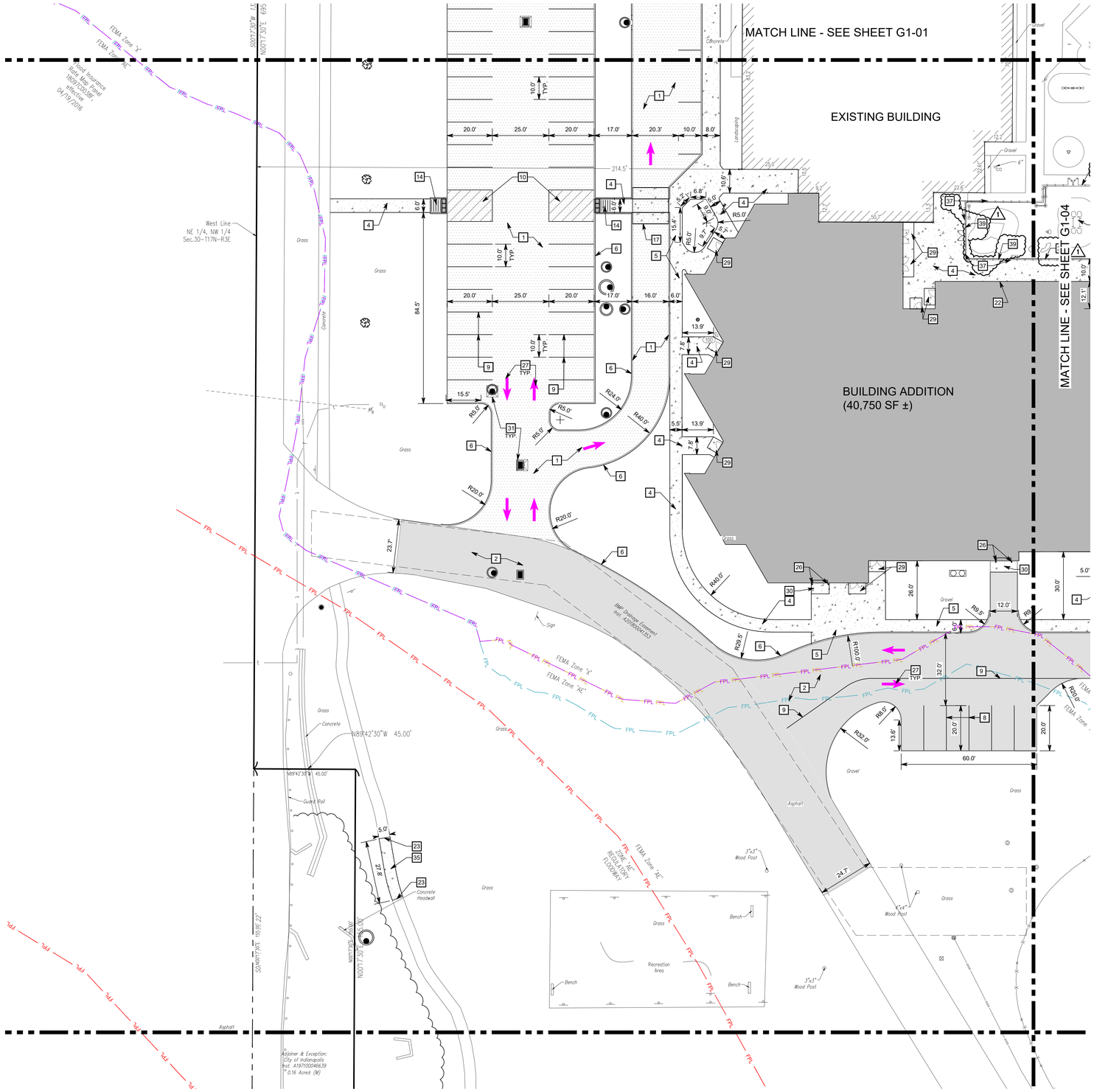
PROJECT MANAGER: CNK
DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

SITE PLAN

G1-02

Drawing Path: P:\2024\452\CAD\CAD\Civil\Active\5-2024-452_G1-01- 06_ Site Plan.dwg
Plotted By: jlaureano Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 2:02pm



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NORTH

20 0 20 40 60

GENERAL NOTES

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☐ SITE KEYNOTES

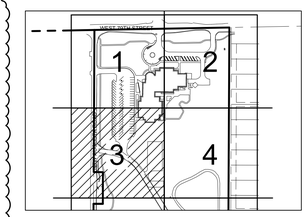
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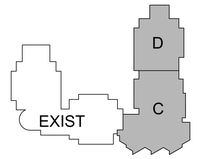
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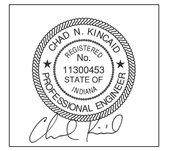
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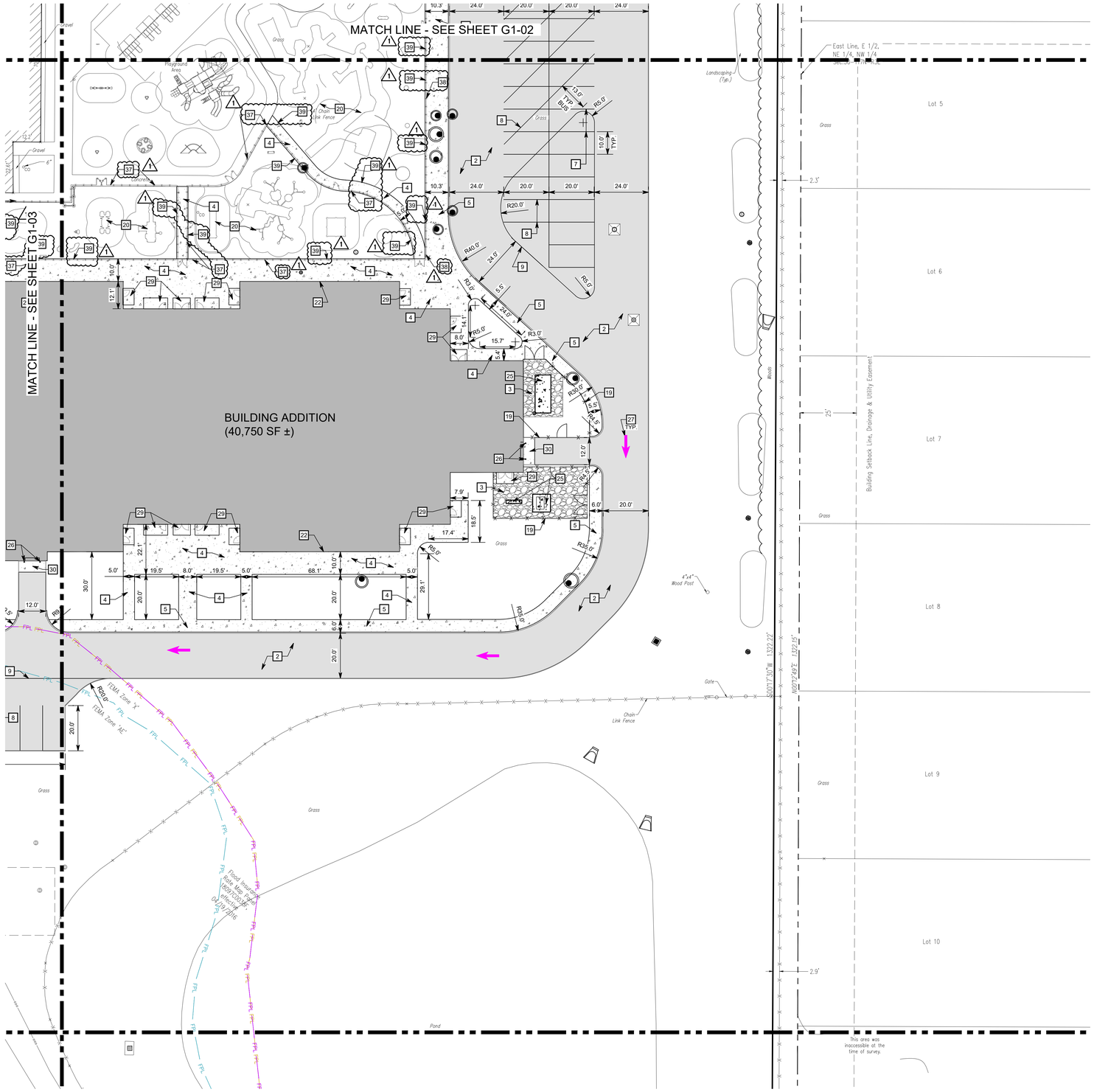
PROJECT MANAGER: CNK
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PROJECT ISSUE DATE: 03-13-26

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

SITE PLAN

G1-03

Drawing Path: P:\2024\452\CAD\Civil\Active\5-2024-452_G1-01- 06_ Site Plan.dwg
Plotted By: jlourenso Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 2:02pm



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NORTH

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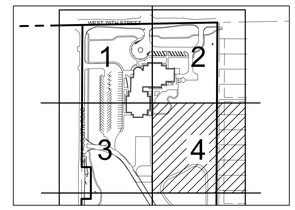
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EXIST D C

KEY PLAN N

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID REGISTERED No. 11300453 STATE OF INDIANA PROFESSIONAL ENGINEER

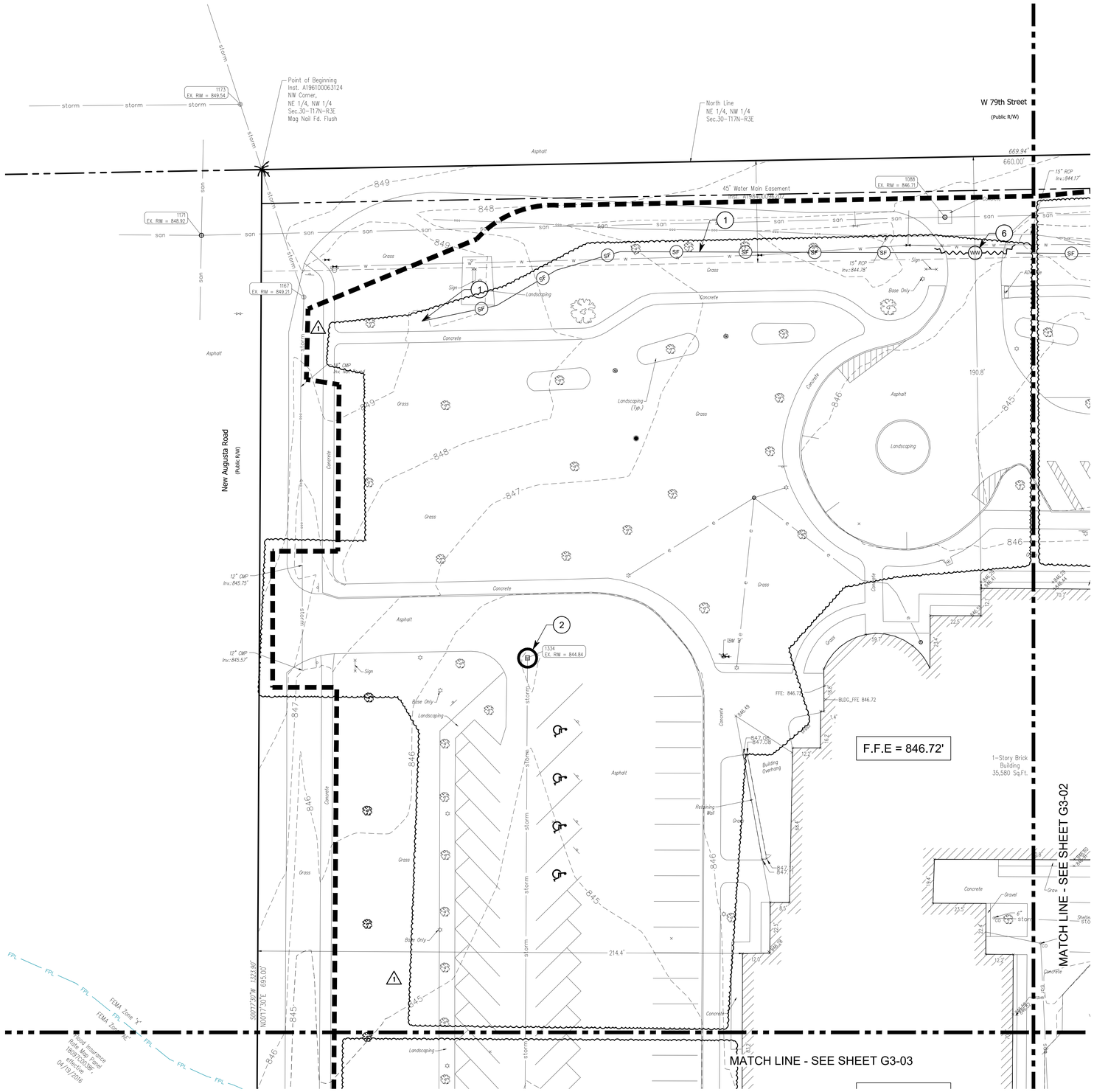
PROJECT MANAGER: CNK
DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.1	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

SITE PLAN

G1-04

Drawing Path: P:\2024\452\Civil\Active\5-2024-452_C1-01- 06_ Site Plan.dwg
Plotted By: jlaureano Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 2:02pm



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NORTH

20 0 20 40 60

GENERAL NOTES

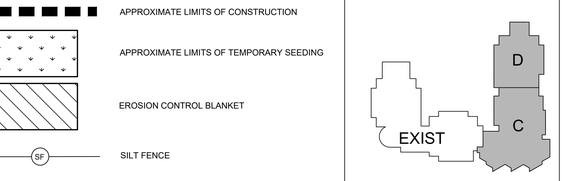
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◯ EROSION CONTROL KEYNOTES

1. SILT FENCE - SEE DETAIL B/G3-07
2. INLET SEDIMENT PROTECTION - SEE DETAIL E/G3-07
3. CONCRETE WASHOUT - SEE DETAIL F/G3-07
4. STONE RIP RAP - SEE DETAIL D/G3-07
5. EROSION CONTROL BLANKET - SEE DETAIL J & K/G3-07
6. WEIGHTED WATTLE - SEE DETAIL L/G3-07
7. NEW SEEDING - SEE DETAIL A/G3-07
8. FODS CONSTRUCTION ENTRANCE - SEE DETAIL C/G3-07
9. SWPPP SIGN SEE DETAIL G/G3-07
10. PORTABLE TOILET

EROSION CONTROL LEGEND

- SEDIMENT BAG INLET PROTECTION
- APPROXIMATE LIMITS OF CONSTRUCTION
- APPROXIMATE LIMITS OF TEMPORARY SEEDING
- EROSION CONTROL BLANKET
- SF — SILT FENCE
- WW — WEIGHTED WATTLE
- PT — INDICATES LOCATION OF PORTABLE TOILETS
- CW — INDICATES LOCATION OF CONCRETE WASHOUT



KEY PLAN

N

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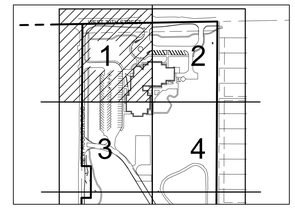
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EROSION CONTROL PLAN

G3-01



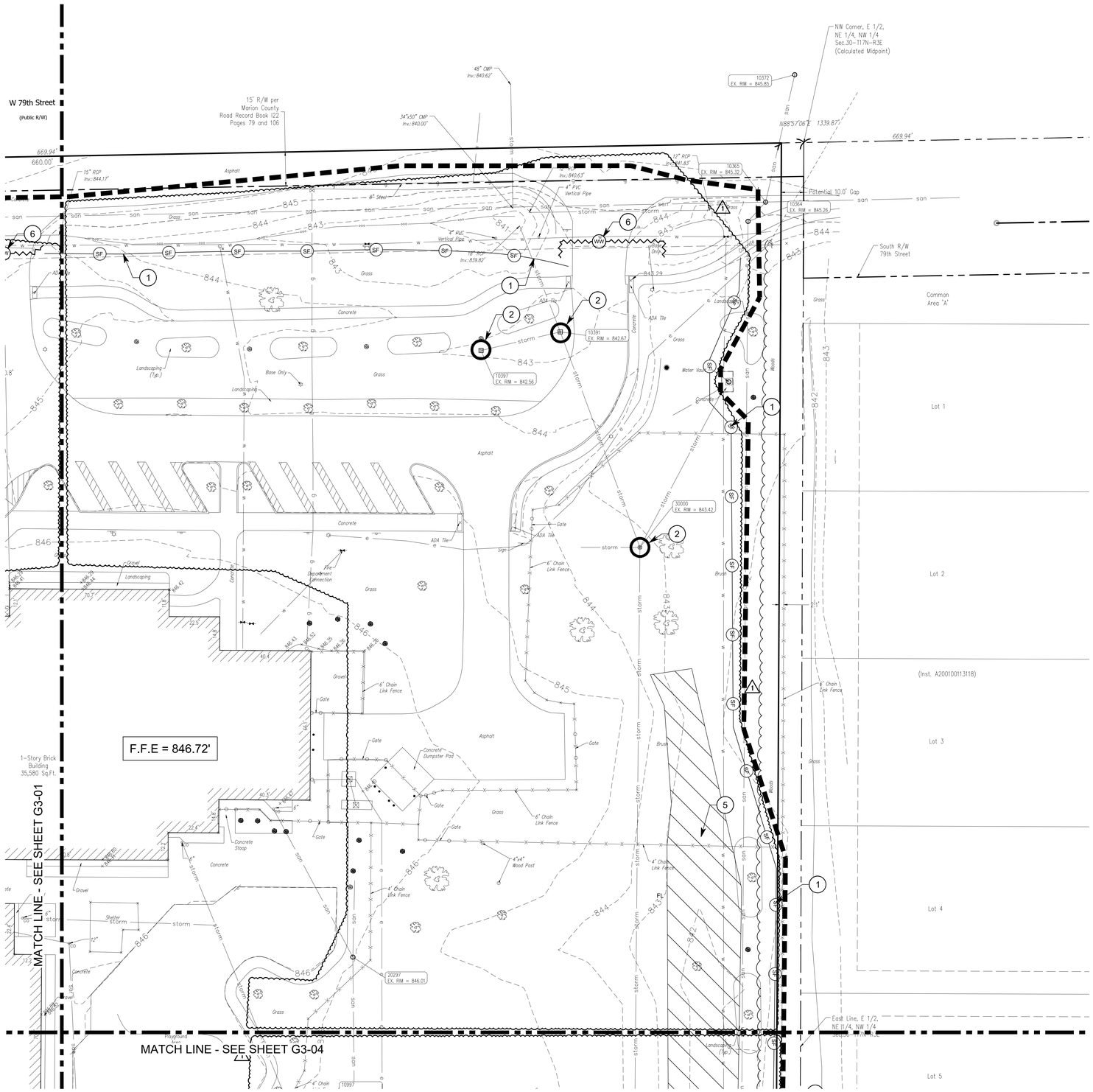
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Drawing Path: P:\2024\400\452\CAD\Civil\Active\13-2024-452_G3-01 - ME_ Erosion Control Plan PRE.dwg
Plotted By: jlourenco Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:59pm



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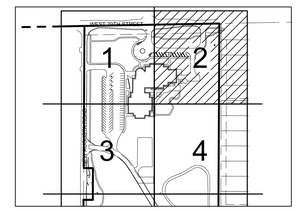
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1. SILT FENCE - SEE DETAIL B/G3-07
2. INLET SEDIMENT PROTECTION - SEE DETAIL E/G3-07
3. CONCRETE WASHOUT - SEE DETAIL F/G3-07
4. STONE RIP RAP - SEE DETAIL D/G3-07
5. EROSION CONTROL BLANKET - SEE DETAIL J & K/G3-07
6. WEIGHTED WATTLE - SEE DETAIL L/G3-07
7. NEW SEEDING - SEE DETAIL A/G3-07
8. FODS CONSTRUCTION ENTRANCE - SEE DETAIL C/G3-07
9. SWPPP SIGN SEE DETAIL G/G3-07
10. PORTABLE TOILET

EROSION CONTROL LEGEND

- SEDIMENT BAG INLET PROTECTION
- APPROXIMATE LIMITS OF CONSTRUCTION
- APPROXIMATE LIMITS OF TEMPORARY SEEDING
- EROSION CONTROL BLANKET
- SF — SILT FENCE
- WW — WEIGHTED WATTLE
- PT — INDICATES LOCATION OF PORTABLE TOILETS
- CW — INDICATES LOCATION OF CONCRETE WASHOUT



KEY MAP

CAUTION !!

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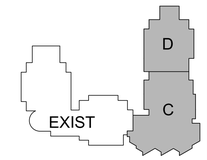
NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

7839 NEW AUGUSTA RD,
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CIVIL ENGINEER

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Phone: (317) 334-1500
www.tlf-engineers.com
TLF Job No: 2024-452



KEY PLAN

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID
REGISTERED No. 11300453 STATE OF INDIANA
PROFESSIONAL ENGINEER

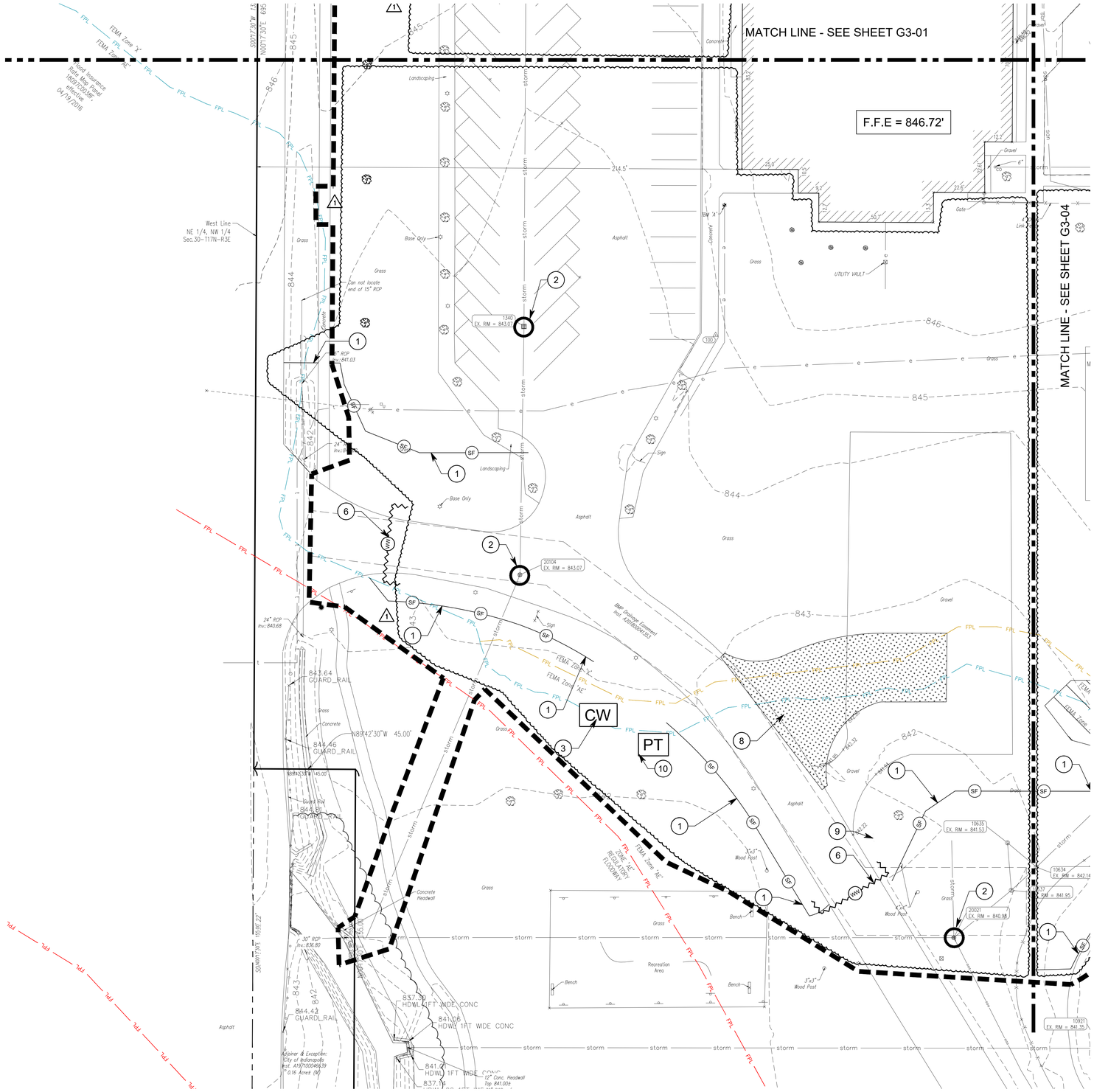
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DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

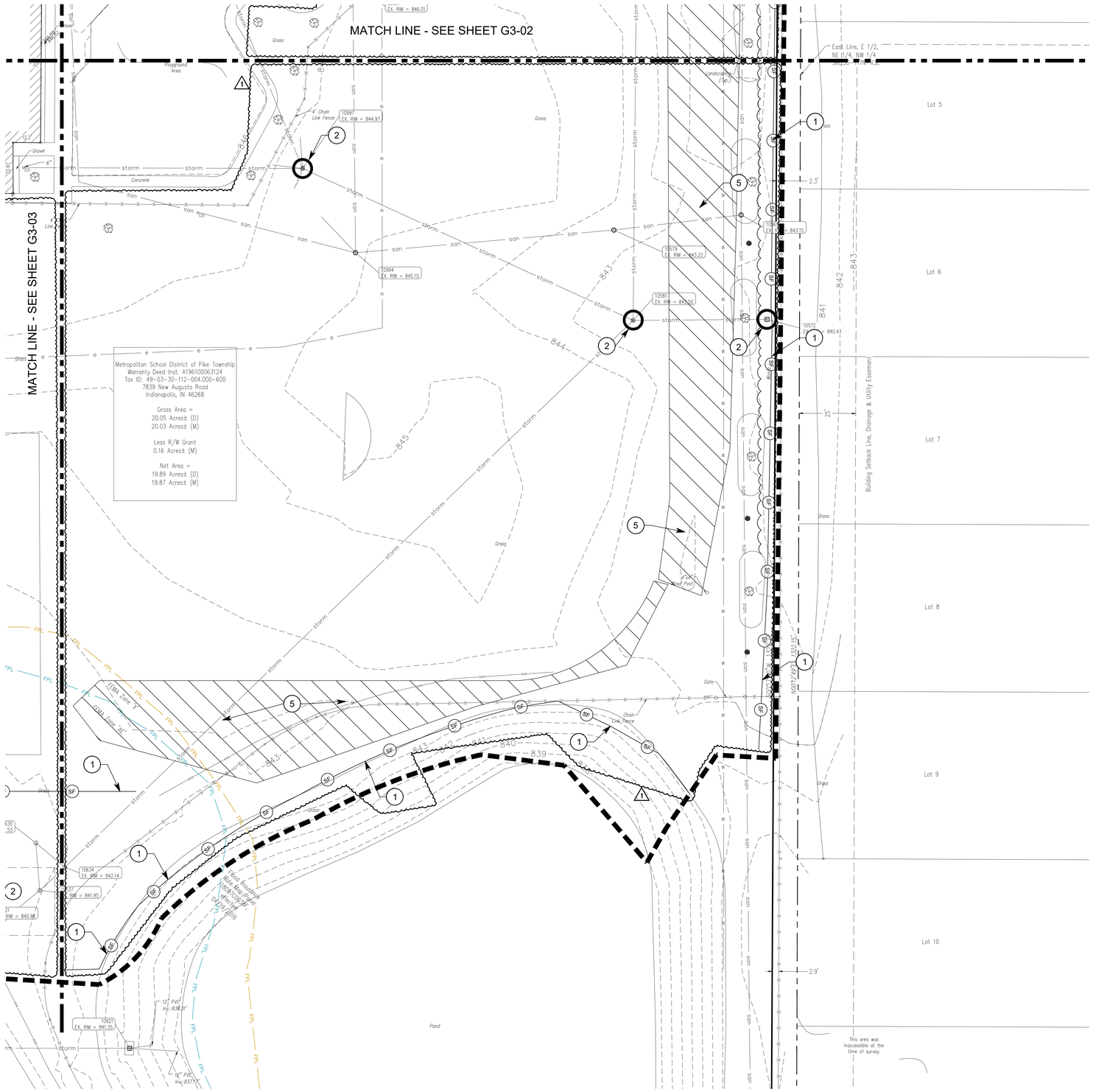
REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

EROSION CONTROL PLAN

G3-02

Drawing Path: P:\2024\452\CAD\Arch\13-2024-452_G3-01 - 06_ Erosion Control Plan PRE.dwg
Plotted By: jlaureano Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:50pm


MATCH LINE - SEE SHEET G3-01
MATCH LINE - SEE SHEET G3-04
F.F.E = 846.72'
West Line NE 1/4, NW 1/4 Sec.30-T17N-R3E
FEMA Zone 'X'
FEMA Zone 'AE'
Flood Insurance Rate Map Panel 18097C0135F, dated 04/19/2016
N00°17'30"E 695.00'
S00°17'30"W 695.00'
N89°42'30"W 45.00'
S89°42'30"E 45.00'
S00°17'30"W 55.55'
Landscaping
Grass
Asphalt
Concrete
Gravel
Base Only
Can not locate end of 15" RCP
24" RCP Inv.:840.68
30" RCP Inv.: 836.80
15" RCP Inv.:841.03
Inv.: 840.68
Inv.: 841.00
Inv.: 841.22
Inv.: 841.32
Inv.: 841.42
Inv.: 841.52
Inv.: 841.62
Inv.: 841.72
Inv.: 841.82
Inv.: 841.92
Inv.: 842.02
Inv.: 842.12
Inv.: 842.22
Inv.: 842.32
Inv.: 842.42
Inv.: 842.52
Inv.: 842.62
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Inv.:



NORTH

20 0 20 40 60

GENERAL NOTES

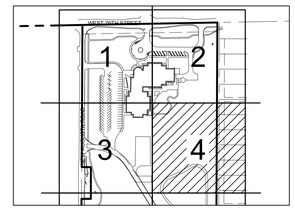
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8. FODS CONSTRUCTION ENTRANCE - SEE DETAIL C/G3-07
9. SWPPP SIGN SEE DETAIL G/G3-07
10. PORTABLE TOILET

EROSION CONTROL LEGEND

- SEDIMENT BAG INLET PROTECTION
- APPROXIMATE LIMITS OF CONSTRUCTION
- APPROXIMATE LIMITS OF TEMPORARY SEEDING
- EROSION CONTROL BLANKET
- SILT FENCE (SF)
- WEIGHTED WATTLE (WW)
- PT — INDICATES LOCATION OF PORTABLE TOILETS
- CW — INDICATES LOCATION OF CONCRETE WASHOUT



KEY MAP

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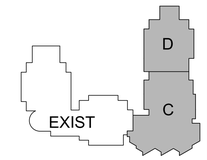
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KEY PLAN

N

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID
REGISTERED
No.
11300453
STATE OF
INDIANA
PROFESSIONAL ENGINEER

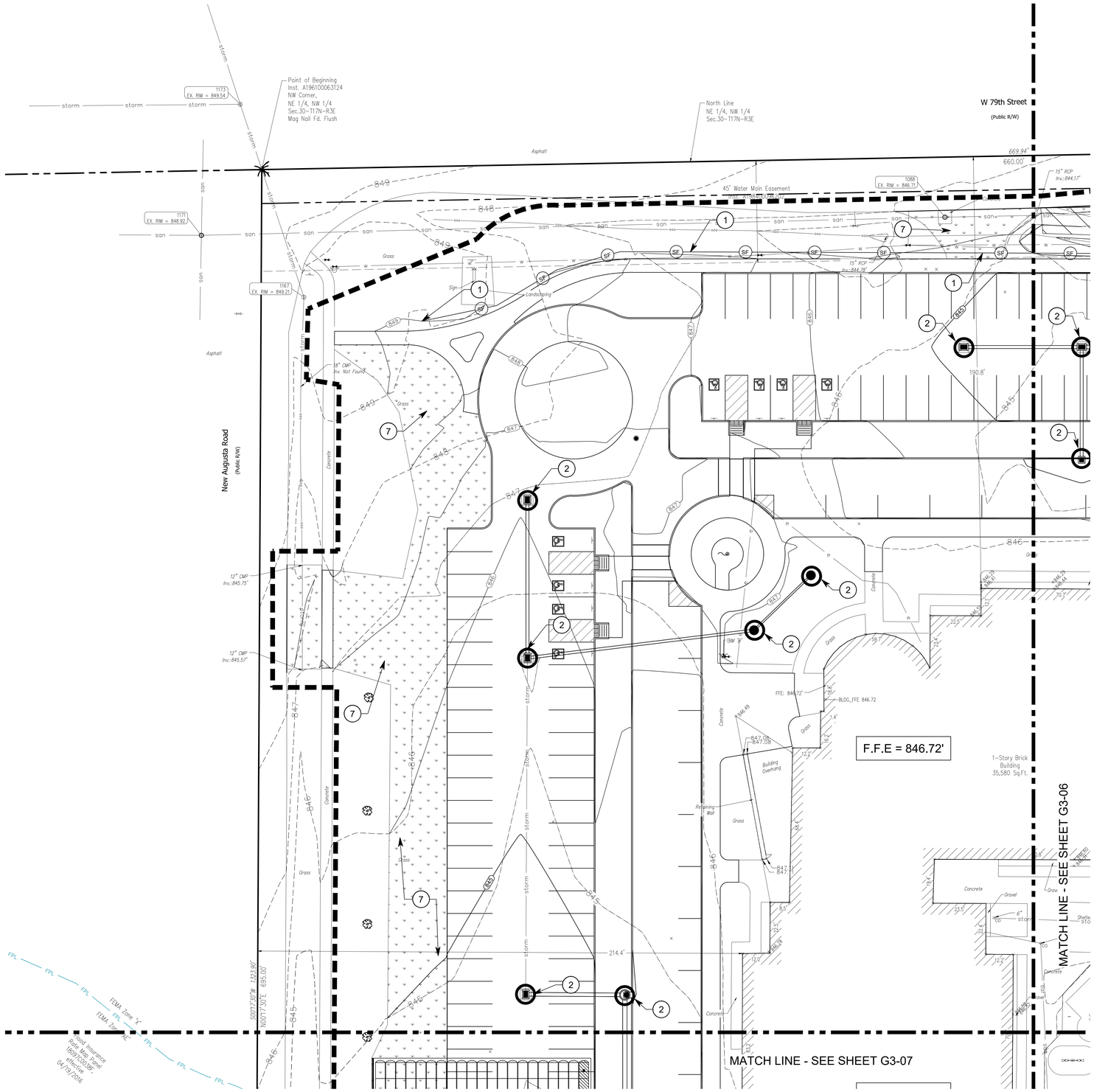
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DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

EROSION CONTROL PLAN

G3-04

Drawing Path: P:\2024\400\452\CAD\Civil\Active\13-2024-452_G3-01 -06_ Erosion Control Plan PRE.dwg
Plotted By: jlourenco Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:55pm



NORTH

20 0 20 40 60

GENERAL NOTES

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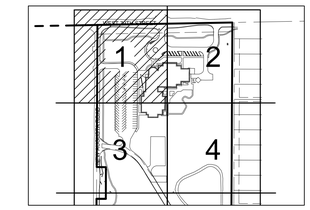
◯ EROSION CONTROL KEYNOTES

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7. NEW SEEDING - SEE DETAIL A/G3-07
8. FODS CONSTRUCTION ENTRANCE - SEE DETAIL C/G3-07

EROSION CONTROL LEGEND

- SEDIMENT BAG INLET PROTECTION
- APPROXIMATE LIMITS OF CONSTRUCTION
- APPROXIMATE LIMITS OF TEMPORARY SEEDING
- EROSION CONTROL BLANKET
- SF — SILT FENCE
- WW — WEIGHTED WATTLE
- PT — INDICATES LOCATION OF PORTABLE TOILETS
- CW — INDICATES LOCATION OF CONCRETE WASHOUT

ENTIRE SHEET 1



KEY MAP

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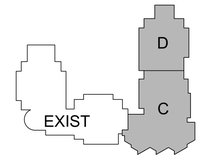
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CIVIL ENGINEER

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Phone: (317) 334-1500
www.tlf-engineers.com
TLF Job No: 2024-452



KEY PLAN

N

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID
REGISTERED
No.
11300453
STATE OF
INDIANA
PROFESSIONAL ENGINEER

PROJECT MANAGER: CNK
DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

POST-CONSTRUCTION EROSION CONTROL PLAN

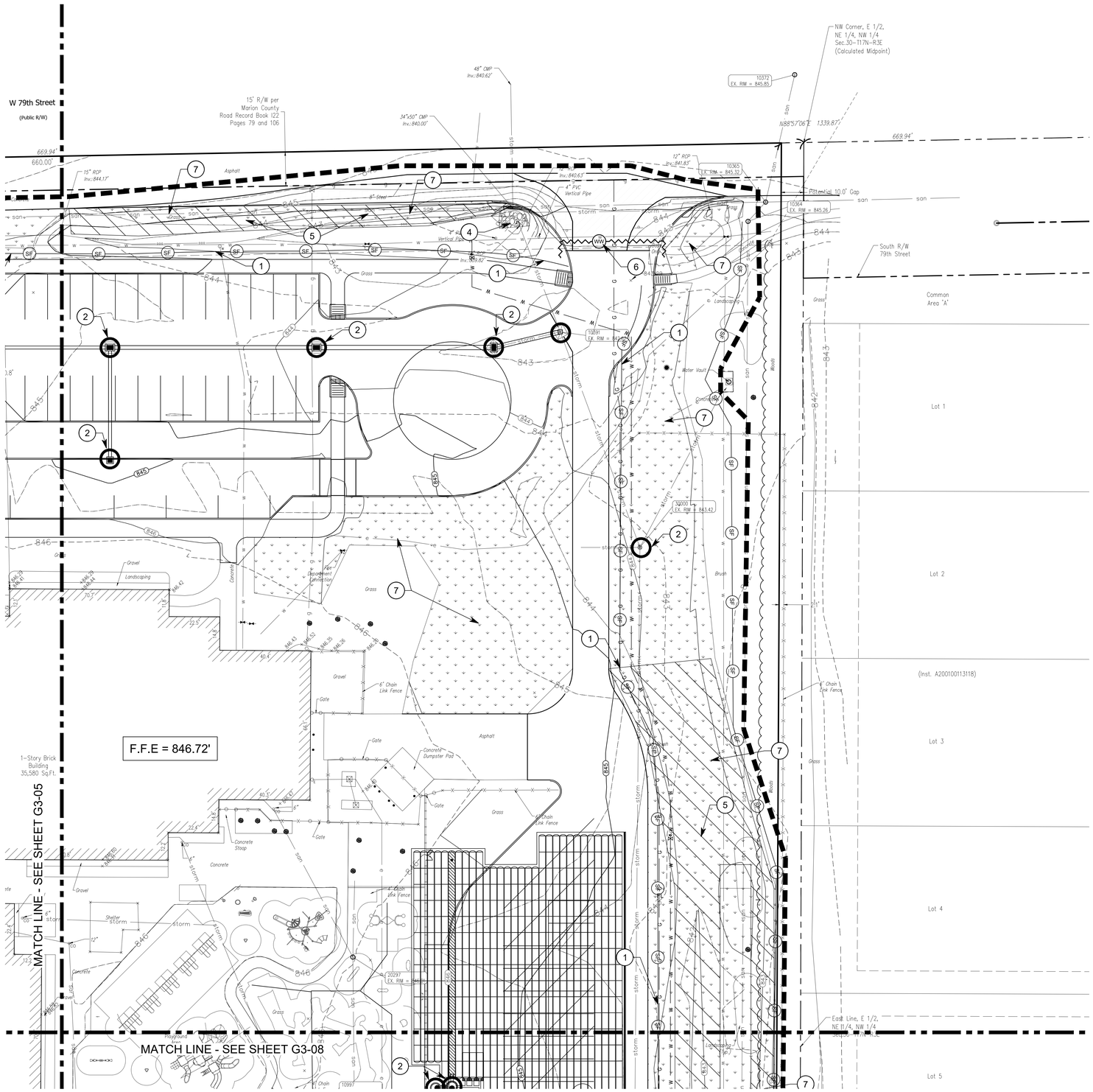
G3-05

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Drawing Path: P:\2024\400\452\CAD\Civil\Active\14-2024-452_G3-01 -06_ Erosion Control Plan POST.dwg
Plotted By: jlourenco Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:53pm



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MSD OF PIKE TOWNSHIP

NORTH

20 0 20 40 60

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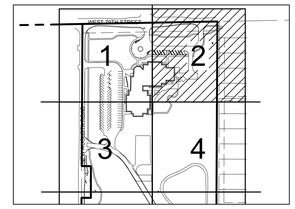
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EROSION CONTROL LEGEND

- SEDIMENT BAG INLET PROTECTION
- APPROXIMATE LIMITS OF CONSTRUCTION
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- EROSION CONTROL BLANKET
- SF — SILT FENCE
- WW — WEIGHTED WATTLE
- PT — INDICATES LOCATION OF PORTABLE TOILETS
- CW — INDICATES LOCATION OF CONCRETE WASHOUT

ENTIRE SHEET 1

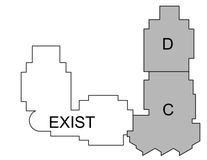


KEY MAP

CIVIL ENGINEER

TLF

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TLF Job No: 2024-452



KEY PLAN N

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID
REGISTERED
No.
11300453
STATE OF
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PROFESSIONAL ENGINEER

PROJECT MANAGER: CNK
DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.△	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

POST-CONSTRUCTION EROSION CONTROL PLAN

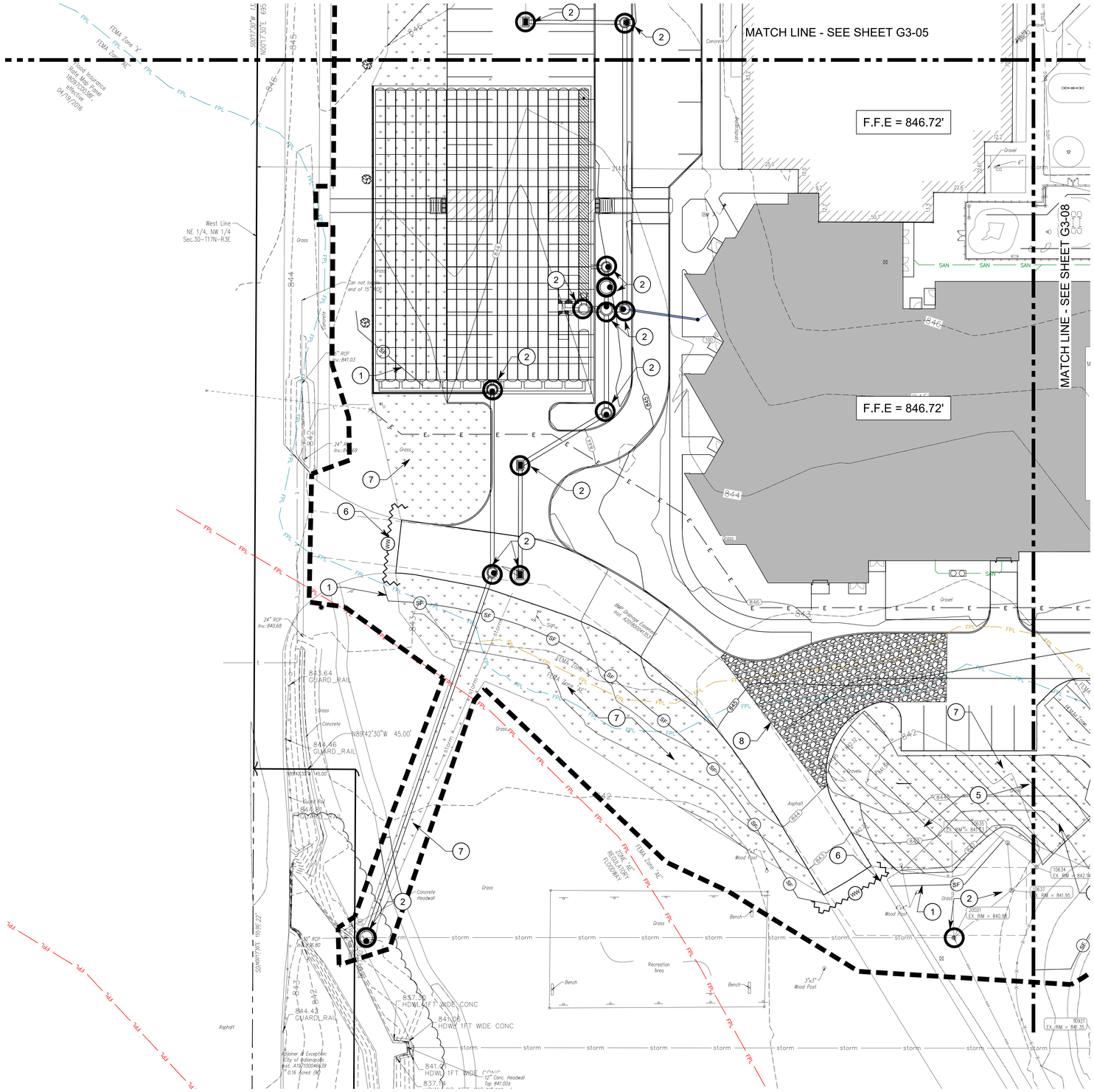
G3-06

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Drawing Path: P:\2024\400\452\Cad\Active\14-2024-452_G3-01 - ESC_Erosion Control Plan POST.dwg
Plotted By: jlourens Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:53pm



NORTH

20 0 20 40 60

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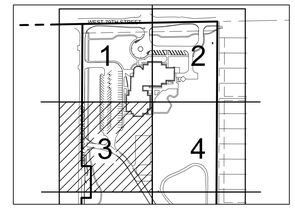
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ENTIRE SHEET 1



KEY MAP

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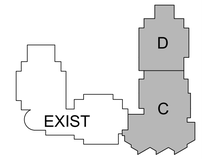
NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

7839 NEW AUGUSTA RD,
INDIANAPOLIS, IN 46268

MSD OF PIKE TOWNSHIP

CIVIL ENGINEER

TLF
3901 W 86th Street, Suite 200
Indianapolis, IN 46268
Phone: (317) 334-1500
www.tlf-engineers.com
TLF Job No: 2024-452



KEY PLAN N

CONSTRUCTION DOCUMENTS

CHAD N. KINCAID REGISTERED No. 11300453 STATE OF Indiana PROFESSIONAL ENGINEER

PROJECT MANAGER: CNK
DRAWN BY: JHL
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-26

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03/26/2026

POST-CONSTRUCTION EROSION CONTROL PLAN

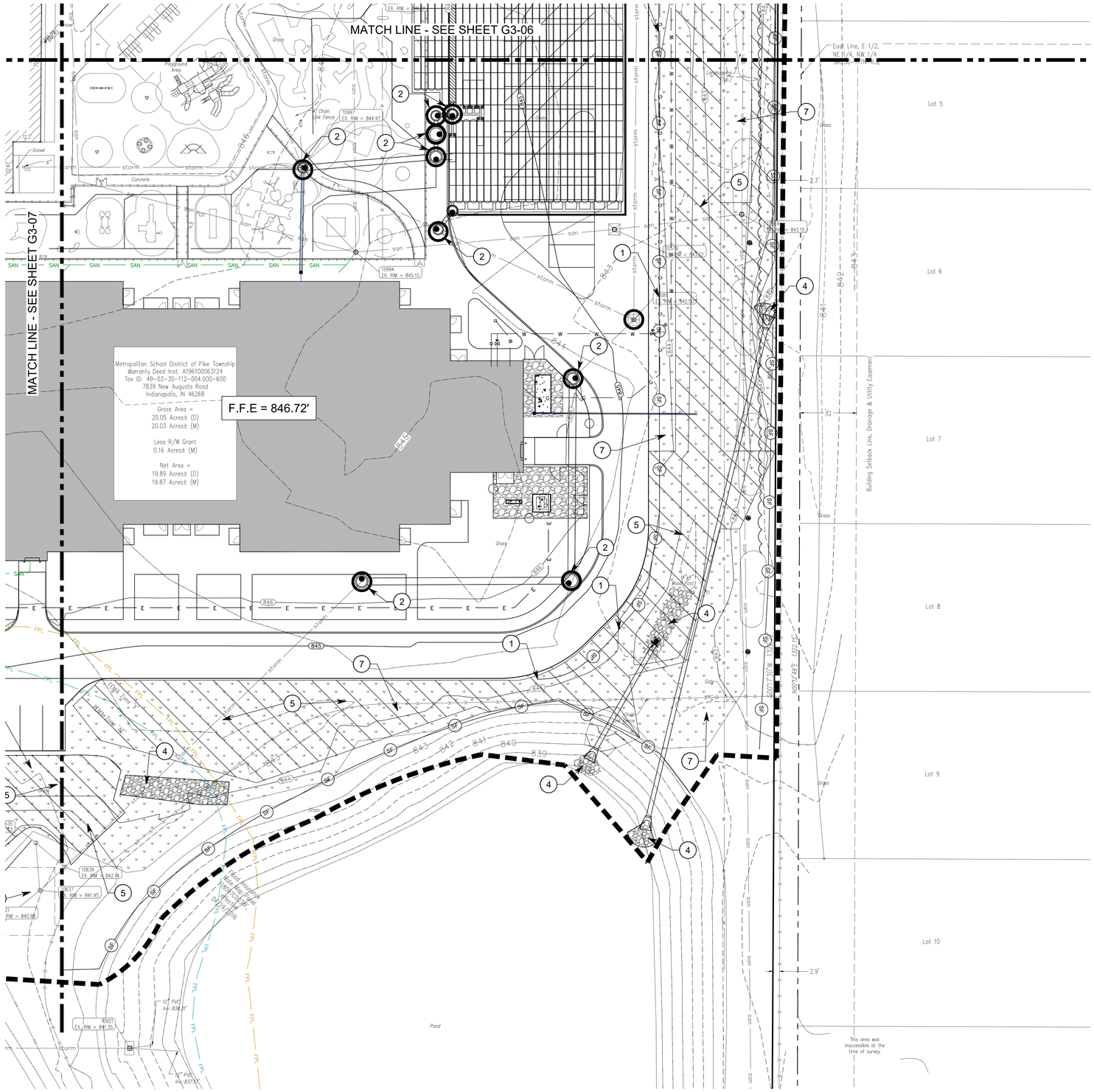
G3-07

811 Know what's below. Call before you dig.
Call 811 or 1-800-382-5544 Before You Begin Any Digging Project.
Call 48 hours or 2 working days before you dig.
It's Fast, It's Easy and It's the Law in the state of Indiana!

CAUTION !!

THE LOCATIONS OF ALL EXISTING UNDERGROUND UTILITIES SHOWN ON THE PLAN ARE BASED UPON ABOVE GROUND EVIDENCE (INCLUDING, BUT NOT LIMITED TO, MANHOLES, INLETS, VALVES, AND MARKS MADE UPON THE GROUND BY OTHERS) AND ARE SPECULATIVE IN NATURE. THERE MAY ALSO BE OTHER EXISTING UNDERGROUND UTILITIES FOR WHICH THERE IS NO ABOVE GROUND EVIDENCE OR FOR WHICH NO ABOVE GROUND EVIDENCE WAS OBSERVED. THE EXACT LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHALL BE VERIFIED BY CONTRACTOR PRIOR TO ANY AND ALL CONSTRUCTION.

Drawing Path: P:\2024\400\452\CAD\Civil\Active\14-2024-452_G3-01 - G6_ Erosion Control Plan POST.dwg
Plotted By: jlaureano Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:55pm

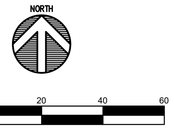


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Drawing Path: P:\2024\400\452\CAD\Active\14-2024-452_G3-01 - NG_ Erosion Control Plan POST.dwg
Plotted By: jlourens Time of Plot: 3/26/26 - 2:04pm Last Edited: 3/26/26 - 1:53pm



GENERAL NOTES

1. SEE DRAWING GD0-0 FOR GENERAL NOTES AND ADDITIONAL LEGEND.
2. TOPOGRAPHIC CONDITIONS AND EXISTING UTILITIES SHOWN WERE PROVIDED BY SCHNEIDER GEOMATICS DATED 10/28/25. THE ENGINEER MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED.
3. CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS IN THE PROJECT AREA INCLUDING UNDERGROUND UTILITY CONDITIONS, LOCATION AND DEPTH PRIOR TO ANY OTHER SITE CONSTRUCTION. REPORT ANY DISCREPANCIES TO THE ENGINEER.
4. ALL PROPOSED EROSION AND SEDIMENT CONTROL SHALL BE IN CONFORMANCE WITH CHAPTER 600 OF THE CITY OF INDIANAPOLIS STORMWATER SPECIFICATIONS MANUAL, LATEST EDITION. DISCREPANCIES BETWEEN THE PLANS AND THE MANUAL SHALL NOT ALLEVIATE THE CONTRACTOR FROM ADHERING TO THE REQUIREMENTS AS SET FORTH IN THE MANUAL.
5. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED BY THE INSPECTOR.
6. PUBLIC AND PRIVATE ROADWAYS SHALL BE KEPT CLEARED OF ACCUMULATED SEDIMENT. BULK CLEARING OF ACCUMULATED SEDIMENT SHALL NOT INCLUDE FLUSHING THE AREA WITH WATER. PROJECTS SUBJECT TO IDEM'S CSGP SHALL REMOVE SEDIMENT FROM PUBLIC RIGHTS-OF-WAY NOT EXCLUSIVE OF CONSTRUCTION TRAFFIC AT THE END OF EACH DAY PER THE CSGP REQUIREMENTS.

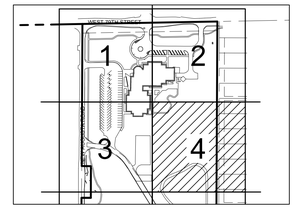
○ EROSION CONTROL KEYNOTES

1. SILT FENCE - SEE DETAIL B/G3-07
2. INLET SEDIMENT PROTECTION - SEE DETAIL E/G3-07
3. CONCRETE WASHOUT - SEE DETAIL F/G3-07
4. STONE RIP RAP - SEE DETAIL D/G3-07
5. EROSION CONTROL BLANKET - SEE DETAIL J & K/G3-07
6. WEIGHTED WATTLE - SEE DETAIL L/G3-07
7. NEW SEEDING - SEE DETAIL A/G3-07
8. FODS CONSTRUCTION ENTRANCE - SEE DETAIL C/G3-07

EROSION CONTROL LEGEND

- SEDIMENT BAG INLET PROTECTION
- APPROXIMATE LIMITS OF CONSTRUCTION
- APPROXIMATE LIMITS OF TEMPORARY SEEDING
- EROSION CONTROL BLANKET
- SF — SILT FENCE
- WW — WEIGHTED WATTLE
- PT — INDICATES LOCATION OF PORTABLE TOILETS
- CW — INDICATES LOCATION OF CONCRETE WASHOUT

ENTIRE SHEET 1



KEY MAP

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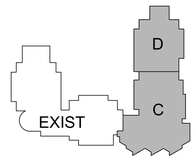
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KEY PLAN N

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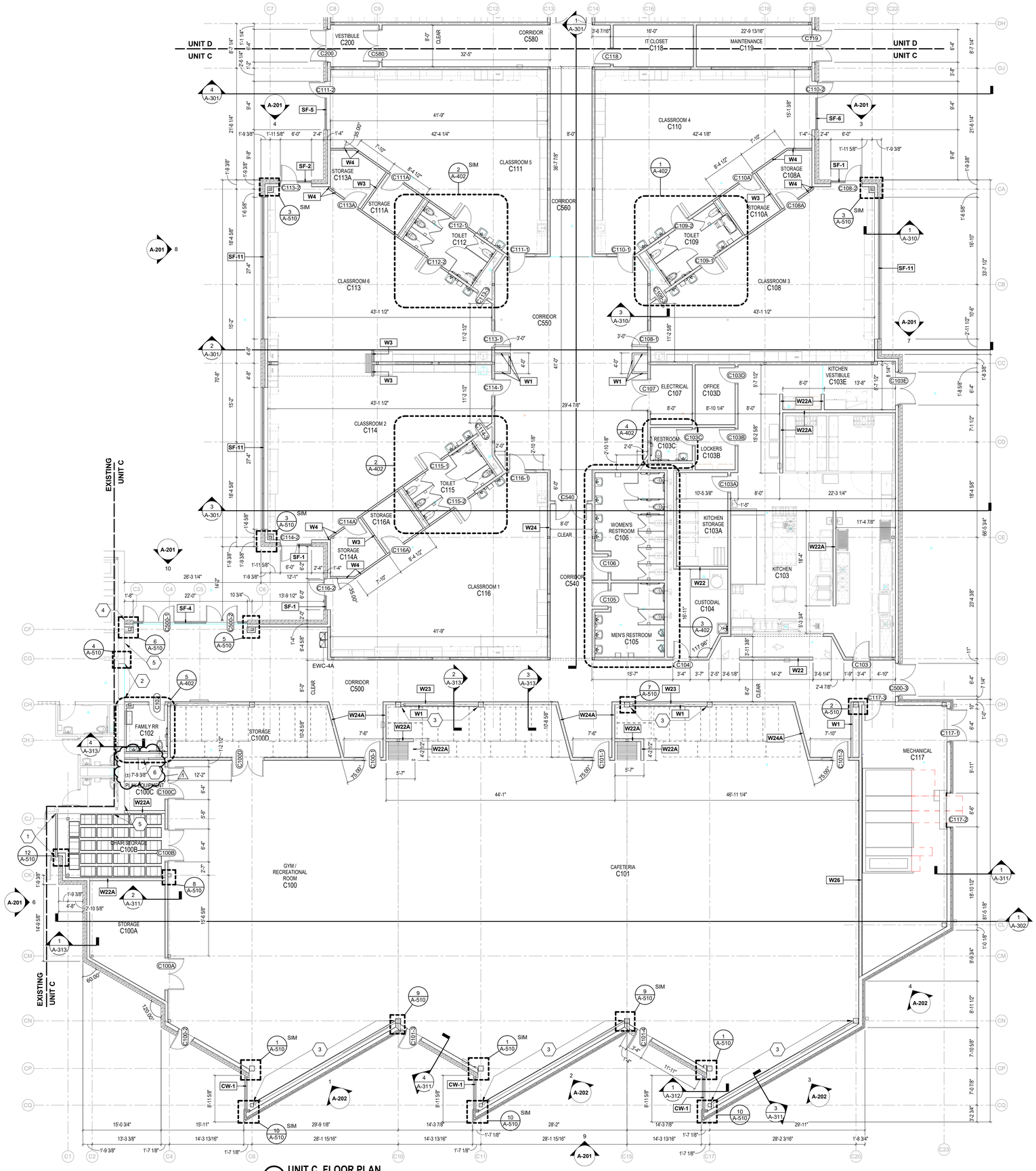
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PROJECT MANAGER: CNK
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POST-CONSTRUCTION EROSION CONTROL PLAN

G3-08



1 **UNIT C FLOOR PLAN**
SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT A

ROOM NO.	ROOM NAME	AREA (SF)
C100	GYM / RECREATIONAL ROOM	2515 SF
C100A	STORAGE	274 SF
C100B	CHAIR STORAGE	248 SF
C100C	PLAY EQUIPMENT	77 SF
C100D	STORAGE	318 SF
C101	CAFETERIA	5761 SF
C102	FAMILY RR	70 SF
C103	KITCHEN	1515 SF
C103A	KITCHEN STORAGE	177 SF
C103B	LOCKERS	62 SF
C103C	RESTROOM	51 SF
C103D	OFFICE	88 SF
C103E	KITCHEN VESTIBULE	122 SF
C104	CUSTODIAL	220 SF
C105	MEN'S RESTROOM	173 SF
C106	WOMEN'S RESTROOM	258 SF
C107	ELECTRICAL	92 SF
C108	CLASSROOM 3	1090 SF
C108A	STORAGE	79 SF
C109	TOILET	136 SF
C110	CLASSROOM 4	1085 SF
C110A	STORAGE	73 SF
C111	CLASSROOM 5	1085 SF
C111A	STORAGE	73 SF
C112	TOILET	136 SF
C113	CLASSROOM 6	1089 SF
C113A	STORAGE	79 SF
C114	CLASSROOM 2	1089 SF
C114A	STORAGE	79 SF
C115	TOILET	135 SF
C116	CLASSROOM 1	1088 SF
C116A	STORAGE	73 SF
C117	MECHANICAL	771 SF
C118	IT CLOSET	123 SF
C119	MAINTENANCE	178 SF
C200	VESTIBULE	75 SF
C500	CORRIDOR	1838 SF
C540	CORRIDOR	272 SF
C550	CORRIDOR	1218 SF
C560	CORRIDOR	293 SF
C580	CORRIDOR	380 SF

ARCHITECTURAL PLAN GENERAL NOTES

A. WHERE DISSIMILAR FLOOR MATERIALS MEET, THEY SHALL DO SO UNDER THE CENTERLINE OF THE DOOR, UNLESS NOTED OTHERWISE.
B. THE BASE FLOOR ELEVATION INDICATED FOR THE PROJECT IS 100'-0". REFER TO SITE PLAN FOR CORRELATION TO USGS DATUM.
C. FOR TYPICAL COMMON JOINT DETAILS AND CONSTRUCTION MOVEMENT JOINT DETAILS REFER TO DETAILS ON SHEET A-501.
D. ALL DIMENSIONS ON FLOOR PLANS ARE TO FINISH FACE OF CMU, CONCRETE, BRICK OR FINISH FACE OF GWB AT METAL STUD WALLS, UNLESS NOTED OTHERWISE.
E. HINGE SIDE DOOR JAMB AT WALLS WILL TYPICALLY BE LOCATED 4" MINIMUM FROM ADJACENT WALL UNLESS NOTED OTHERWISE.
F. SEE REFLECTED CEILING PLANS FOR BULKHEAD LOCATIONS AND DETAIL REFERENCES.
G. REFER TO ROOM FINISH SCHEDULE OR PLAN AND EQUIPMENT PLANS FOR LOCATION AND EXTENT OF FINISH FLOOR MATERIALS.
H. PROVIDE WOOD BLOCKING AS REQUIRED WITHIN METAL STUD WALLS FOR WALL MOUNTED ITEMS.
I. REFER TO MASTER/CODE PLANS FOR CODE INFORMATION AND FIRE RATED WALL LOCATIONS.
J. PROVIDE SPRAY FOAM INSULATION AND THERMAL BARRIER CONTINUOUS AT INTERSECTION OF EXTERIOR WALLS AND DECK.
K. ALL INFORMATION RELATED TO AREAS OF ENLARGED CALLOUTS ARE TO BE LOCATED ON THE ENLARGED PLANS, NOT THE FLOOR PLANS.

ARCHITECTURAL PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

—— W### INDICATES WALL TYPE. REFER TO DRAWING A-001 FOR WALL THICKNESS, HEIGHT AND COMPOSITION. ALL UNTAGGED WALLS ARE TO BE CONSIDERED W24 UNLESS NOTED OTHERWISE.

1 DEMOLISH EXISTING CURTAIN WALL SYSTEM AT ENTRY AS INDICATED ON PLAN. PATCH AND REPAIR EXISTING FLOORING AND CONCRETE SUBFLOOR AS REQUIRED. EXISTING STRUCTURAL ELEMENTS TO REMAIN. DEMOLISH EXISTING WALL BASE IN THE ENTIRE ROOM. PATCH, REPAIR, AND REPAINT WALL UNDER REMOVED WALL BASE AS REQUIRED TO RECEIVE NEW 2 1/2" WALL BASE. REFER TO INTERIOR SHEETS.

2 DEMOLISH EXISTING WINDOW AND WALL BASE COMPLETELY. PATCH AND REPAIR OPENING SIDES AND FLOOR AS REQUIRED. REFER TO RELATED DETAILS ON SHEETS A-502 & A-510

3 COVER STRUCTURAL CROSS BRACING WITH METAL FRAMING AND GYPSUM WALL BOARD. REFER TO RELATED WALL SECTION

4 APPLY 2" EXPANSION JOINT WITH ALUMINUM EXPANSION JOINT COVER AT CONNECTION BETWEEN EXISTING AND NEW WALL. REFER TO RELATED ROOF CONNECTION DETAIL ON SHEET AR101

5 CONTRACTOR TO PROVIDE REQUIRED ROTECTION OF EXISTING WALL SURFACES AND MATERIALS DURING ALL PHASES OF CONSTRUCTION

6 ACCESS DOOR (24" X 24"). BOTTOM OF DOOR AT 3'-4" A.F.F. COORDINATE EXACT LOCATION OF DOOR WITH PLUMBING DRAWINGS

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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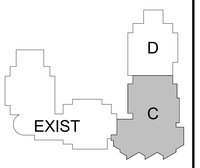
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FANNING HOWEY

317-848-0966 WWW.FHAI.COM

350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



KEY PLAN

BID DOCUMENTS

PAUL A. MILLER REGISTERED No. AR10800161 STATE OF INDIANA ARCHITECT

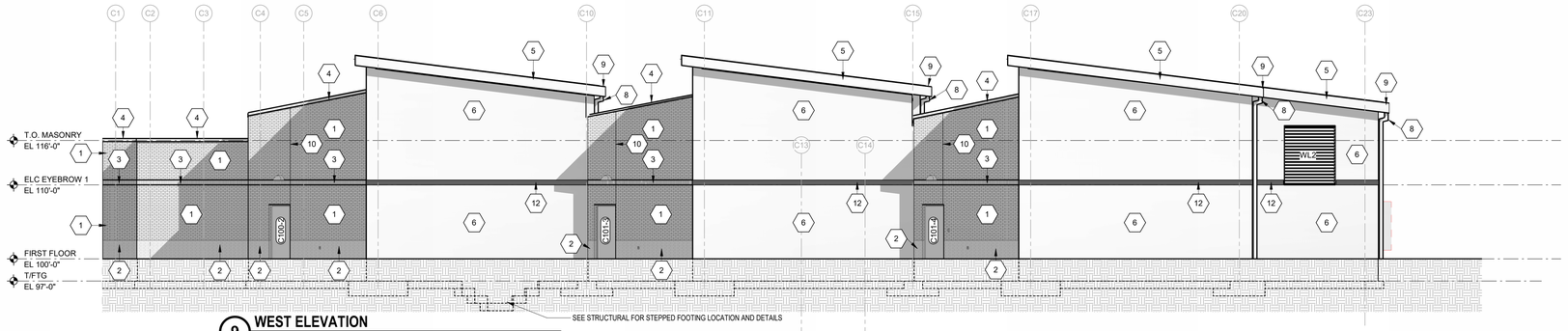
PROJECT MANAGER: PW
DRAWN BY: HA
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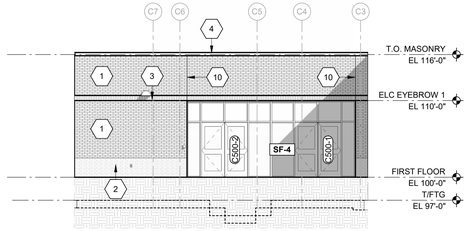
FIRST FLOOR ARCHITECTURE PLAN - UNIT C

A-11C

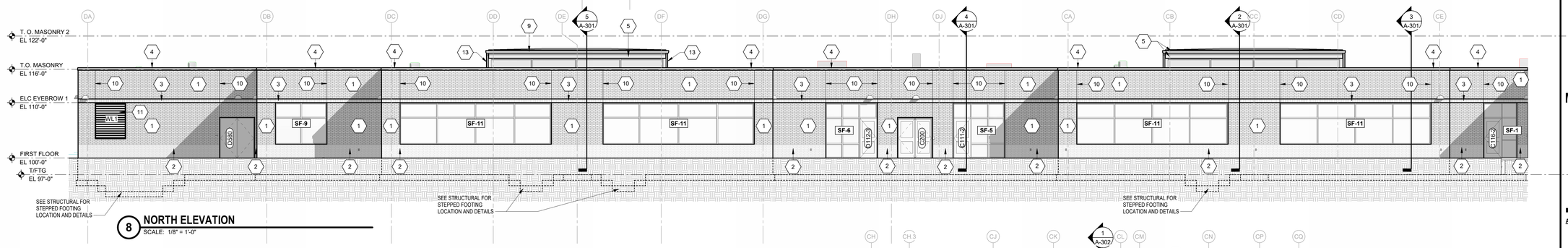
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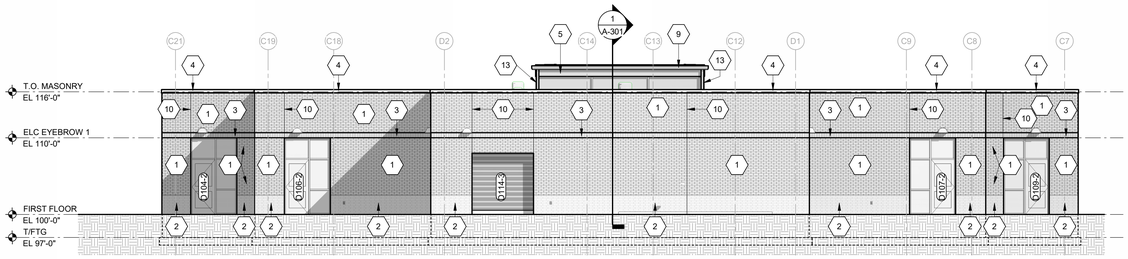
9 WEST ELEVATION
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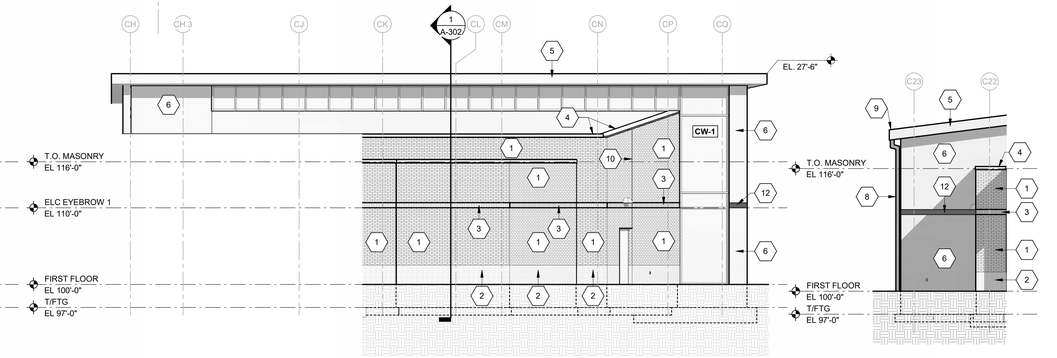
10 EAST ELEVATION - UNIT C
SCALE: 1/8" = 1'-0"



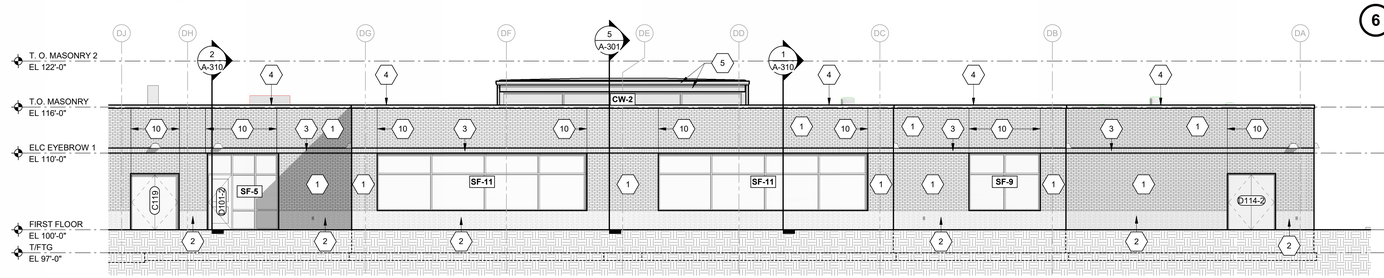
8 NORTH ELEVATION
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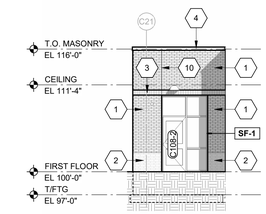
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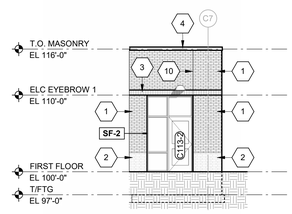
6 NORTH ELEVATION - CAFETERIA
SCALE: 1/8" = 1'-0"



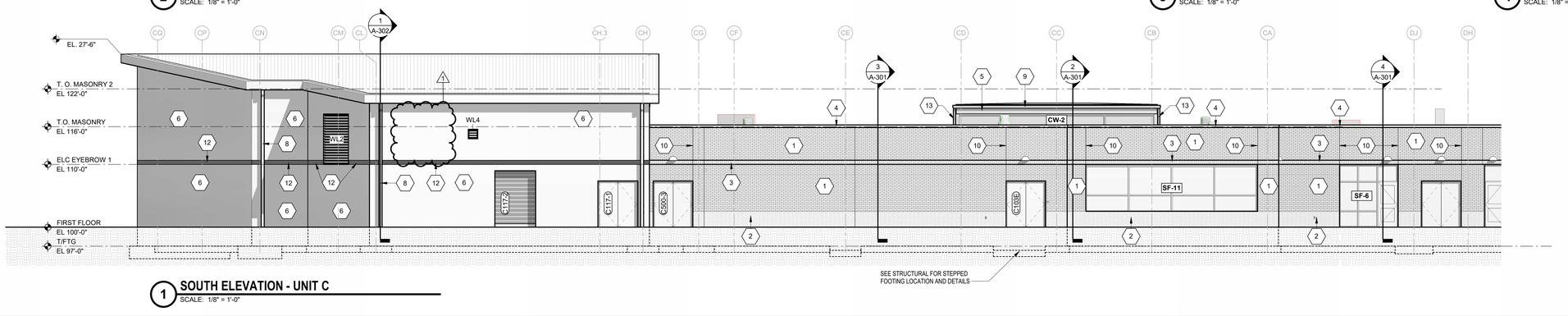
2 SOUTH ELEVATION - UNIT D
SCALE: 1/8" = 1'-0"



3 EAST SMALL - SOUTH SIDE
SCALE: 1/8" = 1'-0"



4 EAST SMALL - NORTH SIDE
SCALE: 1/8" = 1'-0"



1 SOUTH ELEVATION - UNIT C
SCALE: 1/8" = 1'-0"

BUILDING ELEVATION NOTES
(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

1 FACE BRICK - TYPE 1
2 FACE BRICK - TYPE 2
3 FACE BRICK - SOLDIER COURSING
4 PREFINISHED ALUMINUM COPING
5 PREFINISHED ALUMINUM FASCIA PANEL & COPING. REFER TO WALL SECTIONS
6 METAL COMPOSITE PANEL SYSTEM, BEIGE COLOR - REFER TO SPECIFICATIONS
8 6" X 6" DOWNSPOUT
9 6" X 6" ALUMINUM GUTTER
10 BRICK EXPANSION JOINT - REFER TO SHEET A-503
11 MECHANICAL WALL LOUVER, REFER TO SHEET A-602
12 METAL COMPOSITE PANEL SYSTEM, DARK BRONZE COLOR - REFER TO SPECIFICATIONS
13 4" X 4" DOWNSPOUT

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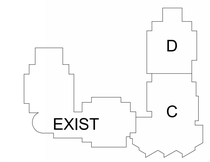
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KEY PLAN N

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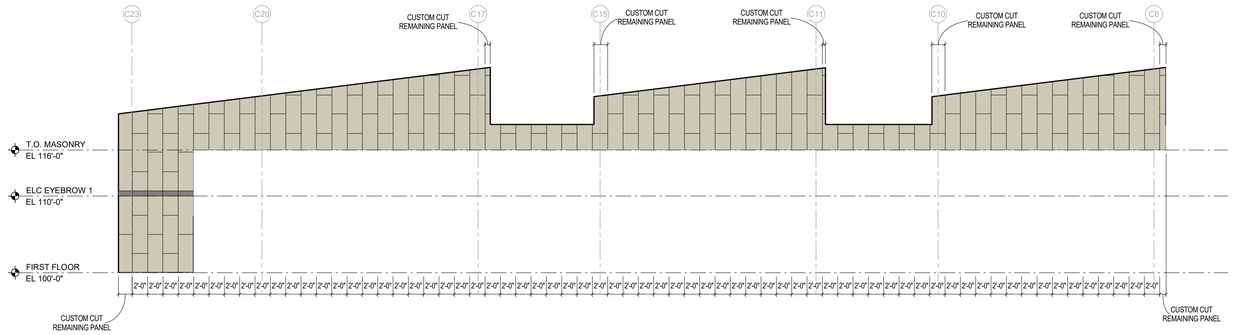
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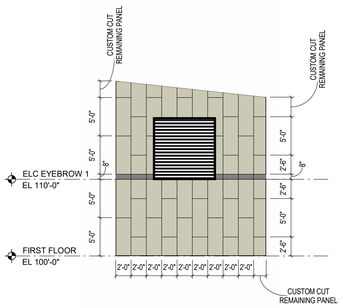
BUILDING ELEVATIONS

A-201

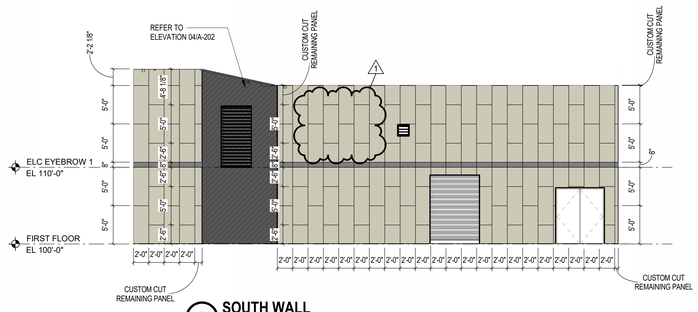
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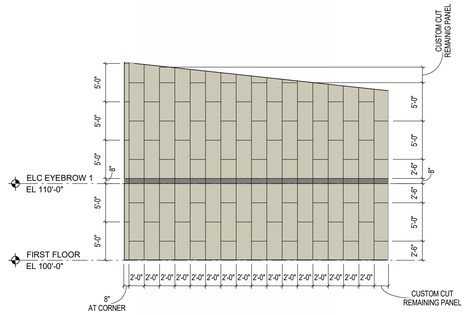
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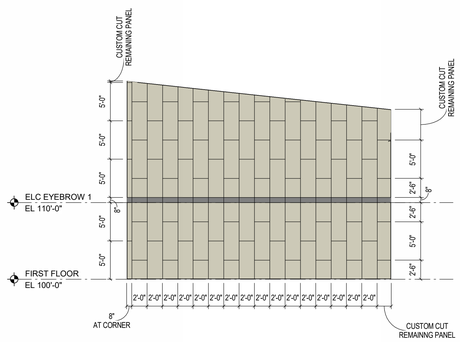
4 WEST WALL - FOUR
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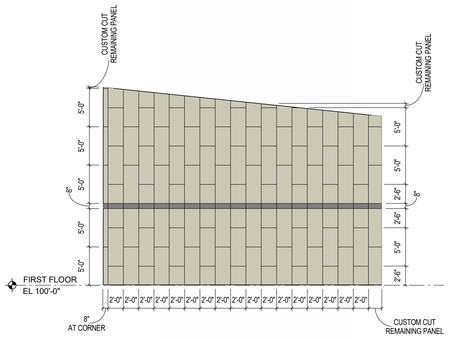
5 SOUTH WALL
SCALE: 1/8" = 1'-0"



1 WEST WALL - ONE
SCALE: 1/8" = 1'-0"



2 WEST WALL - TWO
SCALE: 1/8" = 1'-0"



3 WEST WALL - THREE
SCALE: 1/8" = 1'-0"

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NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

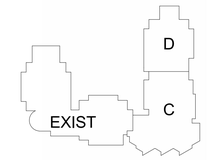
7839 NEW AUGUSTA RD,
INDIANAPOLIS, IN 46268

MSD OF PIKE TOWNSHIP

ARCHITECT

FANNING HOWEY

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350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



KEY PLAN N

BID DOCUMENTS

PAUL A. MILLER REGISTERED No. AR10800161 STATE OF INDIANA ARCHITECT

PROJECT MANAGER: PW
DRAWN BY: Author
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM 2	03/26/2026

METAL PANEL WALL ELEVATIONS

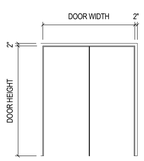
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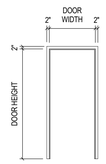
DOOR AND FRAME SCHEDULE -NEW

DOOR MARK	DOORS		FRAME						FIRE RATING	HARDWARE		STC RATING	REMARKS	DOOR MARK
	DOOR SIZE (WxH)	DOOR TYPE	FRAME MATERIAL	FRAME ELEVATION	JAMB DEPTH	DETAILS HEAD	DETAILS JAMB	DETAILS SILL		SET NO.	KEYSIDE ROOM			
C100-1	3'-0" x 7'-2"	FG2 WD	HM	F3	8 3/8"	H1	J1			11.0	EXT			C100-1
C100-2	3'-0" x 7'-2"	F FAL	AL	A1	5 3/4"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		6.0				C100-2
C100A	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1			12.0	EXT			C100A
C100B	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1			12.0	EXT			C100B
C100C	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1			12.0	EXT			C100C
C100D	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1			12.0	EXT			C100D
C101-1	3'-0" x 7'-2"	FG2 WD	HM	F3	8 3/8"	H1	J1			11.0	EXT			C101-1
C101-2	3'-0" x 7'-2"	FG2 WD	HM	F3	8 3/8"	H1	J1			11.0	EXT			C101-2
C101-3	3'-0" x 7'-2"	F FAL	AL	A1	5 3/4"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		6.0				C101-3
C101-4	3'-0" x 7'-2"	F FAL	AL	A1	5 3/4"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		2.0				C101-4
C102	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			22.0	C500			C102
C103	3'-0" x 7'-0"	N WD	HM	F1	8 3/8"	H1	J1			20.0	C500			C103
C103A	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			13.0	C103			C103A
C103B	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			23.0	C103			C103B
C103C	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			21.0	C103B			C103C
C103D	3'-0" x 7'-0"	FG2 WD	HM	F1	8 3/8"	H1	J1			16.0	C103			C103D
C103E	PR 3'-0" x 7'-2"	F FAL	AL	A2	5 3/4"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		3.0				C103E
C104	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			15.0	C500			C104
C105	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			25.0	C540			C105
C106	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			25.0	C540			C106
C107	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1			18.0	C550			C107
C108-1	3'-0" x 7'-0"	FG2 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	C550			C108-1
C108-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			C108-2
C108-3	2'-0" x 7'-0"	F WD	HM	F1	7 3/4"	H1	J1			13.0	C108			C108-3
C108A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	C108			C108A
C109-1	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-		24.0	C108			C109-1
C109-2	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-		24.0	C110			C109-2
C110-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	C550			C110-1
C110-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			C110-2
C110A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	C110			C110A
C111-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	C550			C111-1
C111-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			C111-2
C111A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	C111			C111A
C112-1	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	C111			C112-1
C112-2	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	C113			C112-2
C113-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		11.1	C550			C113-1
C113-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			C113-2
C113-3	2'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1			13.0	C113			C113-3
C113A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	C113			C113A
C114-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		11.1	C550			C114-1
C114-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0				C114-2
C114-3	2'-0" x 7'-0"	F WD	HM	F1	7 3/4"	H1	J1			13.0	C114			C114-3
C114A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		18.0	C114			C114A
C115-1	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	C114			C115-1
C115-2	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	C116			C115-2
C116-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	C550			C116-1
C116-2	3'-0 5/8" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0				C116-2
C116A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	C116			C116A
C117-1	PR 3'-0" x 7'-2"	F FAL	AL	A2	5 3/4"	2/A-603	3/A-603	2E/A-531		4.0				C117-1
C117-2	6'-6" x 9'-0"	OHCD	STL	-	2"	7/A-603	8/A-603	1/A-603		26.0	C117			C117-2
C117-3	3'-0" x 7'-0"	N WD	HM	F1	8 3/8"						C500			C117-3
C118	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-	-	14.2	C580	-		C118
C119	PR 3'-0" x 7'-2"	F FAL	AL	A2	4 1/2"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		5.0	EXT			C119
C200	PR 3'-0" x 7'-2"	FGAL2	AL	A2	5 3/4"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		1.0				C200
C500-1	PR 3'-0" x 7'-2"	FGAL2	AL		4 1/2"	3/A-604	2/A-604	2A, 4B/A-531		1.0	EXT			C500-1
C500-2	PR 3'-0" x 7'-2"	FGAL2	AL		4 1/2"	3/A-604	2/A-604	2A, 4B/A-531		1.0	EXT			C500-2
C500-3	PR 3'-0" x 7'-2"	F FAL	AL	A2	5 3/4"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		7.0				C500-3
C540	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1			8.0	C540			C540
C580	PR 3'-0" x 7'-0"	FG2 WD	HM	F2	8 3/8"	H1	J1			10.0	C200			C580
D101-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	D550			D101-1
D101-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D101-2
D101A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D101			D101A
D102-1	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	D101			D102-1
D102-2	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	D103			D102-2
D103-1	3'-0" x 7'-0"	FG2 WD	HM	F3	8 3/8"	H1	J1	S4		11.1	D550			D103-1
D103-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D103-2
D103-3	2'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1			13.0	D103			D103-3
D103A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D103			D103A
D104-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		11.1	D550			D104-1
D104-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D104-2
D104-3	2'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1			13.0	D104			D104-3
D104A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D104			D104A
D105-1	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-		24.0	D104			D105-1
D105-2	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-		24.0	D106			D105-2
D106-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	D550			D106-1
D106-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D106-2
D106A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D106			D106A
D107-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	D550			D107-1
D107-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D107-2
D107A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D107			D107A
D108-1	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	D107			D108-1
D108-2	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		24.0	D109			D108-2
D109-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		11.1	D550			D109-1
D109-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D109-2
D109-3	2'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1			13.0	D109			D109-3
D109A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1			14.0	D109			D109A
D110-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		11.1	D550			D110-1
D110-2	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531		6.0	EXT			D110-2
D110-3	2'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1			13.0	D110			D110-3
D110A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D110			D110A
D111-1	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-		24.0	D110			D111-1
D111-2	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1	-		24.0	D112			D111-2
D112-1	3'-0" x 7'-0"	FG3 WD	HM	F3	8 3/8"	H1	J1	S4		13.0	D550			D112-1
D112-3	3'-0" x 7'-2"	FGAL2	AL	SEE PLAN	4 1/2"	4/A-604	2/A-604	4B/A-531	-	6.0	EXT	-		D112-3
D112A	3'-0" x 7'-0"	F WD	HM	F1	5 3/4"	H1	J1	-		14.0	D112			D112A
D113	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			9.0	D113			D113
D113A	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			10.1	D113			D113A
D114-1	3'-0" x 7'-0"	F WD	HM	F1	8 3/8"	H1	J1			14.1	D580			D114-1
D114-2	PR 3'-0" x 7'-2"	F FAL	AL	A2	4 1/2"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		4.0	EXT			D114-2
D114-3	8'-0" x 8'-0"	OHCD	STL	-	2"	5/A-603	6/A-603	1/A-603		26.0	EXT			D114-3
D500-2	PR 3'-0" x 7'-0"	F WD	HM	F2	8 3/8"	H1	J1	-	-	8.0	C580	-		D500-2
D580	PR 3'-0" x 7'-2"	F FAL	AL	A2	4 1/2"	4/A-604 SIM.	2/A-604 SIM.	4B/A-531		1.0				D580

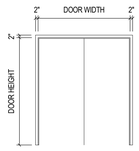
FRAME TYPES:



AL-2
SCALE: 1/4" = 1'-0"

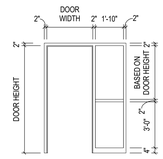


AL-1
SCALE: 1/4" = 1'-0"



HM1
SCALE: 1/4" = 1'-0"

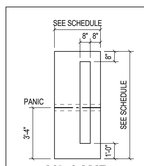
HM-2
SCALE: 1/4" = 1'-0"



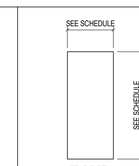
HM-3
SCALE: 1/4" = 1'-0"

NOTES:
SEE DOOR SCHEDULE FOR REFERENCES TO DETAILS NOT SHOWN ON FRAME ELEVATIONS

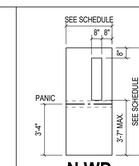
NOTE: DIMENSIONS SHOWN ARE NOMINAL. FIELD MEASURE ALL DIMENSION PRIOR TO FABRICATION AND INSTALLATION.



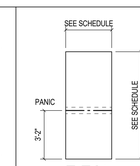
NL1 WD
NARROW LITE LONG



F WD
FLUSH DOOR

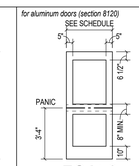


N WD
NARROW LITE

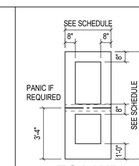


F FAL
FLUSH - FIBER GLASS ALUMINUM

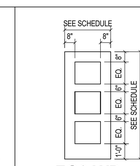
for aluminum doors (section 8120)



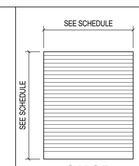
FGAL2
FULL GLASS 2



FG2 WD
FULL GLASS WOOD/HM



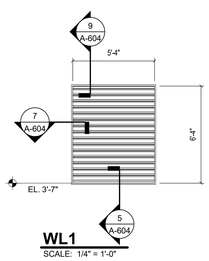
FG3 WD
FULL GLASS WOOD/HM



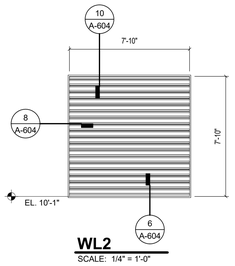
OHCD
INSULATED OVERHEAD COILING DOOR

DOOR TYPES
SCALE: 1/4" = 1'-0"

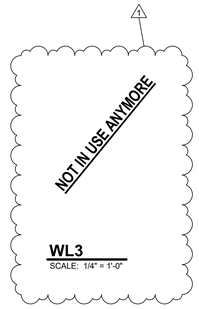
WALL LOUVERS:



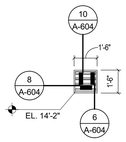
WL1
SCALE: 1/4" = 1'-0"



WL2
SCALE: 1/4" = 1'-0"



WL3
SCALE: 1/4" = 1'-0"



WL4
SCALE: 1/4" = 1'-0"

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NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

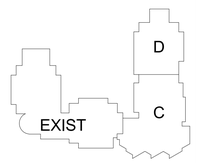
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KEY PLAN N

BID DOCUMENTS

PAUL A. MILLER REGISTERED No. AR10800161 STATE OF INDIANA ARCHITECT

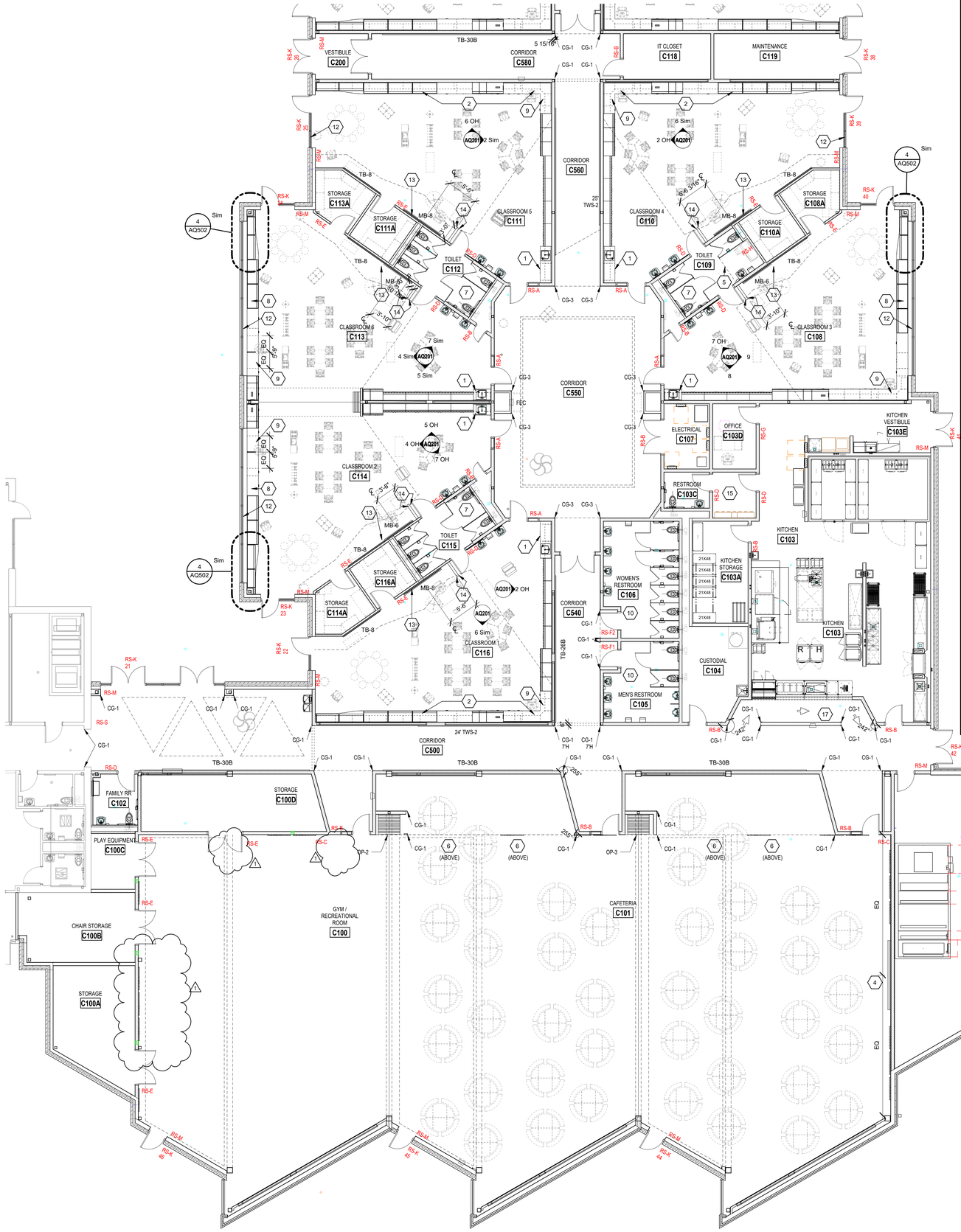
PROJECT MANAGER: PW
DRAWN BY: HA
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM 2	03/26/2026

DOOR SCHEDULE, DOOR TYPES AND FRAME ELEVATIONS

A-601

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ROOM LEGEND

ROOM NO.	OWNER ROOM NO.	ROOM NAME	AREA (SF)
C100		GYM / RECREATIONAL ROOM	2,515 SF
C100		GYM / RECREATIONAL ROOM	2,515 SF
C100A		STORAGE	274 SF
C100A		STORAGE	274 SF
C100B		CHAIR STORAGE	248 SF
C100B		CHAIR STORAGE	248 SF
C100C		PLAY EQUIPMENT	77 SF
C100C		PLAY EQUIPMENT	77 SF
C100D		STORAGE	318 SF
C100D		STORAGE	318 SF
C101		CAFETERIA	5,761 SF
C101		CAFETERIA	5,761 SF
C102		FAMILY RR	70 SF
C102		FAMILY RR	70 SF
C103		KITCHEN	1,515 SF
C103		KITCHEN	1,515 SF
C103A		KITCHEN STORAGE	177 SF
C103A		KITCHEN STORAGE	177 SF
C103B		LOCKERS	62 SF
C103B		LOCKERS	62 SF
C103C		RESTROOM	51 SF
C103C		RESTROOM	51 SF
C103D		OFFICE	88 SF
C103D		OFFICE	88 SF
C103E		KITCHEN VESTIBULE	122 SF
C103E		KITCHEN VESTIBULE	122 SF
C104		CUSTODIAL	220 SF
C104		CUSTODIAL	220 SF
C105		MEN'S RESTROOM	173 SF
C105		MEN'S RESTROOM	173 SF
C106		WOMEN'S RESTROOM	258 SF
C106		WOMEN'S RESTROOM	258 SF
C107		ELECTRICAL	92 SF
C107		ELECTRICAL	92 SF
C108		CLASSROOM 3	1,090 SF
C108		CLASSROOM 3	1,090 SF
C108A		STORAGE	79 SF
C108A		STORAGE	79 SF
C109		TOILET	136 SF
C109		TOILET	136 SF
C110		CLASSROOM 4	1,085 SF
C110		CLASSROOM 4	1,085 SF
C110A		STORAGE	73 SF
C110A		STORAGE	73 SF
C111		CLASSROOM 5	1,085 SF
C111		CLASSROOM 5	1,085 SF
C111A		STORAGE	73 SF
C111A		STORAGE	73 SF
C112		TOILET	136 SF
C112		TOILET	136 SF
C113		CLASSROOM 6	1,089 SF
C113		CLASSROOM 6	1,089 SF
C113A		STORAGE	79 SF
C113A		STORAGE	79 SF
C114		CLASSROOM 2	1,089 SF
C114		CLASSROOM 2	1,089 SF
C114A		STORAGE	79 SF
C114A		STORAGE	79 SF
C115		TOILET	135 SF
C115		TOILET	135 SF
C116		CLASSROOM 1	1,088 SF
C116		CLASSROOM 1	1,088 SF
C116A		STORAGE	73 SF
C116A		STORAGE	73 SF
C117		MECHANICAL	771 SF
C117		MECHANICAL	771 SF
C118		IT CLOSET	123 SF
C118		IT CLOSET	123 SF
C119		MAINTENANCE	178 SF
C119		MAINTENANCE	178 SF
C200		VESTIBULE	75 SF
C200		VESTIBULE	75 SF
C500		CORRIDOR	1,838 SF
C500		CORRIDOR	1,838 SF
C540		CORRIDOR	272 SF
C540		CORRIDOR	272 SF
C550		CORRIDOR	1,218 SF
C550		CORRIDOR	1,218 SF
C560		CORRIDOR	293 SF
C560		CORRIDOR	293 SF
C580		CORRIDOR	380 SF
C580		CORRIDOR	380 SF
D101		CLASSROOM 7	1,076 SF
D101		CLASSROOM 7	1,076 SF
D112		CLASSROOM 14	1,076 SF
D112		CLASSROOM 14	1,076 SF
D540		CORRIDOR	259 SF
D540		CORRIDOR	259 SF

EQUIPMENT GENERAL NOTES

A. ALL COUNTERTOPS TO HAVE CONTINUOUS 4" HIGH BACKSPLASHES AND ENDSPLASHES UNLESS NOTED OTHERWISE.
B. HIDDEN LINES ( ) INDICATE ITEMS TO BE PART OF LOOSE EQUIPMENT PACKAGE OR BY OWNER, NOT INCLUDED IN CONSTRUCTION CONTRACTS. DASHED LINES (– – –) INDICATE OVERHEAD ITEMS (INCLUDED IN CONSTRUCTION CONTRACTS).
C. (TB) INDICATES 4' HIGH TACK BOARD LENGTH AS INDICATED, UNLESS NOTED OTHERWISE. REFER TO MOUNTING HEIGHT DRAWING.
D. (MB) INDICATES 4' HIGH TACK BOARD LENGTH AS INDICATED. REFER TO MOUNTING HEIGHT DRAWING.
E. (MH) INDICATES MOP HOLDER REFER TO MOUNTING HEIGHT DRAWING.
F. PROVIDE FILLER STRIPS BETWEEN CASEWORK UNITS AND WALL OR BETWEEN ANY UNIT AS REQUIRED. EXTEND COUNTER TO FACE OF WALL OR ADJACENT TALL CABINET.
G. ALL CASEWORK DOORS AND DRAWERS SHALL BE LOCKABLE AND KEYED ALIKE.
H. ALL EXPOSED ENDS AND BACKS OF CASEWORK SHALL BE FINISHED.
I. CASEWORK INSTALLER SHALL CUT CASEWORK AS REQUIRED FOR PLUMBING/ELECTRICAL LINES.
J. CASEWORK INSTALLER SHALL CAULK BETWEEN COUNTERS, BACKSPLASHES, AND WALLS.
K. ALL WALL-MOUNTED CASEWORK SHALL BE MOUNTED WITH THE TOP AT 7'-0" AFF UNLESS OTHERWISE NOTED.
L. PROVIDE SLOPE TOPS AT ALL WALL CABINETS AND TALL CABINETS, UNLESS OTHERWISE NOTED. SEE DETAIL 5/AQ501.
M. COUNTERTOPS TO RECEIVE NO BACKSPLASH WHERE INTEGRAL WITH WINDOW SILL, UNLESS NOTED OTHERWISE.
N. (IWB-L) INDICATES INTERACTIVE WHITE BOARD. NOT IN CONTRACT.
O. (TD) INDICATES TOWEL DISPENSER. REFER TO MOUNTING HEIGHT SHEET.
P. (SD) INDICATES SOAP DISPENSER. REFER TO MOUNTING HEIGHT SHEET.
Q. TALL CABINETS SHOULD BE SAME DEPTH AS ADJACENT WORKSURFACE OR COUNTERTOP AS WELL AS ADJACENT BASE CABINETS UNLESS OTHERWISE NOTED.
R. WHERE CASEWORK IS LOCATED WALL TO WALL, FIELD VERIFY SIZE AND PROVIDE FILLERS AS REQUIRED TO CLOSE OFF ALL SIDES AND TOP.
S. REFER TO SHEET AQ501 FOR CUSTOM CASEWORK DETAILS.
T. REFER TO AF601 LIST OF FINISHES FOR COLOR SELECTIONS.
U. (TWS) INDICATES TACKABLE WALL SURFACE. REFER TO CASEWORK AND INTERIOR ELEVATIONS FOR HEIGHTS AND DETAIL 15/AQ501.
V. CORNER GUARDS TO BE 6' HIGH UNLESS NOTED OTHERWISE.
W. (XTB) INDICATES EXISTING TACK BOARDS TO REMAIN.
X. (XMB) INDICATES EXISTING MARKER BOARDS TO REMAIN.
Y. (XTWS) INDICATES EXISTING TACKABLE WALL SURFACE TO REMAIN.
Z. (RS-) INDICATES ROOM SIGNAGE. REFER TO AQ502.
AA. (FEC) INDICATES FIRE EXTINGUISHER CABINET.

CASEWORK COLOR NOTES

A. ALL CLASSROOM CABINETS TO BE PL-1.
B. ALL PLASTIC LAMINATE COUNTERTOPS IN CLASSROOMS TO BE PL-2.
C. ALL CLASSROOM SOLID SURFACE COUNTERTOPS TO BE SSM-1.
D. REFER TO LIST OF FINISHES FOR COLOR SELECTIONS.
E. ALL CLASSROOM TACKBOARDS TO BE TB-A.
F. ALL CORRIDOR TACKBOARDS TO BE TB-B. REFER TO AF200 SERIES DRAWINGS FOR MORE INFORMATION.
G. ALL CLASSROOM TACKABLE WALL SURFACE TO BE TWS-1.
H. ALL CORRIDOR TACKABLE WALL SURFACE TO BE TWS-2.

EQUIPMENT NOTES

(X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DECSRIPTION
1	SOLID SURFACE COUNTERTOP AT 26" A.F.F. BACKSPLASH TO CONTINUE ON ALL THREE SIDES FOR EXTENT OF COUNTERTOP OR ADJACENT CABINET DEPTH.
2	PLASTIC LAMINATE COUNTERTOP AT 30" A.F.F.
3	NOT USED.
4	10'-0" DIAGONAL, WALL MOUNTED, ELECTRICALLY OPERATED PROJECTION SCREEN WITH 5" DROP. BOTTOM OF HOUSING TO BE MOUNTED AT 10'-8" AFF TO ALIGN WITH BOTTOM OF BEAM ON ADJACENT WALL.
5	CEILING MOUNTED CUBICLE CURTAIN (CC).
6	LED MONITOR MOUNTED ON WALL. REFER TO TECHNOLOGY DRAWINGS.
7	RESTROOM TO RECEIVE STUDENT/CHILD TOILET PARTITIONS (TPP-1). REFER TO DETAILS ON AQ502 AND THE LIST OF FINISHES.
8	SOLID SURFACE COUNTERTOP AND INTEGRAL WINDOW SILL AT 30" A.F.F., NO BACKSPLASH. REFER TO 1/A-310.
9	KNEE SPACE. PROVIDE CONTINUOUS COUNTERTOP. REFER TO DETAIL 2/AQ501.
10	RESTROOM TO RECEIVE STANDARD TOILET PARTITIONS (TPP-2). REFER TO LIST OF FINISHES AND MOUNTING HEIGHT SHEET.
11	WALL CABINETS ON THIS WALL EXTEND TO CEILING - NO SLOPE TOP IN SECTION INDICATED.
12	MANUAL WINDOW ROLLER SHADES TO BE PROVIDED ON FULL EXTENT OF ALL EXTERIOR WINDOWS. STOP SHADE AT ANY APPLICABLE DOOR OPENINGS. DO NOT INSTALL SHADE AT TRANSOM ABOVE DOORS.
13	MANUAL WALL MOUNTED 109" DIAGONAL RETRACTABLE PROJECTION SCREEN WITH 12" EXTRA DROP.
14	CORNER GUARD TO TOP OF PARTIAL HEIGHT WALL (CG-1).
15	LOCKERS BY FOOD SERVICE.
16	MIRROR. REFER TO SPECIFICATIONS.
17	SERVING LINE EQUIPMENT LAMINATE EXTERIOR IS TO BE PL-3. REFER TO FOOD SERVICE DRAWINGS.

VERIFICATION NOTE

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SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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350 E New York St, Ste 300 Indianapolis, IN 46060

EXIST D C

KEY PLAN N

BID DOCUMENTS

PAUL A. MILLER REGISTERED No. AR10800161 STATE OF INDIANA ARCHITECT

PROJECT MANAGER: PW

DRAWN BY: MKH

PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 2-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03-26-2026

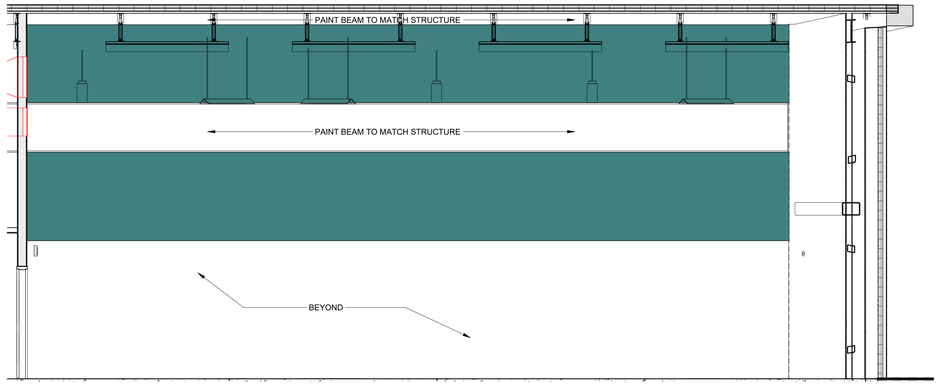
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SCALE: 1/8" = 1'-0"

FIRST FLOOR EQUIPMENT PLAN - UNIT C

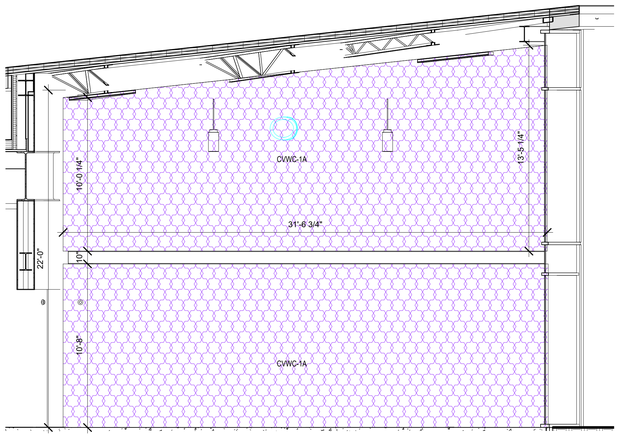
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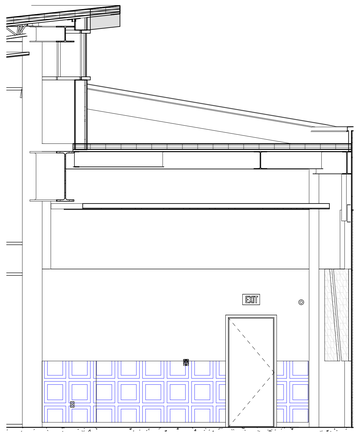
1 C100 BULKHEAD 1 SOUTH

SCALE: 1/4" = 1'-0"



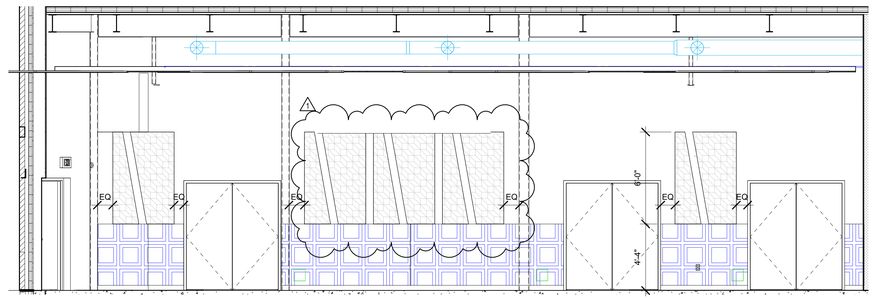
4 C100 WEST 2

SCALE: 1/4" = 1'-0"



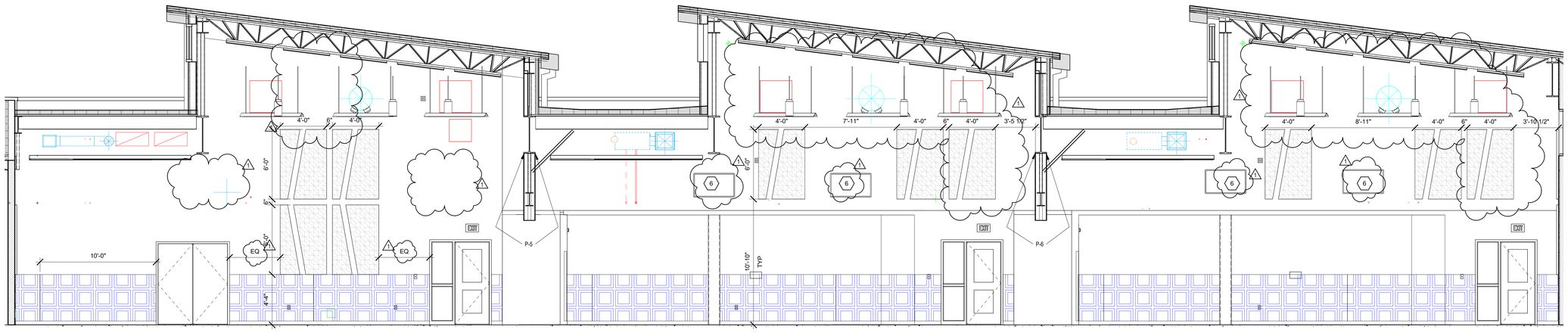
3 C100 WEST 1

SCALE: 1/4" = 1'-0"



2 C100 NORTH

SCALE: 1/4" = 1'-0"



5 C100 EAST

SCALE: 1/4" = 1'-0"

INTERIOR ELEVATION NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
1	REFER TO DOOR AND FRAME SCHEDULE OR OTHER ARCHITECTURAL DRAWINGS.
6	LED MONITOR. REFER TO TECHNOLOGY DRAWINGS.
8	IRWC TO BE MITERED AT ANGLE OF CORNER.
10	1/2"D x 3/4"H DRYWALL REVEAL. BOTTOM OF REVEAL TO ALIGN WITH TOP OF RESILIENT BASE. TOP OF REVEAL TO ALIGN WITH FINISHED CEILING.
11	ALL FACES OF COLUMN OR BULKHEAD TO BE PAINTED COLOR INDICATED ON PLANS.
12	IRWC-1 OR IRWC-3 REFER TO LEGEND. PRE PRINTED WITH CUSTOM IMAGE. REFER TO LIST OF FINISHES , FINISH PLANS, AND DETAILS ON SHEET AF501.
13	PAINTED GYPSUM BOARD WALL.
14	4"H BASE AS SCHEDULED.
17	ALIGN CORNER WITH CORNER OR ACCENT RUBBER FLOOR TILE BELOW.
19	ACCENT PAINT COLOR INDICATED.

INTERIOR ELEVATIONS LEGEND

- P-4
- P-5
- P-6
- P-7
- IRWC-1
- IRWC-2
- IRWC-3A
- CVWC
- IRWC-3B
- AWT-2

VERIFICATION NOTE

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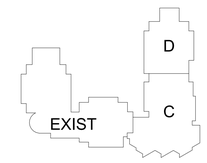
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KEY PLAN N

BID DOCUMENTS

PAUL A. MILLER REGISTERED No. AR10800161 STATE OF INDIANA ARCHITECT

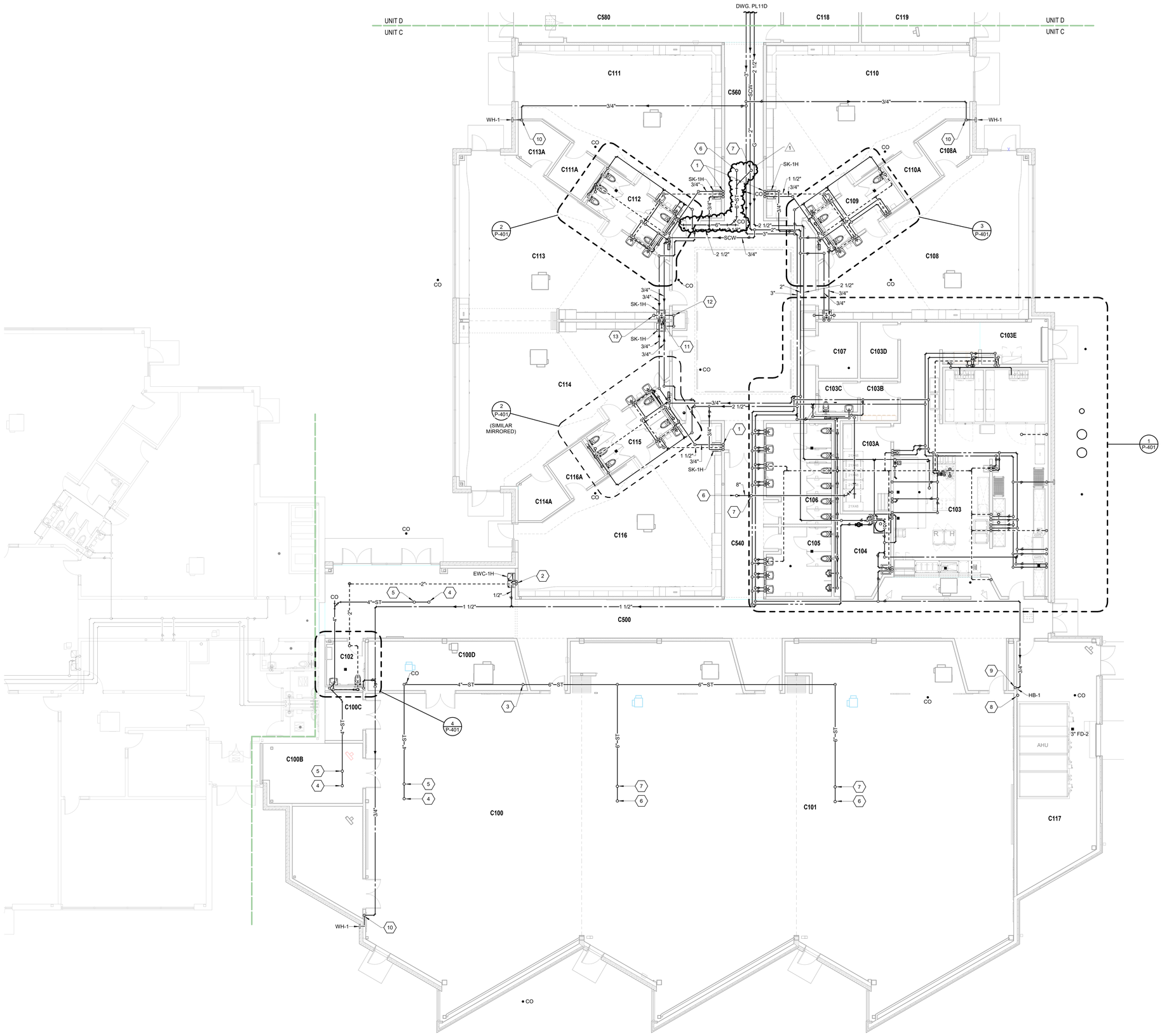
PROJECT MANAGER: PW
DRAWN BY: MKH
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 2-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03-26-2026

INTERIOR ELEVATIONS

AF203

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FIRST FLOOR PLUMBING PLAN - UNIT C

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT C

ROOM NO.	ROOM NAME	AREA (SF)
C1	STAGE	Not Placed
C100	GYM / RECREATIONAL ROOM	2515 SF
C100A	STORAGE	274 SF
C100B	CHAIR STORAGE	248 SF
C100C	PLAY EQUIPMENT	77 SF
C100D	STORAGE	318 SF
C101	CAFETERIA	5761 SF
C102	FAMILY RR	70 SF
C103	KITCHEN	1515 SF
C103A	KITCHEN STORAGE	177 SF
C103B	LOCKERS	62 SF
C103C	RESTROOM	51 SF
C103D	OFFICE	88 SF
C103E	KITCHEN VESTIBULE	122 SF
C104	CUSTODIAL	220 SF
C105	MEN'S RESTROOM	173 SF
C106	WOMEN'S RESTROOM	258 SF
C107	ELECTRICAL	92 SF
C108	CLASSROOM 3	1090 SF
C108A	STORAGE	79 SF
C109	TOILET	136 SF
C110	CLASSROOM 4	1085 SF
C110A	STORAGE	73 SF
C111	CLASSROOM 5	1085 SF
C111A	STORAGE	73 SF
C112	TOILET	136 SF
C113	CLASSROOM 6	1089 SF
C113A	STORAGE	79 SF
C114	CLASSROOM 2	1089 SF
C114A	STORAGE	79 SF
C115	TOILET	135 SF
C116	CLASSROOM 1	1088 SF
C116A	STORAGE	73 SF
C117	MECHANICAL	771 SF
C118	IT CLOSET	123 SF
C119	MAINTENANCE	178 SF

FIRST FLOOR PLAN NOTES UNIT C

1 3/4" HOT AND COLD WATER DOWN. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

2 1/2" COLD WATER DOWN. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

3 8" STORM DOWN TO BELOW SLAB. PROVIDE ACCESSIBLE CLEANOUT AT BASE OF RISER.

4 4" STORM FROM ROOF DRAIN ABOVE.

5 4" STORM FROM OVERFLOW ROOF DRAIN ABOVE.

6 6" STORM FROM ROOF DRAIN ABOVE.

7 6" STORM FROM OVERFLOW ROOF DRAIN ABOVE.

8 2" VENT FROM BELOW SLAB UP TO 3" VENT THRU ROOF.

9 3/4" COLD WATER DOWN TO HOSE BIBB.

10 3/4" COLD WATER DOWN TO WALL HYDRANT.

11 3/4" HOT AND COLD WATER DOWN.

12 2" WASTE DOWN TO BELOW SLAB, 2" VENT UP TO ABOVE CEILING.

13 2" VENT UP TO 3" VENT THRU ROOF.

VERIFICATION NOTE

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SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

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ARCHITECT

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350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204

KEY PLAN

BID DOCUMENTS

MARK Z. HOPE REGISTERED No. PE 12005001 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: JE

PROJECT NUMBER: 223216.00

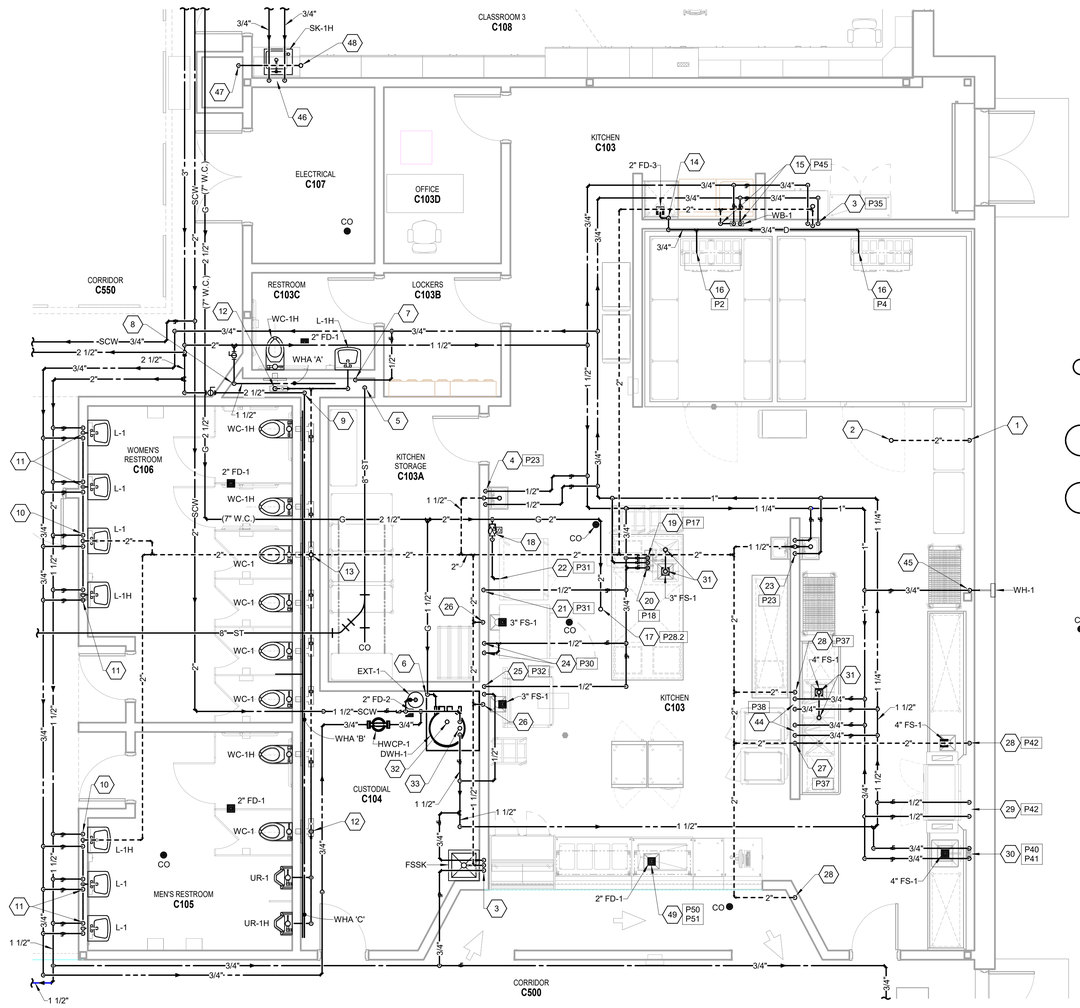
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03-26-2026

FIRST FLOOR PLUMBING PLAN - UNIT C

PL11C

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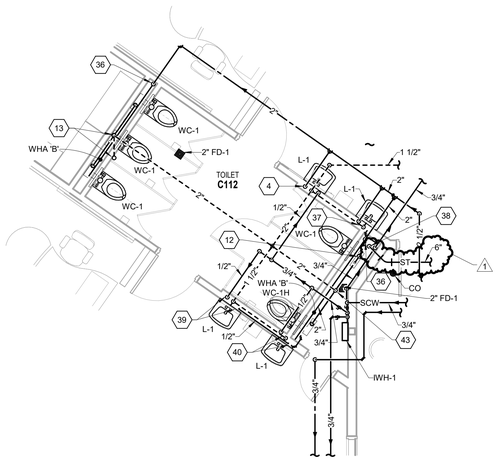
1 ENLARGED KITCHEN AND MAIN RESTROOMS PLUMBING PLAN

SCALE: 1/4" = 1'-0"

XX PXX
- PXX: FOODSERVICE FIXTURE TAG DESIGNATION - REFER TO FOODSERVICE DRAWINGS
- XX: DRAWING PLAN NOTE

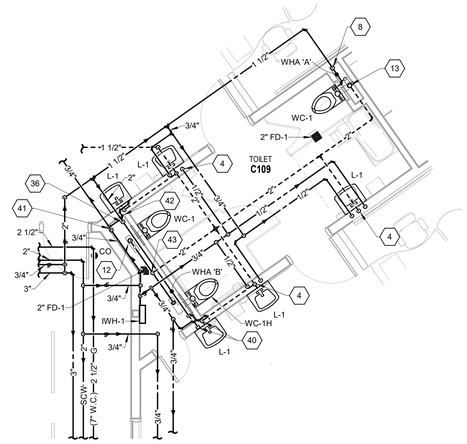
WASTE WATER SAMPLING PORT ACCESS LID

GREASE INTERCEPTOR ACCESS LIDS



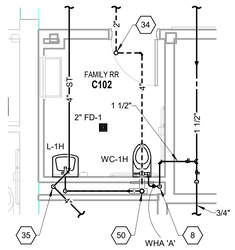
2 ENLARGED TYPICAL CLASSROOM RESTROOM PLUMBING PLAN - LAYOUT 1

SCALE: 1/4" = 1'-0"



3 ENLARGED TYPICAL CLASSROOM RESTROOM PLUMBING PLAN - LAYOUT 2

SCALE: 1/4" = 1'-0"



4 ENLARGED SINGLE RESTROOM PLUMBING PLAN

SCALE: 1/4" = 1'-0"

ENLARGED PLAN NOTES P401

40 1/2" HOT WATER DOWN. EXTEND 1/2" COLD WATER FROM CHASE TO FIXTURE. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT ROUTED HORIZONTALLY IN WALL.

41 3/4" HOT WATER FROM CHASE UP TO ABOVE CEILING.

42 EXTEND 1/2" HOT AND COLD WATER FROM CHASE TO FIXTURE. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

43 2" VENT FROM CHASE UP TO ABOVE CEILING.

44 3/4" HOT AND COLD WATER DOWN TO 3-COMPARTMENT SINK FAUCET. EXTEND TO FAUCET AS REQUIRED.

45 3/4" COLD WATER DOWN TO WALL HYDRANT.

46 3/4" HOT AND COLD WATER DOWN.

47 2" WASTE DOWN TO BELOW SLAB, 2" VENT UP TO ABOVE CEILING.

48 2" VENT UP TO 3" VENT THRU ROOF.

49 TERMINATE INDIRECT WASTE OVER FLOOR DRAIN WITH AIR GAP.

50 4" WASTE DOWN TO BELOW SLAB, 4" VENT UP TO ABOVE CEILING.

ENLARGED PLAN NOTES P401

1 2" VENT UP FROM BELOW SLAB UP TO ABOVE CEILING.

2 2" VENT UP TO 3" VENT THRU ROOF.

3 3/4" HOT AND COLD WATER WITH SHUTOFF VALVES AND CHECK VALVES IN SUPPLIES DOWN TO MOP BASIN FAUCET. 1 1/2" VENT FROM BELOW SLAB UP TO ABOVE CEILING.

4 1/2" HOT AND COLD WATER DOWN. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

5 8" STORM DOWN TO BELOW SLAB.

6 1 1/2" GAS DOWN. EXTEND TO DOMESTIC WATER HEATER WITH SHUTOFF VALVE, MIN. 6" DIRT LEG AND UNION. REFER TO DETAIL ON DRAWING P-501 FOR MORE INFORMATION.

7 1/2" HOT WATER DOWN IN CHASE. EXTEND TO LAVATORY AS REQUIRED.

8 1 1/2" COLD WATER DOWN IN CHASE. EXTEND TO FIXTURES AS REQUIRED. PROVIDE ACCESSIBLE WATER HAMMER ARRESTER TYPE 'A' AT FLUSH VALVE CONNECTION.

9 2 1/2" COLD WATER DOWN IN CHASE. ROUTE COLD WATER HEADER FULL SIZE THRU ENTIRE LENGTH OF CHASE. EXTEND COLD WATER TO FIXTURES AS REQUIRED. PROVIDE (2) ACCESSIBLE WATER HAMMER ARRESTERS AT LOCATIONS SHOWN ON THIS PLAN.

10 1/2" HOT AND COLD WATER DOWN. 2" WASTE DOWN TO BELOW SLAB, 2" VENT UP TO ABOVE CEILING.

11 1/2" HOT AND COLD WATER DOWN. 1 1/2" WASTE AND VENT WITHIN CHASE.

12 4" WASTE DOWN TO BELOW SLAB, 2" VENT UP INTO CHASE.

13 4" WASTE DOWN TO BELOW SLAB, 4" VENT UP TO 4" VENT THRU ROOF.

14 3/4" CONDENSATE DOWN. TERMINATE OVER FLOOR DRAIN WITH P-TRAP ASSEMBLY AND AIR GAP.

15 3/4" HOT AND COLD WATER DOWN TO CLOTHES WASHER SUPPLY BOX. 3" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

16 CONNECT 3/4" CONDENSATE TO EVAPORATOR COIL DRAIN PAN.

17 2" GAS UP THRU ROOF.

18 EMERGENCY GAS SHUTOFF SOLENOID VALVE, ACCESSIBLE BELOW THE CEILING. INTERCONNECT TO COOKING HOOD FIRE SUPPRESSION SYSTEM AS REQUIRED. COORDINATE SYSTEM WITH FOODSERVICE EQUIPMENT DRAWINGS.

19 3/4" HOT AND COLD WATER DOWN IN S.S. CHASE. EXTEND TO FAUCET AS REQUIRED. TERMINATE INDIRECT WASTE FROM SINK OVER FLOOR SINK WITH AIR GAP.

20 1/2" COLD WATER DOWN IN S.S. CHASE. EXTEND TO COUNTERTOP HOT WATER DISPENSER THRU SHUTOFF VALVE AND KEC PROVIDED IN-LINE WATER FILTER. TERMINATE INDIRECT WASTE OVER FLOOR SINK WITH AIR GAP.

21 1/2" COLD WATER DOWN. EXTEND TO CONVECTION OVEN THRU SHUTOFF VALVE AND KEC PROVIDED IN-LINE WATER FILTER. MAKE FINAL CONNECTION AS REQUIRED.

22 EXTEND 3/4" GAS TO CONVECTION OVEN THRU SHUTOFF VALVE AND KEC PROVIDED FLEX HOSE AND QUICK-DISCONNECT KIT. MAKE FINAL CONNECTION AS REQUIRED.

23 1/2" HOT AND COLD WATER DOWN. EXTEND HOT AND COLD WATER TO EACH LAVATORY. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

24 1/2" COLD WATER DOWN. EXTEND TO COMBI-OVEN THRU SHUTOFF VALVE AND KEC PROVIDED IN-LINE WATER FILTER. MAKE FINAL CONNECTION AS REQUIRED. TERMINATE INDIRECT WASTE OVER FLOOR SINK WITH AIR GAP.

25 1/2" HOT AND COLD WATER DOWN. EXTEND TO TILTING SKILLET THRU SHUTOFF VALVE. MAKE FINAL CONNECTION AS REQUIRED. TERMINATE INDIRECT WASTE OVER FLOOR SINK WITH AIR GAP.

26 1 1/2" VENT FROM BELOW SLAB UP TO ABOVE CEILING.

27 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

28 2" VENT FROM BELOW SLAB UP TO ABOVE CEILING.

29 1/2" HOT AND COLD WATER DOWN TO DISH MACHINE. MAKE FINAL CONNECTIONS AS REQUIRED. TERMINATE INDIRECT WASTE OVER FLOOR SINK WITH AIR GAP.

30 3/4" HOT AND COLD WATER DOWN TO PRE-RINSE SINK. MAKE FINAL CONNECTIONS AS REQUIRED. TERMINATE INDIRECT WASTE OVER FLOOR SINK WITH AIR GAP.

31 MANIFOLD (2) 2" WASTE TOGETHER AND TERMINATE OVER FLOOR SINK WITH AIR GAP.

32 3" PVC EXHAUST FLUE UP THRU ROOF.

33 3" PVC AIR INTAKE UP THRU ROOF.

34 4" VENT UP TO 4" VENT THRU ROOF.

35 4" STORM DOWN TO BELOW SLAB. PROVIDE ACCESSIBLE CLEANOUT AT BASE OF RISER.

36 2" COLD WATER DOWN IN CHASE. ROUTE FULL SIZE THRU ENTIRE LENGTH OF CHASE. EXTEND COLD WATER TO FIXTURES AS REQUIRED. PROVIDE ACCESSIBLE WATER HAMMER ARRESTER TYPE 'B' AT LAST FLUSH VALVE CONNECTION.

37 1/2" COLD WATER DOWN. EXTEND 1/2" HOT WATER FROM CHASE TO FIXTURE. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

38 6" STORM DOWN TO BELOW SLAB. PROVIDE ACCESSIBLE CLEANOUT AT BASE OF RISER. 3/4" HOT WATER FROM CHASE UP TO ABOVE CEILING.

39 1/2" HOT WATER DOWN. EXTEND 1/2" COLD WATER FROM CHASE TO FIXTURE. 2" WASTE DOWN TO BELOW SLAB, 1 1/2" VENT UP TO ABOVE CEILING.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

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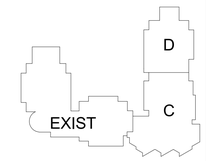
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KEY PLAN N

BID DOCUMENTS

MARK Z. HOPE REGISTERED No. PE 12000601 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: JE

PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03-26-2026

ENLARGED PLUMBING PLANS

P-401

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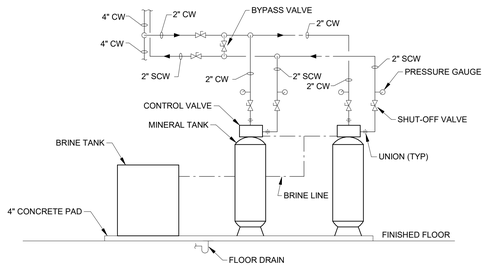
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PLUMBING FIXTURE SCHEDULE

MARK	FIXTURE ITEM	FIXTURE MFGR	FIXTURE MODEL	FIXTURE MATERIAL	FIXTURE TYPE	FIXTURE COLOR	TRIM ITEM	TRIM MFGR	TRIM MODEL	ACCESSORIES ITEM	ACCESSORIES MFGR	ACCESSORIES MODEL	CONNECTIONS CW	CW	HW	W	V	COMMENTS
EWC-1H	ELECTRIC WATER COOLER	ELKAY	EZSTL8WSSK	STAINLESS	WALL MOUNTED	-	BUBBLER	-	-	BOTTLE FILLER	-	-	1/2"			2"	1 1/2"	IN-LINE WATER FILTER PROVIDED BY MANUFACTURER.
FSSK	MOP SERVICE BASIN	FIAT	TSB-3000	TERAZZO	FLOOR MOUNTED	-	FAUCET	CHICAGO	897-CCP	-	-	-	3/4"	3/4"		3"	1 1/2"	PROVIDE SHUTOFF VALVES AND CHECK VALVES IN SUPPLIES
HB-1	HOSE BIBB	CHICAGO	387-E27CP	ROUGH BRONZE	WALL MOUNTED	-	-	-	-	-	-	-	3/4"					MOUNT AT 24" A.F.F.
L-1	LAVATORY	AMERICAN STANDARD	0355.012	VIT. CHINA	WALL MOUNTED	WHITE	FAUCET	SLOAN	420-E2805ABCP	POINT-OF-USE TMV	POWERS	LFG480	1/2"	1/2"	1 1/2"	1 1/2"		MANUALLY OPERATED FAUCET. SET OUTLET TEMP OF TMV AT 105 DEG. F.; SIZE TMV FOR 0.25 GPM.
L-1H	LAVATORY - ADA	AMERICAN STANDARD	0355.012	VIT. CHINA	WALL MOUNTED	WHITE	FAUCET	SLOAN	420-E2805ABCP	POINT-OF-USE TMV	POWERS	LFG480	1/2"	1/2"	1 1/2"	1 1/2"		MANUALLY OPERATED FAUCET. SET OUTLET TEMP OF TMV AT 105 DEG. F.; SIZE TMV FOR 0.25 GPM.
RH-1	ROOF HYDRANT	ZURN	Z1388XL	ROUGH BRONZE									3/4"					ROUTE DRAIN LINE THRU EXTERIOR WALL. TERMINATE TURNED DOWN WITH BUG SCREEN.
SK-1H	SINGLE COMPARTMENT CLASSROOM SINK - ADA	ELKAY	DRKAD222055C	STAINLESS	COUNTERTOP	-	FAUCET	CHICAGO	201-AGN8AE2805FAB	BUBBLER	ELKAY	LK1141A	1/2"	1/2"	2"	1 1/2"		MANUALLY OPERATED FAUCET. PROVIDE REAR-CENTER DRAIN TO ACCOMMODATE ADA APPROACH.
UR-1	URINAL	AMERICAN STANDARD	6590.001	VIT. CHINA	WALL MOUNTED	WHITE	FLUSH VALVE	SLOAN	186-0.125	-	-	-	3/4"		2"	1 1/2"		MANUALLY OPERATED FLUSH VALVE.
UR-1H	URINAL - ADA	AMERICAN STANDARD	6590.001	VIT. CHINA	WALL MOUNTED	WHITE	FLUSH VALVE	SLOAN	186-0.125	-	-	-	3/4"		2"	1 1/2"		MANUALLY OPERATED FLUSH VALVE.
WB-1	WATER SUPPLY / DRAIN BOX	ACORN	8186	STAINLESS	WALL MOUNTED	-	-	-	-	-	-	-	3/4"	3/4"	2"	1 1/2"		REFER TO DETAIL ON THIS DRAWING FOR MORE INFORMATION.
WC-1	WATER CLOSET	AMERICAN STANDARD	2257.101	VIT. CHINA	WALL MOUNTED	WHITE	FLUSH VALVE	SLOAN	111-1.28	SEAT	CENTOCO	1500 STSCCSS	1 1/2"		4"	2"		MANUALLY OPERATED FLUSH VALVE.
WC-1H	WATER CLOSET - ADA	AMERICAN STANDARD	2257.101	VIT. CHINA	WALL MOUNTED	WHITE	FLUSH VALVE	SLOAN	111-1.28	SEAT	CENTOCO	1500 STSCCSS	1 1/2"		4"	2"		MANUALLY OPERATED FLUSH VALVE.
WH-1	NON-FREEZE WALL HYDRANT	J.R. SMITH	5509QT	ROUGH BRONZE	WALL MOUNTED	-	-	-	-	-	-	-	3/4"					MOUNT AT 18" A.F.G.

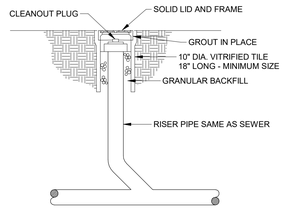
PLUMBING EQUIPMENT SCHEDULE

MARK	DESCRIPTION	LOCATION	MANUFACTURER/MODEL NUMBER	CAPACITY	REMARKS	ELECTRICAL DATA HP	KW	V	AMP	PH	COMMENTS
BFP-1	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER NO. 1 (INCOMING DOMESTIC WATER)	MECH. ROOM D114	WILKINS MODEL NO. 375ASTFSC (4" SIZE)	150 GPM @ 8 PSI DROP MAX.	PIPE DISCHARGE FULL SIZE TO FLOOR SINK AND TERMINATE WITH AIR GAP	-	-	-	-	-	
BFP-2	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER NO. 2 (INCOMING DOMESTIC WATER)	MECH. ROOM D114	WILKINS MODEL NO. 375ASTFSC (4" SIZE)	150 GPM @ 8 PSI DROP MAX.	PIPE DISCHARGE FULL SIZE TO FLOOR SINK AND TERMINATE WITH AIR GAP	-	-	-	-	-	
BFP-3	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER NO. 3 (BOILER MAKE-UP WATER)	MECH. ROOM D114	WATTS MODEL (1 1/4" SIZE")	5 GPM @ 10 PSI MAX. DROP	PIPE DISCHARGE FULL SIZE TO FLOOR SINK AND TERMINATE WITH AIR GAP	-	-	-	-	-	EXTEND NON-POTABLE WATER TO HVAC BOILER MAKE-UP WATER CONNECTION. REFER TO HVAC DRAWINGS FOR EXACT LOCATION AND SIZE.
DWH-1	DOMESTIC WATER HEATER - GAS FIRED (KITCHEN)	CUSTODIAL C104	LOCHINVAR MODEL NO. SWA150N	175 GALLONS PER HOUR @ 100 DEG. RISE. - 90 GALLONS STORAGE	PIPE RELIEF VALVE TO FLOOR DRAIN	-	-	120	5	1	
EXT-1	DOMESTIC HOT WATER EXPANSION TANK	MECH. ROOM D114	AMTROL MODEL NO. ST-12C-DD	3.2 GAL. MAX ACCEPT VOLUME, 6.4 GAL. TOTAL VOLUME; .50 MAX. ACCEPT. FACTOR	A.S.M.E. RATED - SECTION VIII	-	-	-	-	-	
GI-1	GREASE INTERCEPTOR	EXTERIOR - SOUTH OF KITCHEN	SCHIER MODEL GB-250	100 GPM / 200 GPM - 1895 LBS. GREASE CAPACITY; 277 GAL. LIQUID CAPACITY	PROVIDE FIELD-CUT RISER MODEL FCR2						
HWCP-1	HOT WATER RETURN PUMP NO. 1 (140 DEG. F.)	CUSTODIAL C104	BELL AND GOSSETT MODEL NO. PL-30	2 GPM @ 24' T.D.H.	ALL BRONZE CONSTRUCTION	1/12	-	115	-	1	PIPE MOUNTED AQUASTAT
IWH-1	INSTANTANEOUS ELECTRIC WATER HEATER (CLASSROOM PODS)	PLUMBING CHASE	HUBBELL TX SERIES LOW-FLOW MODEL TX018-3S-208(18KW)	2.3 GPM AT 55 DEG. F. TEMP. RISE	INSTALL PER MANUFACTURER'S INSTRUCTIONS		18	208	50	3	TURN ON AT 0.25 GPM - SET OUTLET TEMPERATURE AT 110 DEG. F. REFER TO DETAIL ON THIS DRAWING FOR MORE INFORMATION.
WS-1	DUPLEX WATER SOFTENER AND BRINE TANK	MECH. ROOM D114	WATERCARE COMMERCIAL SOFTENER MODEL WC-C2-24X72-10-DA-BAS	53 GPM @ 15 PSI P.D., 69 GPM @ 25 PSI P.D. - 15 GPM TO DRAIN - 24" X 72" MEDIA TANK, 24" X 50" BRINE TANK	PIPE DISCHARGE FULL SIZE TO FLOOR SINK AND TERMINATE WITH AIR GAP	-	-	120	-	1	PROVIDED WITH CORD AND PLUG
WWSP-1	WASTE WATER SAMPLING PORT	EXTERIOR - SOUTH OF KITCHEN	SCHIER MODEL S-4-P								PROVIDE FIELD-CUT RISER FCR2 TO ACCOMMODATE SAMPLING PORT ACCESS. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.



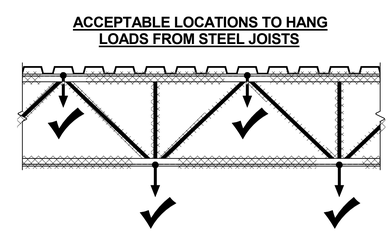
1 DUPLEX WATER SOFTENER DETAIL

N.T.S.



2 EXTERIOR CLEANOUT DETAIL

N.T.S.

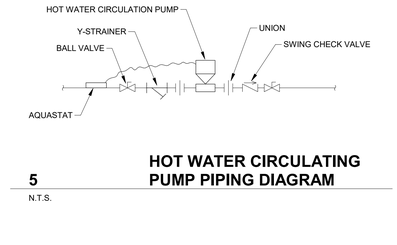


ACCEPTABLE LOCATIONS TO HANG LOADS FROM STEEL JOISTS

1. LOADS IN EXCESS OF 100 LBS ARE ONLY TO BE HUNG FROM STEEL JOISTS AT THE LOCATIONS INDICATED WITH A CHECKMARK.
2. DO NOT HANG LOADS IN EXCESS OF 100 LBS FROM LOCATIONS AND/OR MEMBERS INDICATED WITH DIAGONAL HATCHING UNLESS ADDITIONAL REINFORCING ANGLES ARE INSTALLED PER THE STRUCTURAL DRAWINGS.
3. LOADS LESS THAN 100 LBS MAY BE HUNG ANYWHERE ALONG THE HORIZONTAL MEMBERS. DO NOT HANG ANY LOADS FROM THE DIAGONAL NOR VERTICAL MEMBERS.
4. THIS SECTIONS APPLIES TO LOADS HANGING FROM BOTH NEW AND EXISTING JOISTS.
5. SPACE HANGERS OUT SO THAT NOT ALL LOADS ARE HANGING FROM THE SAME JOIST.

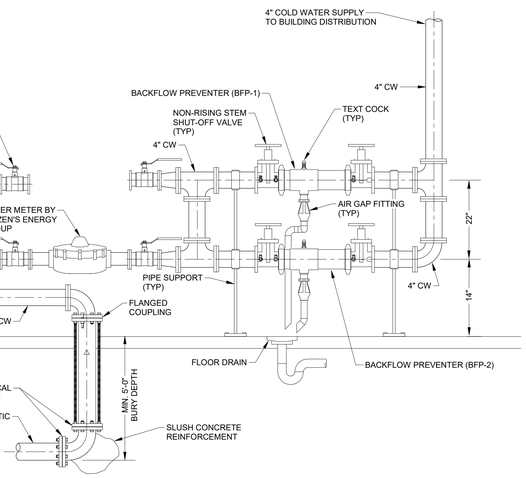
4 HANGING FROM JOIST DETAIL

N.T.S.



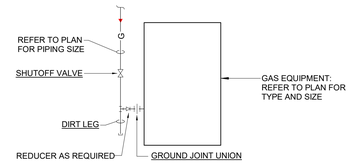
5 HOT WATER CIRCULATING PUMP PIPING DIAGRAM

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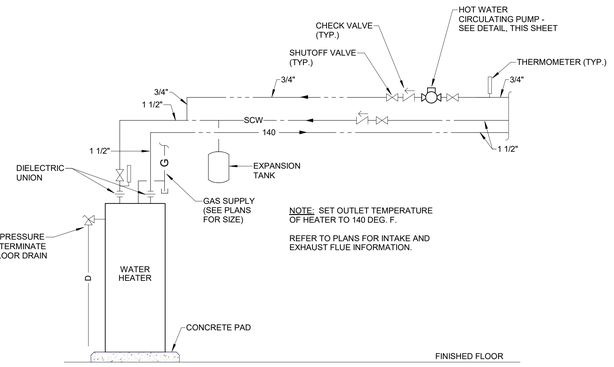
7 WATER METER & BACLFLOW PREVENTER ASSEMBLY DETAIL

N.T.S.



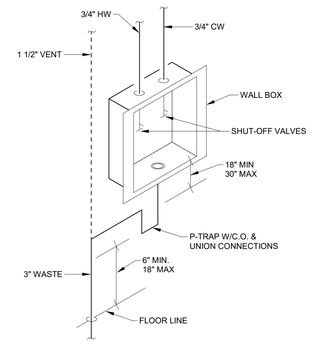
3 GAS DIRT LEG PIPING DETAIL

N.T.S.



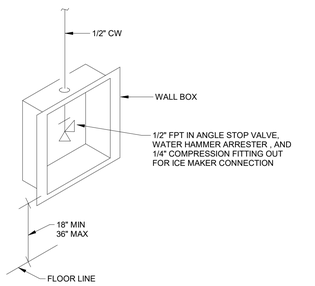
8 GAS-FIRED DOMESTIC WATER HEATER PIPING DIAGRAM

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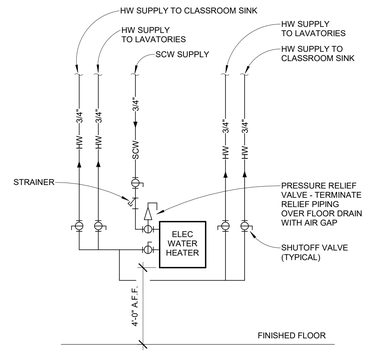
9 WATER SUPPLY DRAIN BOX DETAIL

N.T.S.



6 ICE MAKER BOX DETAIL

N.T.S.



10 INSTANTANEOUS ELECTRIC WATER HEATER PIPING DIAGRAM

N.T.S.

BID DOCUMENTS

MARK Z. HOSE REGISTERED No. PE 12006101 STATE OF INDIANA PROFESSIONAL ENGINEER

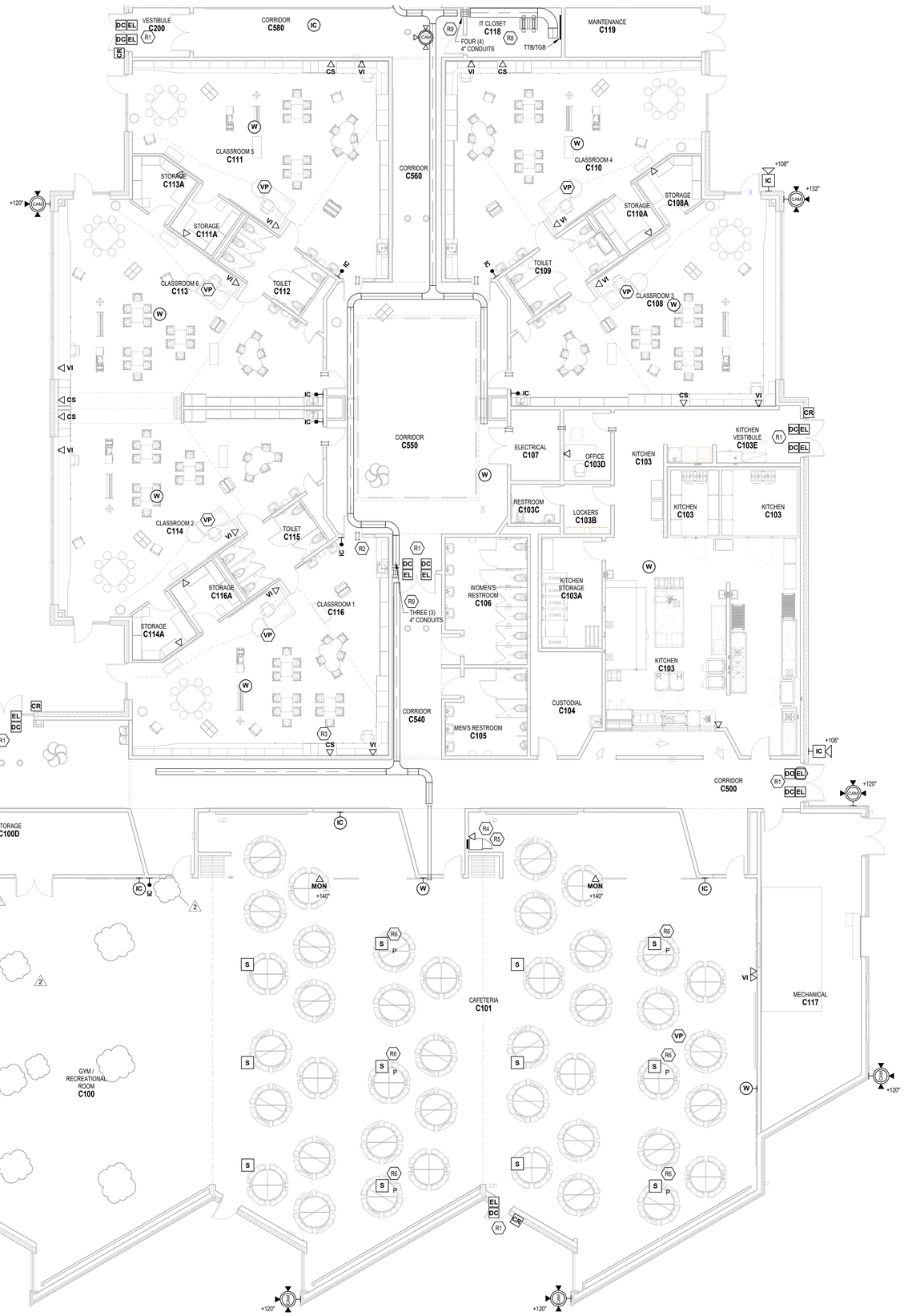
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DRAWN BY: JE
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM-02	03-26-2026

PLUMBING SCHEDULES AND DETAILS

P-501

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1 FIRST FLOOR TECHNOLOGY ROUGH-IN PLAN - UNIT C

SCALE: 1/8" = 1'-0"

ROOM LEGEND

ROOM NO.	OWNER ROOM NO.	ROOM NAME	AREA (SF)
FIRST FLOOR			
C100		GYM / RECREATIONAL ROOM	2515 SF
C100A		STORAGE	274 SF
C100B		CHAIR STORAGE	248 SF
C100C		PLAY EQUIPMENT	77 SF
C100D		STORAGE	318 SF
C101		CAFETERIA	5761 SF
C102		FAMILY RR	70 SF
C103		KITCHEN	1515 SF
C103A		KITCHEN STORAGE	177 SF
C103B		LOCKERS	62 SF
C103C		RESTROOM	51 SF
C103D		OFFICE	88 SF
C103E		KITCHEN VESTIBULE	122 SF
C104		CUSTODIAL	220 SF
C105		MEN'S RESTROOM	173 SF
C106		WOMEN'S RESTROOM	258 SF
C107		ELECTRICAL	92 SF
C108		CLASSROOM 3	1090 SF
C108A		STORAGE	79 SF
C109		TOILET	136 SF
C110		CLASSROOM 4	1085 SF
C110A		STORAGE	73 SF
C111		CLASSROOM 5	1085 SF
C111A		STORAGE	73 SF
C112		TOILET	136 SF
C113		CLASSROOM 6	1089 SF
C113A		STORAGE	79 SF
C114		CLASSROOM 2	1089 SF
C114A		STORAGE	79 SF
C115		TOILET	135 SF
C116		CLASSROOM 1	1088 SF
C116A		STORAGE	73 SF
C117		MECHANICAL	771 SF
C118		IT CLOSET	123 SF
C119		MAINTENANCE	178 SF
C200		VESTIBULE	75 SF
C500		CORRIDOR	1838 SF
C540		CORRIDOR	272 SF
C550		CORRIDOR	1218 SF
C560		CORRIDOR	293 SF
C580		CORRIDOR	380 SF

TECHNOLOGY ROUGH-IN GENERAL NOTES

A. DEVICES SHALL BE INSTALLED AT LOCATIONS SHOWN ON DRAWINGS. LOCATIONS OF DEVICES SHALL BE COORDINATED WITH OTHER ELECTRICAL DEVICES/ CASEWORK/ ARCHITECTURAL FEATURES AND OTHER TRADES PRIOR TO ROUGH-IN. IF RELOCATION OF DEVICES IS REQUIRED DUE TO LACK OF COORDINATION BETWEEN ELECTRICAL DRAWINGS AND OTHER TRADES, ANY ASSOCIATED COSTS SHALL BE RESPONSIBILITY OF ELECTRICAL CONTRACTOR.

ROUGH-IN PLAN NOTES (X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

#	NOTE
R1	PROVIDE JUNCTION BOX & DOOR CONTACT AS REQUIRED. SEE DETAIL 1/ET502. COORDINATE WITH SECURITY CONTRACTOR & DOOR SUPPLIER. TYPICAL OF ALL DOOR CONTACT LOCATIONS.
R2	SEE DETAIL 3/ET501 FOR CLASSROOM SLEEVE ROUGH-IN REQUIREMENTS PROVIDED BY ELECTRICAL CONTRACTOR. TYPICAL OF ALL CLASSROOM SLEEVE LOCATIONS.
R3	SEE DETAIL 6/ET502 FOR CLASSROOM SOUND SYSTEM ROUGH-IN TYPICAL OF ALL TEACHER'S WARDROBE LOCATION.
R4	COORDINATE WITH TECH CONTRACTOR TO CONFIRM ELECTRICAL NEEDS.
R5	SEE DETAIL 5/ET502 FOR MULTIPURPOSE ROOM SOUND SYSTEM CONDUIT RISER DIAGRAM.
R6	PROVIDE JUNCTION BOX FOR PENDANT TYPE SPEAKER, LOCATED UP IN BAR JOIST AREA (BELOW ROOF DECK AS REQUIRED BY CODE) SO THAT BOTTOM OF SUSPENDED SPEAKER IS LOCATED ABOVE THE BOTTOM OF BAR JOIST. PROVIDE CONDUITS BETWEEN JUNCTION BOXES AS REQUIRED. SEE DETAILS FOR SPEAKER CONNECTIONS.
R8	SEE SPECIFICATION SECTION 27 11 00 AND DETAIL 4&5/ET501 TYPICAL TR ROOM REQUIREMENTS.
R9	SEE DETAIL 8/ET501 FOR CONDUIT SUPPORT DETAIL.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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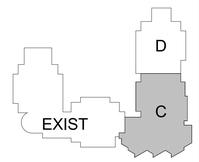
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KEY PLAN N

BID DOCUMENTS

BRIAN W. BUTLER REGISTERED No. PE10500 STATE OF INDIANA PROFESSIONAL ENGINEER

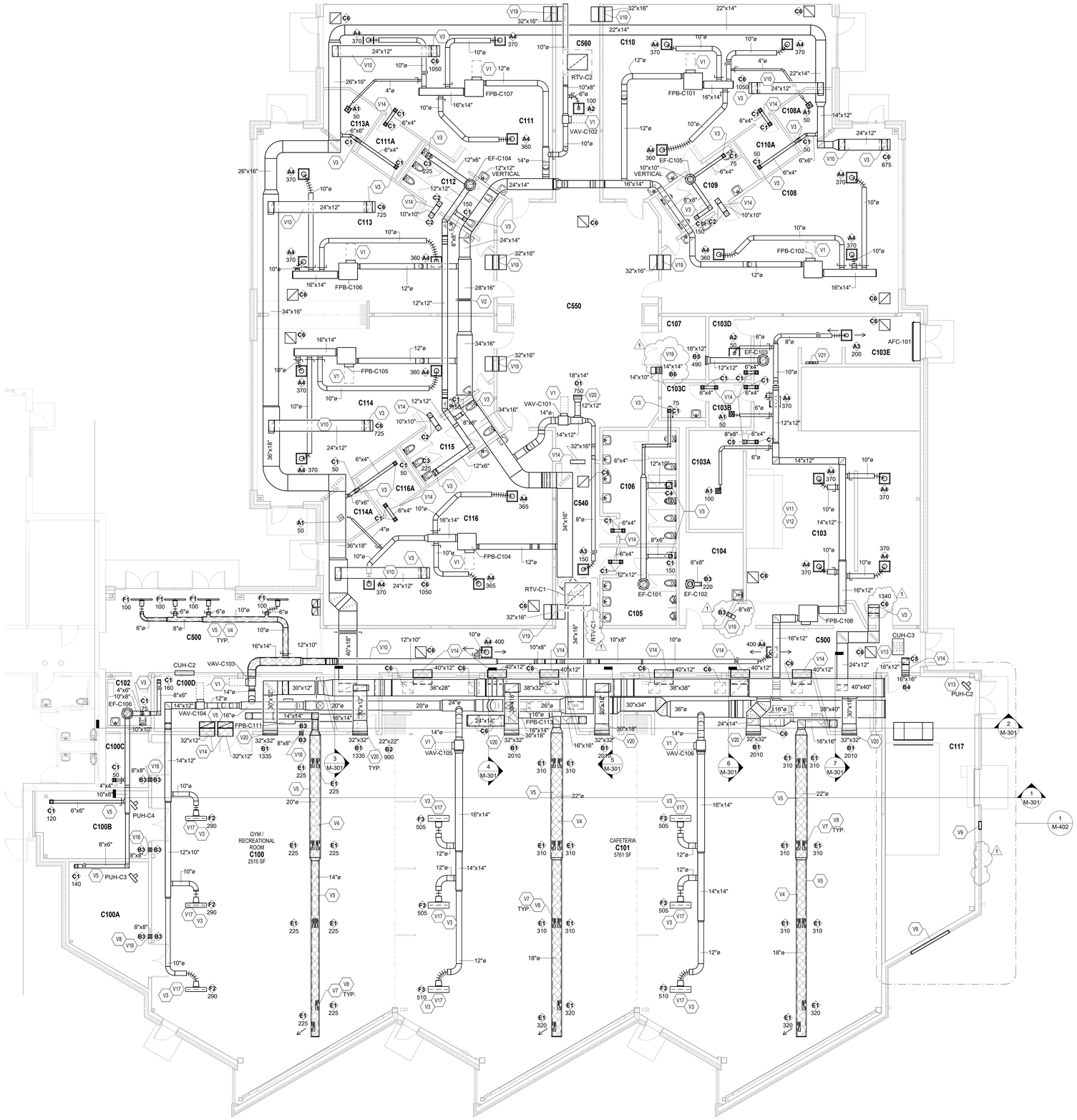
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DRAWN BY: CD
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

FIRST FLOOR TECHNOLOGY ROUGH-IN PLAN - UNIT C

ET11C

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FIRST FLOOR VENTILATION PLAN - UNIT C

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT C

ROOM NO.	ROOM NAME	AREA (SF)
C1	STAGE	Not Placed
C100	GYM / RECREATIONAL ROOM	2515 SF
C100A	STORAGE	274 SF
C100B	CHAIR STORAGE	248 SF
C100C	PLAY EQUIPMENT	77 SF
C100D	STORAGE	318 SF
C101	CAFETERIA	5761 SF
C102	FAMILY RR	70 SF
C103	KITCHEN	1515 SF
C103A	KITCHEN STORAGE	177 SF
C103B	LOCKERS	62 SF
C103C	RESTROOM	51 SF
C103D	OFFICE	88 SF
C103E	KITCHEN VESTIBULE	122 SF
C104	CUSTODIAL	220 SF
C105	MEN'S RESTROOM	173 SF
C106	WOMEN'S RESTROOM	258 SF
C107	ELECTRICAL	92 SF
C108	CLASSROOM 3	1090 SF
C108A	STORAGE	79 SF
C109	TOILET	136 SF
C110	CLASSROOM 4	1085 SF
C110A	STORAGE	73 SF
C111	CLASSROOM 5	1085 SF
C111A	STORAGE	73 SF
C112	TOILET	136 SF
C113	CLASSROOM 6	1089 SF
C113A	STORAGE	79 SF
C114	CLASSROOM 2	1089 SF
C114A	STORAGE	79 SF
C115	TOILET	135 SF
C116	CLASSROOM 1	1088 SF
C116A	STORAGE	73 SF
C117	MECHANICAL	771 SF
C118	IT CLOSET	123 SF
C119	MAINTENANCE	178 SF
C200	VESTIBULE	75 SF
C500	CORRIDOR	1838 SF
C540	CORRIDOR	272 SF
C550	CORRIDOR	1218 SF
C560	CORRIDOR	293 SF
C580	CORRIDOR	380 SF

VENTILATION PLAN GENERAL NOTES

A. ALL DUCTWORK, PIPING AND VALVES SHALL BE CONCEALED ABOVE THE CEILING AND WITHIN WALLS, UNLESS OTHERWISE NOTED.
B. REFER TO THE SPECIFICATIONS FOR REQUIREMENTS RELATED TO EQUIPMENT QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
C. ARRANGE DUCTWORK, PIPING, ETC. TO ALLOW FOR EASY ACCESS TO COILS, VALVES, DAMPERS AND CONTROLS. KEEP AREAS ADJACENT TO ACCESS PANELS FREE AND CLEAR OF ANY OBSTRUCTIONS.
D. SEAL DUCT PENETRATIONS THROUGH THE FLOOR AND/OR WALLS IN ACCORDANCE WITH MECHANICAL CODE AND SMACNA REQUIREMENTS. SEAL DUCT PENETRATIONS THROUGH FIRE RATED FLOORS AND/OR WALLS WITH A MATERIAL HAVING SAME FIRE RATING AS THE WALL AND/OR FLOOR.
E. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR HIS RESPECTIVE WORK FOR REPAIRING AND PATCHING TO MATCH EXISTING SURFACES, SIDEWALKS, STREETS, FLOORS, WALLS, ROOFS, CEILING AND PAVEMENT.
F. ALL RECTANGULAR SHEET METAL DUCT SIZES SHOWN ARE INSIDE FREE AREA DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
G. PROVIDE BALANCING DAMPER AT EACH DUCT BRANCH, SERVING DIFFUSER, GRILLE AND REGISTER.
H. INSTALL WALL THERMOSTATS, TEMPERATURE SENSORS, HUMIDISTATS, ETC. 44" ABOVE THE FINISH FLOOR IN ACCORDANCE WITH ADA REQUIREMENTS.
I. COORDINATE ALL REQUIRED WALL, ROOF AND FLOOR OPENINGS (BOTH DIMENSIONS AND LOCATIONS) WITH ALL OTHER TRADES.
J. COORDINATE MECHANICAL SYSTEM INSTALLATION WITH STRUCTURE, FIRE PROTECTION AND LIGHTING LAYOUT.
K. PROVIDE ALL NECESSARY TRANSITIONS TO EQUIPMENT FROM SIZES SHOWN ON PLAN.
L. THE CLEARANCE FOR THE DESIGNED FAN-POWERED VAV TERMINAL UNITS IS FROM THE BOTTOM OF THE UNIT. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR COORDINATING APPROVED FAN-POWERED VAV TERMINAL UNITS WITH ALL TRADES PRIOR TO INSTALLATION.

VENTILATION PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
V1	DASHED LINE INDICATED APPROXIMATE CLEARANCE REQUIRED IN FRONT OF VARIABLE VOLUME TERMINAL UNIT CONTROL PANEL. COORDINATE LOCATION WITH ALL TRADES.
V2	APPROXIMATE LOCATION OF DUCT STATIC PRESSURE SENSOR. PROVIDE ACCESS PANEL IN GYP. CEILING IN UNIT C AND IN CHASE WALL IN UNIT D. COORDINATE LOCATION WITH ALL TRADES.
V3	PROVIDE VOLUME DAMPER IN VERTICAL DUCTWORK TO AIR DEVICE. VOLUME DAMPER ADJUSTMENT THROUGH FACE OF DEVICE INSTALLED IN GYP. BOARD CEILINGS.
V4	DUCTWORK PROVIDED WITH INTERNAL LINED INSULATION. REFER TO SPECIFICATIONS.
V5	PAINT DUCTWORK TO COLOR SELECTED BY THE ARCHITECT/ENGINEER. CLEAN AND PREPARE DUCTWORK TO ENSURE PAINT ADHERES TO DUCTWORK.
V7	AIR DEVICE TO BE MOUNTED AT 30 DEGREES FROM VERTICAL ON SUPPLY DUCT. AIR DEVICE TO BE INCLUDED WITH FACTORY MOUNTED DAMPER.
V8	PAINT AIR DEVICES TO COLOR SELECTED BY ARCHITECT.
V9	INSTALL DRIP PAN UNDER WALL LOUVER. PAN SHALL BE SEALED WATER TIGHT. DRIP PAN TO EXTEND A MINIMUM OF 6" BEYOND DUCTWORK.
V10	ROUTE DUCTWORK BETWEEN/THROUGH STRUCTURAL STEEL. COORDINATE EXACT LOCATION WITH STRUCTURAL CONTRACTOR AND ALL OTHER TRADES.
V11	KITCHEN HOOD BY OTHERS. REFER TO FOOD SERVICE PLANS.
V12	MAKE UP AIR UNIT BY OTHERS.
V13	SUPPORT UNIT HEATER FROM STRUCTURE ABOVE WITH SUPPLEMENTAL STEEL AND THREADED ROD AS REQUIRED.
V14	PROVIDE INTERNALLY LINED AIR TRANSFER DUCTWORK BETWEEN THE TWO AREAS. COORDINATE EXACT LOCATION WITH ALL TRADES.
V16	BOTTOM OF AIR TRANSFER GRILLE TO BE 8" AFF.
V17	SURFACE MOUNT SUPPLY DIFFUSER AND RETURN GRILLE. PROVIDE ALL NECESSARY TRIM PIECES AND MOUNTING HARDWARE. COORDINATE LOCATIONS WITH ALL TRADES.
V19	ACCOUSTICALLY LINED RELIEF AIR TRANSFER SOUND TRAP ABOVE THE CEILING. EXTEND DUCTWORK TO PROVIDE NO LINE OF SIGHT FROM OPENING TO OPENING
V20	VOLUME DAMPER ADJUSTMENT ACCESSABLE THROUGH FACE OF WALL GRILLE.
V21	4" DIA. METAL DRYER DUCT THROUGH THE ROOF WITH GOOSENECK TURN DOWN. PROVIDE BACKDRAFT DAMPER ACCESSIBLE ABOVE CEILING. REFER TO DETAILS.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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KEY PLAN

BID DOCUMENTS

MARK Z. HOFF REGISTERED No. PE 12000001 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: CMS

PROJECT NUMBER: 223216.00

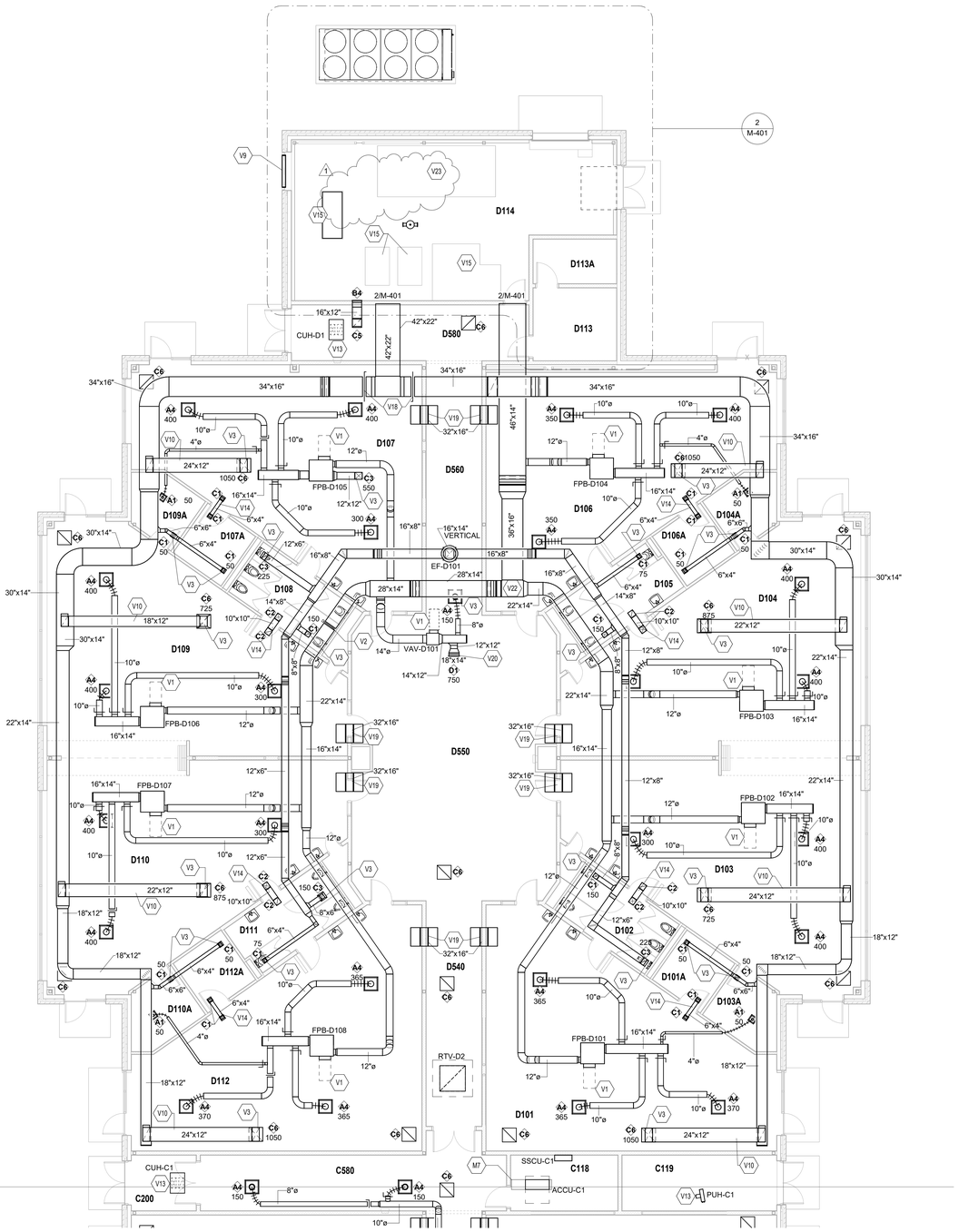
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

FIRST FLOOR VENTILATION PLAN - UNIT C

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FIRST FLOOR VENTILATION PLAN - UNIT D

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT D

ROOM NO.	ROOM NAME	AREA (SF)
D101	CLASSROOM 7	1076 SF
D101A	STORAGE	73 SF
D102	TOILET	135 SF
D103	CLASSROOM 8	1089 SF
D103A	STORAGE	83 SF
D104	CLASSROOM 9	1089 SF
D104A	STORAGE	79 SF
D105	TOILET	136 SF
D106	CLASSROOM 10	1045 SF
D106A	STORAGE	73 SF
D107	CLASSROOM 11	1083 SF
D107A	STORAGE	73 SF
D108	TOILET	135 SF
D109	CLASSROOM 12	1089 SF
D109A	STORAGE	79 SF
D110	CLASSROOM 13	1089 SF
D110A	STORAGE	83 SF
D111	TOILET	136 SF
D112	CLASSROOM 14	1076 SF
D112A	STORAGE	73 SF
D113	ELECTRICAL	126 SF
D113A	EMERGENCY ELECTRICAL	77 SF
D114	MECHANICAL	961 SF
D540	CORRIDOR	259 SF
D550	CORRIDOR	1170 SF
D560	CORRIDOR	293 SF
D580	CORRIDOR	273 SF

VENTILATION PLAN GENERAL NOTES

A. ALL DUCTWORK, PIPING AND VALVES SHALL BE CONCEALED ABOVE THE CEILING AND WITHIN WALLS, UNLESS OTHERWISE NOTED.
B. REFER TO THE SPECIFICATIONS FOR REQUIREMENTS RELATED TO EQUIPMENT QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
C. ARRANGE DUCTWORK, PIPING, ETC. TO ALLOW FOR EASY ACCESS TO COILS, VALVES, DAMPERS AND CONTROLS. KEEP AREAS ADJACENT TO ACCESS PANELS FREE AND CLEAR OF ANY OBSTRUCTIONS.
D. SEAL DUCT PENETRATIONS THROUGH THE FLOOR AND/OR WALLS IN ACCORDANCE WITH MECHANICAL CODE AND SMACNA REQUIREMENTS. SEAL DUCT PENETRATIONS THROUGH FIRE RATED FLOORS AND/OR WALLS WITH A MATERIAL HAVING SAME FIRE RATING AS THE WALL AND/OR FLOOR.
E. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR HIS RESPECTIVE WORK FOR REPAIRING AND PATCHING TO MATCH EXISTING SURFACES, SIDEWALKS, STREETS, FLOORS, WALLS, ROOFS, CEILING AND PAVEMENT.
F. ALL RECTANGULAR SHEET METAL DUCT SIZES SHOWN ARE INSIDE FREE AREA DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
G. PROVIDE BALANCING DAMPER AT EACH DUCT BRANCH, SERVING DIFFUSER, GRILLE AND REGISTER.
H. INSTALL WALL THERMOSTATS, TEMPERATURE SENSORS, HUMIDISTATS, ETC. 44" ABOVE THE FINISH FLOOR IN ACCORDANCE WITH ADA REQUIREMENTS.
I. COORDINATE ALL REQUIRED WALL, ROOF AND FLOOR OPENINGS (BOTH DIMENSIONS AND LOCATIONS) WITH ALL OTHER TRADES.
J. COORDINATE MECHANICAL SYSTEM INSTALLATION WITH STRUCTURE, FIRE PROTECTION AND LIGHTING LAYOUT.
K. PROVIDE ALL NECESSARY TRANSITIONS TO EQUIPMENT FROM SIZES SHOWN ON PLAN.
L. THE CLEARANCE FOR THE DESIGNED FAN-POWERED VAV TERMINAL UNITS IS FROM THE BOTTOM OF THE UNIT. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR COORDINATING APPROVED FAN-POWERED VAV TERMINAL UNITS WITH ALL TRADES PRIOR TO INSTALLATION.

VENTILATION PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
M7	OUTSIDE AIR CONTROL DAMPERS FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED AND INSTALLED BY TEMPERATURE CONTROL CONTRACTOR.
V1	DASHED LINE INDICATED APPROXIMATE CLEARANCE REQUIRED IN FRONT OF VARIABLE VOLUME TERMINAL UNIT CONTROL PANEL. COORDINATE LOCATION WITH ALL TRADES.
V2	APPROXIMATE LOCATION OF DUCT STATIC PRESSURE SENSOR. PROVIDE ACCESS PANEL IN GYP. CEILING IN UNIT C AND IN CHASE WALL IN UNIT D. COORDINATE LOCATION WITH ALL TRADES.
V3	PROVIDE VOLUME DAMPER IN VERTICAL DUCTWORK TO AIR DEVICE. VOLUME DAMPER ADJUSTMENT THROUGH FACE OF DEVICE INSTALLED IN GYP. BOARD CEILINGS.
V9	INSTALL DRIP PAN UNDER WALL LOUVER. PAN SHALL BE SEALED WATER TIGHT. DRIP PAN TO EXTEND A MINIMUM OF 6" BEYOND DUCTWORK.
V10	ROUTE DUCTWORK BETWEEN/THROUGH STRUCTURAL STEEL. COORDINATE EXACT LOCATION WITH STRUCTURAL CONTRACTOR AND ALL OTHER TRADES.
V13	SUPPORT UNIT HEATER FROM STRUCTURE ABOVE WITH SUPPLEMENTAL STEEL AND THREADED ROD AS REQUIRED.
V14	PROVIDE INTERNALLY LINED AIR TRANSFER DUCTWORK BETWEEN THE TWO AREAS. COORDINATE EXACT LOCATION WITH ALL TRADES.
V15	INSTALL EQUIPMENT ON 3-1/2" HIGH CONCRETE HOUSEKEEPING PAD. COORDINATE SIZE OF HOUSEKEEPING PAD WITH EQUIPMENT TO BE PROVIDED.
V18	BALANCE RETURN AIR MANUAL VOLUME DAMPER TO 4,500 CFM.
V19	ACCOUSTICALLY LINED RELIEF AIR TRANSFER SOUND TRAP ABOVE THE CEILING. EXTEND DUCTWORK TO PROVIDE NO LINE OF SIGHT FROM OPENING TO OPENING
V20	VOLUME DAMPER ADJUSTMENT ACCESSABLE THROUGH FACE OF WALL GRILLE.
V22	PROVIDE TURNING VANES WITHIN DUCT TEE.
V23	INSTALL EQUIPMENT ON 6" HIGH CONCRETE HOUSEKEEPING PAD.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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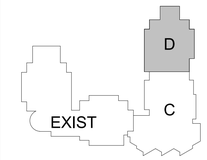
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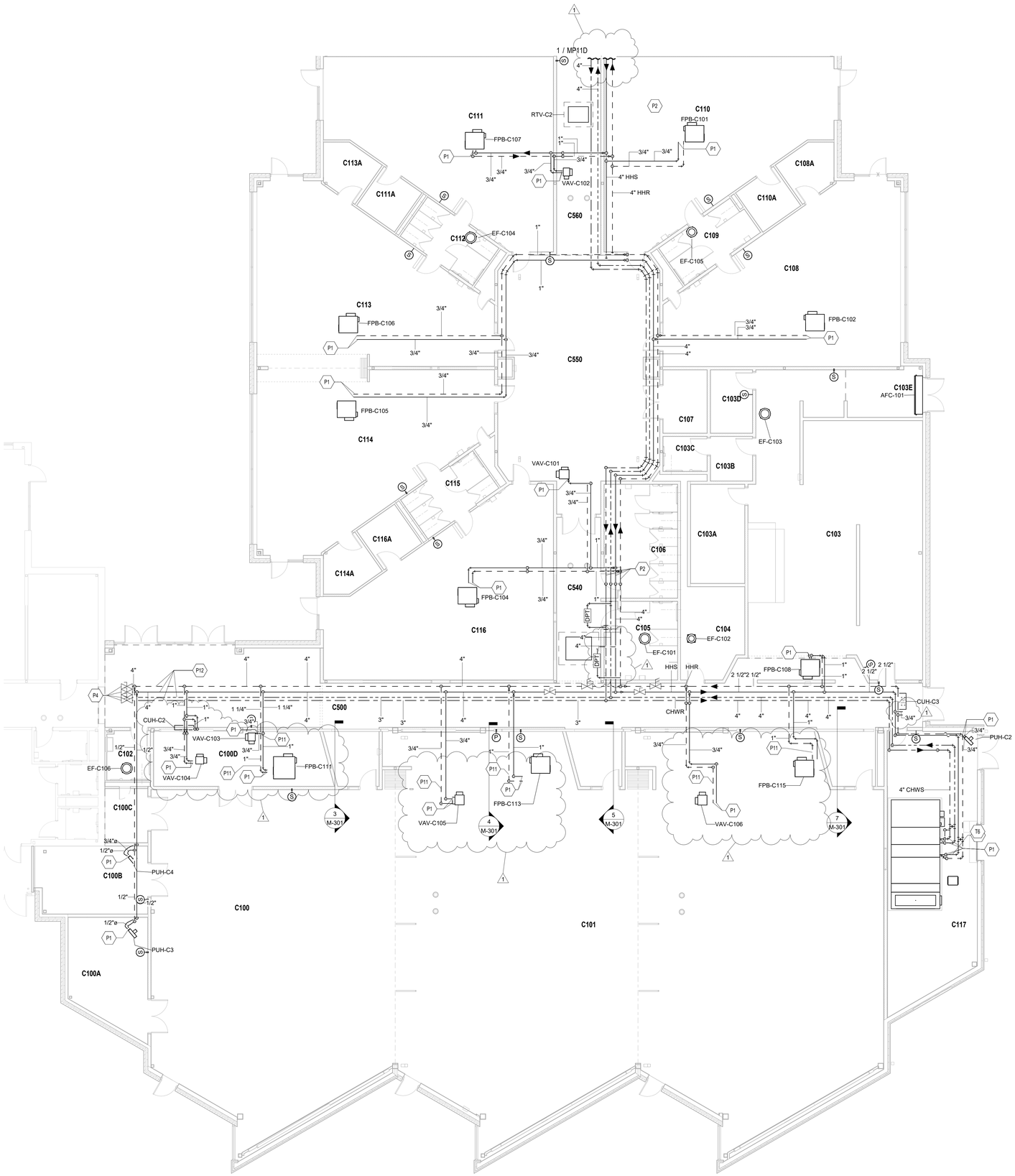
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DRAWN BY: CMS
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

FIRST FLOOR VENTILATION PLAN - UNIT D

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FIRST FLOOR PIPING PLAN - UNIT C

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT C

ROOM NO.	ROOM NAME	AREA (SF)
C1	STAGE	Not Placed
C100	GYM / RECREATIONAL ROOM	2515 SF
C100A	STORAGE	274 SF
C100B	CHAIR STORAGE	248 SF
C100C	PLAY EQUIPMENT	77 SF
C100D	STORAGE	318 SF
C101	CAFETERIA	5761 SF
C102	FAMILY RR	70 SF
C103	KITCHEN	1515 SF
C103A	KITCHEN STORAGE	177 SF
C103B	LOCKERS	62 SF
C103C	RESTROOM	51 SF
C103D	OFFICE	88 SF
C103E	KITCHEN VESTIBULE	122 SF
C104	CUSTODIAL	220 SF
C105	MEN'S RESTROOM	173 SF
C106	WOMEN'S RESTROOM	258 SF
C107	ELECTRICAL	92 SF
C108	CLASSROOM 3	1090 SF
C108A	STORAGE	79 SF
C109	TOILET	136 SF
C110	CLASSROOM 4	1085 SF
C110A	STORAGE	73 SF
C111	CLASSROOM 5	1085 SF
C111A	STORAGE	73 SF
C112	TOILET	136 SF
C113	CLASSROOM 6	1089 SF
C113A	STORAGE	79 SF
C114	CLASSROOM 2	1089 SF
C114A	STORAGE	79 SF
C115	TOILET	135 SF
C116	CLASSROOM 1	1088 SF
C116A	STORAGE	73 SF
C117	MECHANICAL	771 SF
C118	IT CLOSET	123 SF
C119	MAINTENANCE	178 SF
C200	VESTIBULE	75 SF
C500	CORRIDOR	1838 SF
C540	CORRIDOR	272 SF
C550	CORRIDOR	1218 SF
C560	CORRIDOR	293 SF
C580	CORRIDOR	380 SF

HVAC PIPING PLAN GENERAL NOTES

A. ALL PIPING AND VALVES SHALL BE CONCEALED ABOVE THE CEILING AND WITHIN WALLS, UNLESS OTHERWISE NOTED.
B. REFER TO THE SPECIFICATIONS FOR REQUIREMENTS RELATED TO EQUIPMENT QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
C. ARRANGE PIPING, ETC. TO ALLOW FOR EASY ACCESS TO COILS, VALVES, DAMPERS AND CONTROLS. KEEP AREAS ADJACENT TO ACCESS PANELS FREE AND CLEAR OF ANY OPSTRUCTIONS.
D. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR HIS RESPECTIVE WORK FOR REPAIRING AND PATCHING TO MATCH EXISTING SURFACES, SIDEWALKS, STREETS, FLOORS, WALLS, ROOFS, CEILING AND PAVEMENT.
E. HYDRONIC SUPPLY AND RETURN PIPING SHALL BE THE SAME SIZE UNLESS OTHERWISE NOTED.

HVAC PIPING PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
P1	APPROXIMATE CONNECTION LOCATION. COORDINATE WITH CONTRACTOR ON-SITE FOR EQUIPMENT CONNECTION LOCATION.
P2	CHILLED/HOT WATER PIPING SHALL BE ROUTED THROUGH STEEL JOISTS IN AREA. COORDINATE EXACT LOCATION WITH STRUCTURAL CONTRACTOR AND ALL OTHER TRADES.
P4	CAP PIPING ABOVE ACCESSIBLE CEILING FOR FUTURE CONNECTION POINT.
P11	INSTALL CONTROL VALVE ABOVE ACCESSIBLE CEILING
P12	PAINT EXPOSED PIPING
T5	APPROXIMATE LOCATION OF 3-WAY MODULATING CHILLED WATER CONTROL VALVE.
T6	APPROXIMATE LOCATION OF 3-WAY MODULATING HEATING WATER CONTROL VALVE.

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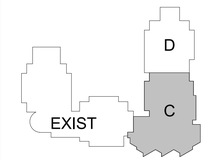
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KEY PLAN

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BID DOCUMENTS

MARK Z. HOSE REGISTERED No. PE 12005001 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW
DRAWN BY: CMS
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

VERIFICATION NOTE

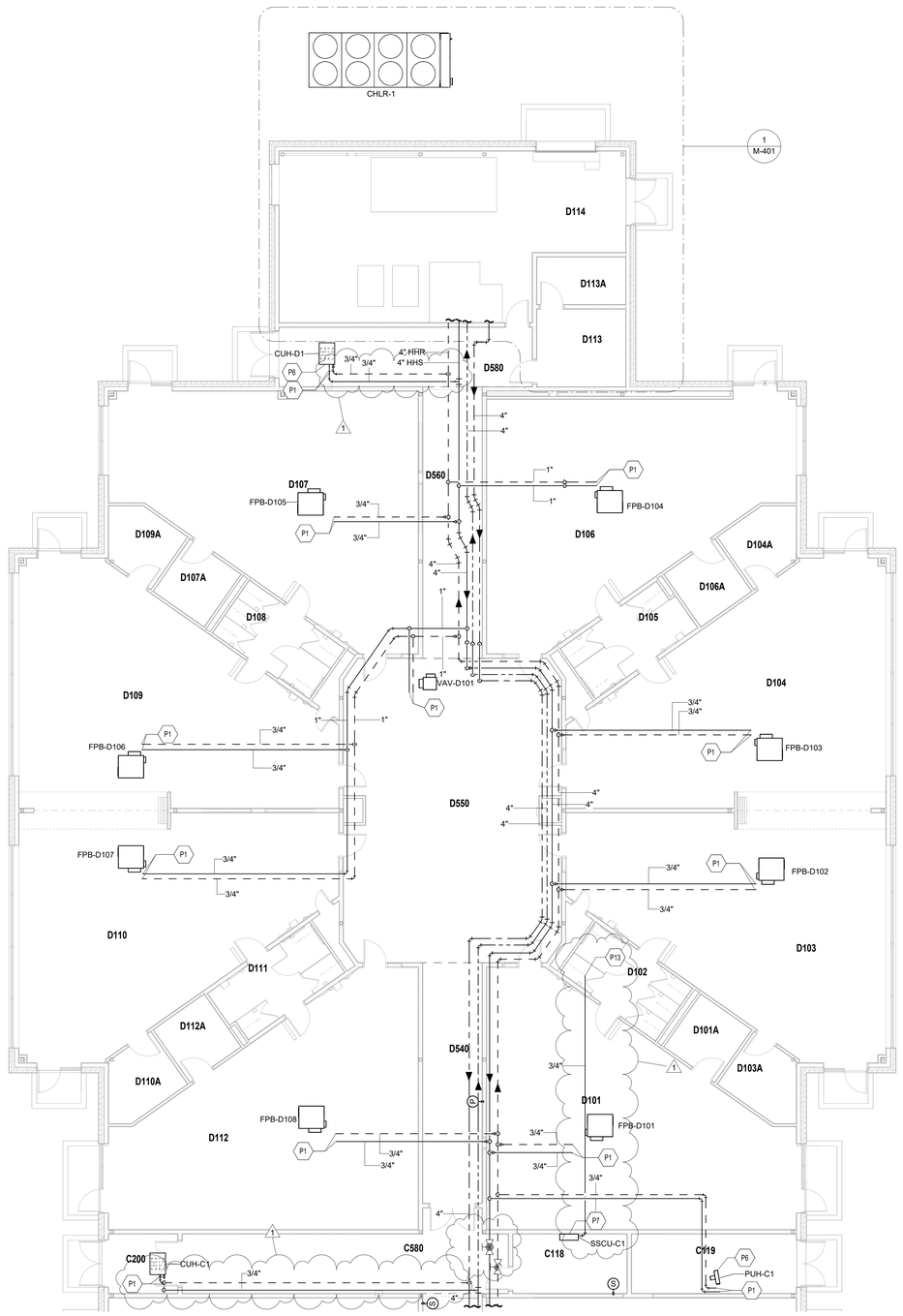
CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

FIRST FLOOR PIPING PLAN - UNIT C

MP11C

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1 / MP11C

FIRST FLOOR PIPING PLAN - UNIT D

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT D

ROOM NO.	ROOM NAME	AREA (SF)
D101	CLASSROOM 7	1076 SF
D101A	STORAGE	73 SF
D102	TOILET	135 SF
D103	CLASSROOM 8	1089 SF
D103A	STORAGE	83 SF
D104	CLASSROOM 9	1089 SF
D104A	STORAGE	79 SF
D105	TOILET	136 SF
D106	CLASSROOM 10	1045 SF
D106A	STORAGE	73 SF
D107	CLASSROOM 11	1083 SF
D107A	STORAGE	73 SF
D108	TOILET	135 SF
D109	CLASSROOM 12	1089 SF
D109A	STORAGE	79 SF
D110	CLASSROOM 13	1089 SF
D110A	STORAGE	83 SF
D111	TOILET	136 SF
D112	CLASSROOM 14	1076 SF
D112A	STORAGE	73 SF
D113	ELECTRICAL	126 SF
D113A	EMERGENCY ELECTRICAL	77 SF
D114	MECHANICAL	961 SF
D540	CORRIDOR	259 SF
D550	CORRIDOR	1170 SF
D560	CORRIDOR	293 SF
D580	CORRIDOR	273 SF

HVAC PIPING PLAN GENERAL NOTES

A. ALL PIPING AND VALVES SHALL BE CONCEALED ABOVE THE CEILING AND WITHIN WALLS, UNLESS OTHERWISE NOTED.
B. REFER TO THE SPECIFICATIONS FOR REQUIREMENTS RELATED TO EQUIPMENT QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
C. ARRANGE PIPING, ETC. TO ALLOW FOR EASY ACCESS TO COILS, VALVES, DAMPERS AND CONTROLS. KEEP AREAS ADJACENT TO ACCESS PANELS FREE AND CLEAR OF ANY OPSTRUCTIONS.
D. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR HIS RESPECTIVE WORK FOR REPAIRING AND PATCHING TO MATCH EXISTING SURFACES, SIDEWALKS, STREETS, FLOORS, WALLS, ROOFS, CEILING AND PAVEMENT. HYDRONIC SUPPLY AND RETURN PIPING SHALL BE THE SAME SIZE UNLESS OTHERWISE NOTED.

HVAC PIPING PLAN NOTES

(X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
P1	APPROXIMATE CONNECTION LOCATION. COORDINATE WITH CONTRACTOR ON-SITE FOR EQUIPMENT CONNECTION LOCATION.
P6	SUPPORT UNIT HEATER FROM STRUCTURE ABOVE OR ADJACENT WALL WITH SUPPLEMENTAL STEEL AND THREADED ROD WITH VIBRATION ISOLATORS AS REQUIRED.
P7	ROUTE REFRIGERANT PIPING FROM CONDENSING UNIT TO TECHNOLOGY ROOM UNIT. REFRIGERANT PIPING AND ACCESSORIES TO BE SIZED PER UNIT MANUFACTURERS REQUIREMENTS. REFRIGERANT PIPING SHALL BE INSULATED AND INSULATION SHALL BE COVERED WITH PVC JACKET.
P13	COPPER CONDENSATE PIPE TO BE ROUTED THROUGH THE WALL AND TURNED DOWN. END OF PIPE TO BE CUT AT 45 DEGREE ANGLE. SEAL WALL PENETRATION WATERTIGHT.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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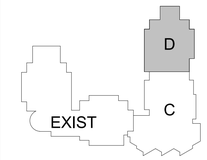
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350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



KEY PLAN

N

BID DOCUMENTS

MARK Z. HOPE REGISTERED No. PE 12000301 STATE OF INDIANA PROFESSIONAL ENGINEER

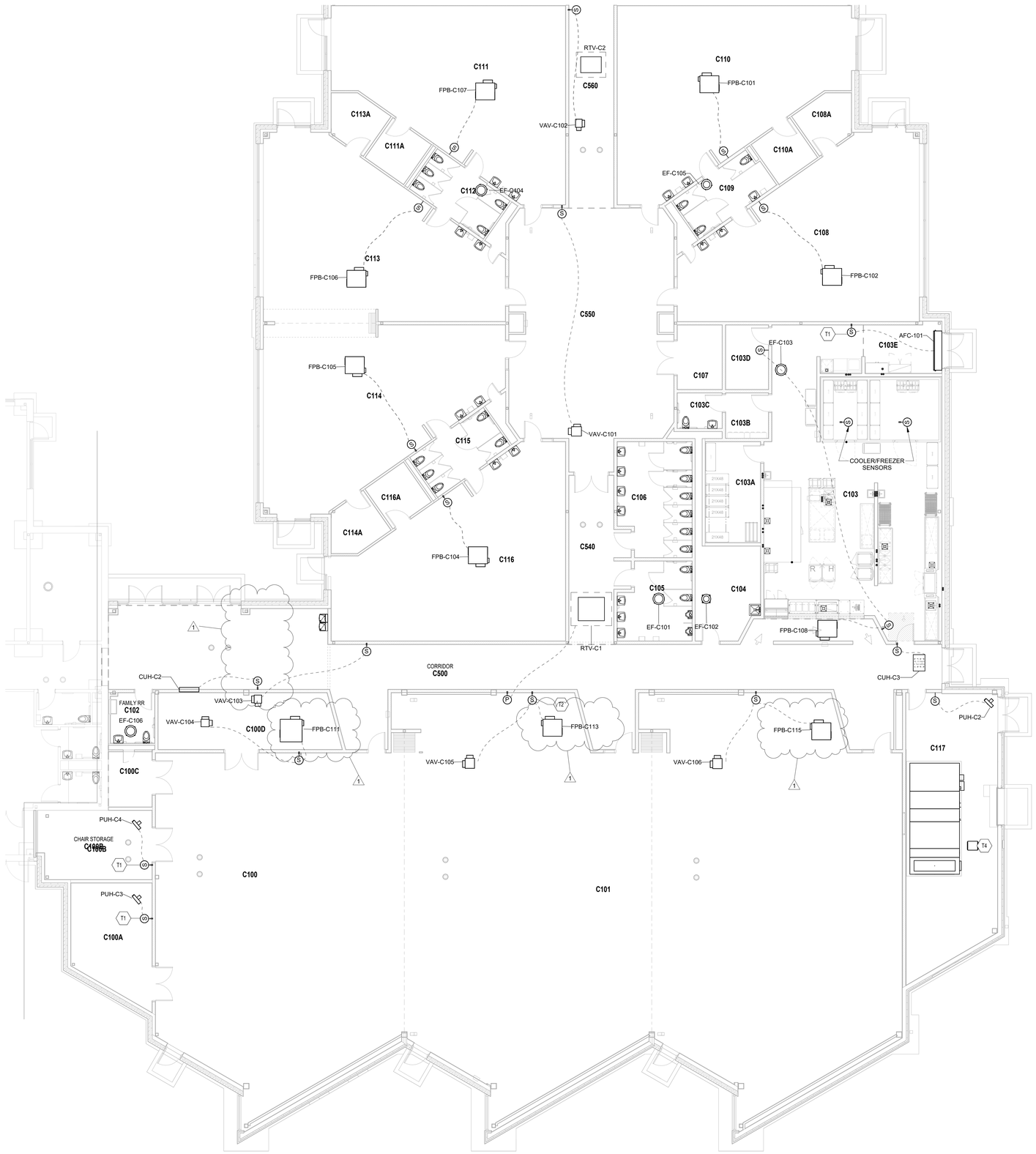
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DRAWN BY: CMS
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

FIRST FLOOR PIPING PLAN - UNIT D

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FIRST FLOOR CONTROLS PLAN - UNIT C

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT C

ROOM NO.	ROOM NAME	AREA (SF)
C1	STAGE	Not Placed
C100	GYM / RECREATIONAL ROOM	2515 SF
C100A	STORAGE	274 SF
C100B	CHAIR STORAGE	248 SF
C100C	PLAY EQUIPMENT	77 SF
C100D	STORAGE	318 SF
C101	CAFETERIA	5761 SF
C102	FAMILY RR	70 SF
C103	KITCHEN	1515 SF
C103A	KITCHEN STORAGE	177 SF
C103B	LOCKERS	62 SF
C103C	RESTROOM	51 SF
C103D	OFFICE	88 SF
C103E	KITCHEN VESTIBULE	122 SF
C104	CUSTODIAL	220 SF
C105	MEN'S RESTROOM	173 SF
C106	WOMEN'S RESTROOM	258 SF
C107	ELECTRICAL	92 SF
C108	CLASSROOM 3	1090 SF
C108A	STORAGE	79 SF
C109	TOILET	136 SF
C110	CLASSROOM 4	1085 SF
C110A	STORAGE	73 SF
C111	CLASSROOM 5	1085 SF
C111A	STORAGE	73 SF
C112	TOILET	136 SF
C113	CLASSROOM 6	1089 SF
C113A	STORAGE	79 SF
C114	CLASSROOM 2	1089 SF
C114A	STORAGE	79 SF
C115	TOILET	135 SF
C116	CLASSROOM 1	1088 SF
C116A	STORAGE	73 SF
C117	MECHANICAL	771 SF
C118	IT CLOSET	123 SF
C119	MAINTENANCE	178 SF
C200	VESTIBULE	75 SF
C500	CORRIDOR	1838 SF
C540	CORRIDOR	272 SF
C550	CORRIDOR	1218 SF
C560	CORRIDOR	293 SF
C580	CORRIDOR	380 SF

TEMPERATURE CONTROL PLAN GENERAL NOTES

A. REFER TO SECTION 23 05 00 GENERAL REQUIREMENTS AND CONDITIONS FOR THE TRANSPORT, STORAGE, DEMOLITION, & INSTALLATION AS DESCRIBED HEREIN.

B. **BUILDING HEATING & COOLING PLANT CONTROLS:** TEMPERATURE CONTROL CONTRACTOR SHALL PROVIDE ITEMS SUCH AS, BUT NOT BE LIMITED TO, CONTROL EQUIPMENT, VALVES, ACTUATORS, SENSORS, DEVICES, COMPONENTS, & COORDINATION FOR NEW COMPLETE & FUNCTIONAL BUILDING TEMPERATURE CONTROL SYSTEM.

C. **TEMP CONTROL (WALL MTD) SENSORS/THERMOSTATS:** ANTICIPATED LOCATIONS FOR TEMPERATURE CONTROL SYSTEMS AMBIENT SENSORS & THERMOSTATIC CONTROLLERS ARE SHOWN. REFER TO SECTIONS 23 09 00 & 23 09 93 FOR DEVICE REQUIREMENT(S) RELEVANT TO EQUIPMENT & ZONE INSTALLATIONS. CONTRACTOR IS RESPONSIBLE TO IDENTIFY MOST APPROPRIATE DEVICE LOCATION. CONTACT PROJECT ENGINEER IF CLARIFICATION BECOMES NECESSARY.

D. CONTRACTOR SHALL PROVIDE ALL WIRING, DEVICES AND COMPONENTS.

TEMPERATURE CONTROL PLAN NOTES

(X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
T1	TEMPERATURE SENSOR PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR TO MONITOR SPACE TEMPERATURE.
T2	THERMOSTAT PROVIDED BY THE COOLING UNIT MANUFACTURER AND INSTALLED BY THE TEMPERATURE CONTROL CONTRACTOR.
T4	EXHAUST AIR CONTROL DAMPER SHALL BE FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED BY TEMPERATURE CONTROL CONTRACTOR.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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MSD OF PIKE TOWNSHIP

ARCHITECT

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KEY PLAN

N

BID DOCUMENTS

MARK Z. HOOF REGISTERED No. PE 12000301 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: CMS

PROJECT NUMBER: 223216.00

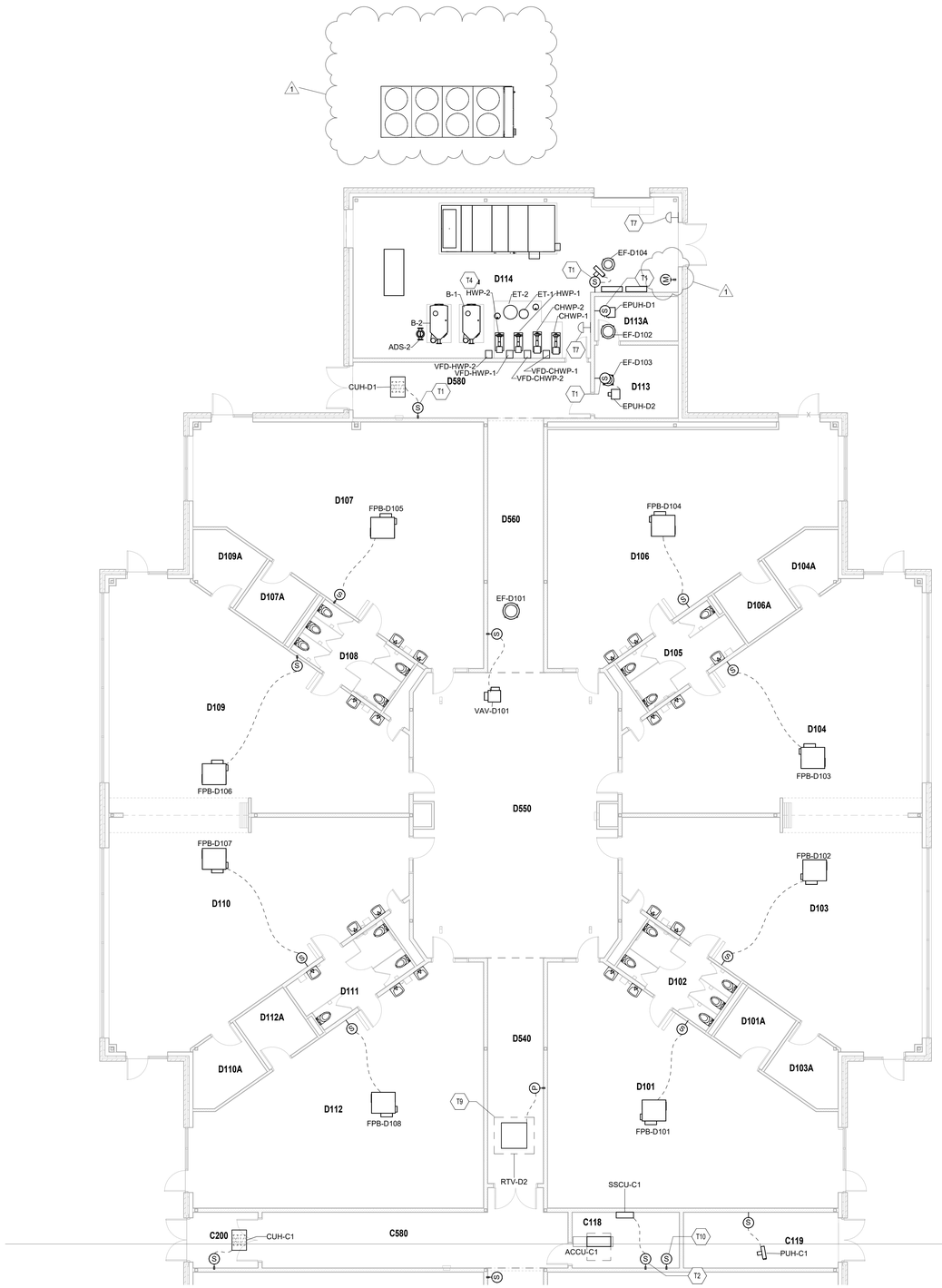
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

FIRST FLOOR CONTROLS PLAN - UNIT C

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FIRST FLOOR CONTROLS PLAN - UNIT D

SCALE: 1/8" = 1'-0"

ROOM LEGEND - FIRST FLOOR UNIT D

ROOM NO.	ROOM NAME	AREA (SF)
D101	CLASSROOM 7	1076 SF
D101A	STORAGE	73 SF
D102	TOILET	135 SF
D103	CLASSROOM 8	1089 SF
D103A	STORAGE	83 SF
D104	CLASSROOM 9	1089 SF
D104A	STORAGE	79 SF
D105	TOILET	136 SF
D106	CLASSROOM 10	1045 SF
D106A	STORAGE	73 SF
D107	CLASSROOM 11	1083 SF
D107A	STORAGE	73 SF
D108	TOILET	135 SF
D109	CLASSROOM 12	1089 SF
D109A	STORAGE	79 SF
D110	CLASSROOM 13	1089 SF
D110A	STORAGE	83 SF
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D112	CLASSROOM 14	1076 SF
D112A	STORAGE	73 SF
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D113A	EMERGENCY ELECTRICAL	77 SF
D114	MECHANICAL	961 SF
D540	CORRIDOR	259 SF
D550	CORRIDOR	1170 SF
D560	CORRIDOR	293 SF
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TEMPERATURE CONTROL PLAN GENERAL NOTES

A. REFER TO SECTION 23 05 00 GENERAL REQUIREMENTS AND CONDITIONS FOR THE TRANSPORT, STORAGE, DEMOLITION, & INSTALLATION AS DESCRIBED HEREIN.

B. **BUILDING HEATING & COOLING PLANT CONTROLS**: TEMPERATURE CONTROL CONTRACTOR SHALL PROVIDE ITEMS SUCH AS, BUT NOT BE LIMITED TO, CONTROL EQUIPMENT, VALVES, ACTUATORS, SENSORS, DEVICES, COMPONENTS, & COORDINATION FOR NEW COMPLETE & FUNCTIONAL BUILDING TEMPERATURE CONTROL SYSTEM.

C. **TEMP CONTROL (WALL MTD) SENSORS/THERMOSTATS**: ANTICIPATED LOCATIONS FOR TEMPERATURE CONTROL SYSTEMS AMBIENT SENSORS & THERMOSTATIC CONTROLLERS ARE SHOWN. REFER TO SECTIONS 23 09 00 & 23 09 93 FOR DEVICE REQUIREMENT(S) RELEVANT TO EQUIPMENT & ZONE INSTALLATIONS. CONTRACTOR IS RESPONSIBLE TO IDENTIFY MOST APPROPRIATE DEVICE LOCATION. CONTACT PROJECT ENGINEER IF CLARIFICATION BECOMES NECESSARY.

D. CONTRACTOR SHALL PROVIDE ALL WIRING, DEVICES AND COMPONENTS.

TEMPERATURE CONTROL PLAN NOTES

(X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
T1	TEMPERATURE SENSOR PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR TO MONITOR SPACE TEMPERATURE.
T2	THERMOSTAT PROVIDED BY THE COOLING UNIT MANUFACTURER AND INSTALLED BY THE TEMPERATURE CONTROL CONTRACTOR.
T4	EXHAUST AIR CONTROL DAMPER SHALL BE FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED BY TEMPERATURE CONTROL CONTRACTOR.
T7	APPROXIMATE LOCATION OF BOILER SHUT-DOWN SWITCH PROVIDED AND INSTALLED BY TEMPERATURE CONTROL CONTRACTOR.
T9	TEMPERATURE CONTROL CONTRACTOR SHALL PROVIDE MOTOR CONTROLS FOR RELIEF VENT.s
T10	SENSOR PROVIDED BY TEMPERATURE CONTROL MANUFACTURER FOR SPACE TEMP MONITORING THROUGH THE BAS.

VERIFICATION NOTE

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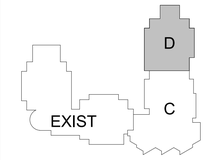
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KEY PLAN

N

BID DOCUMENTS

MARK Z. HOSE REGISTERED No. PE 12005101 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: CMS

PROJECT NUMBER: 223216.00

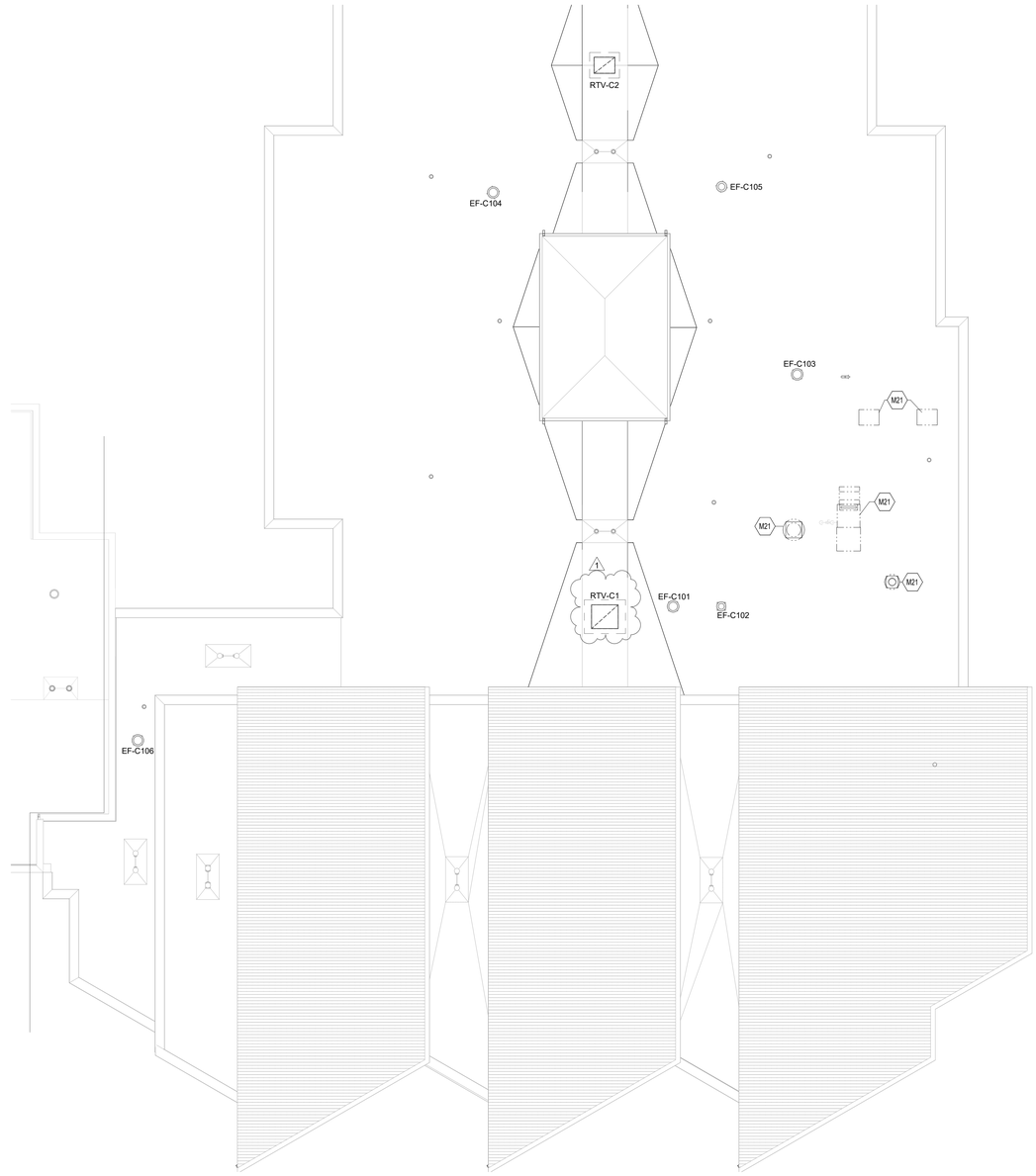
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

FIRST FLOOR CONTROLS PLAN - UNIT D

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MECHANICAL ROOF PLAN - UNIT C

SCALE: 3/32" = 1'-0"

MECHANICAL ROOF PLAN GENERAL NOTES

A. THE DIVISION 23 CONTRACTOR SHALL VISIT THE PROJECT AND DETERMINE THE EXACT EXTENT OF THE DEMOLITION
B. WHERE BUILDING SURFACES ARE DAMAGED BY THE REMOVAL OF OLD WORK, SAME SHALL BE PATCHED TO MATCH THE ADJACENT SURFACES BY THIS CONTRACTOR.
C. EXISTING OPENINGS WHICH ARE TO BE REUSED SHALL NOT BE REMOVED AND SHALL BE MODIFIED OR ENLARGED AS NEED BE TO SUIT THE NEW SYSTEMS. PROVIDE ALL REQUIRED CUTTING AND PATCHING TO MATCH ADJACENT SURFACES.
D. IF ASBESTOS IS PRESENT, CONTACT THE CONSTRUCTION MANAGER. IT WILL BE REMOVED OR RENDERED HARMLESS UNDER SEPARATE CONTRACT BY THE OWNER.
E. THE OWNER SHALL HAVE THE RIGHT TO CLAIM ANY MATERIALS THAT ARE BEING DEMOLISHED PRIOR TO THE CONTRACTOR DISPOSING OF THEM OFF SITE. CONTRACTOR IS REQUIRED TO VERIFY THAT THE OWNER DOES NOT WANT TO CLAIM AN ITEM BEFORE DISPOSING THEM OFF SITE.
F. ALL FLOOR, WALL AND ROOF CUTTING WORK TO BE DONE BY DIVISION 23-HVAC CONTRACTOR UNLESS OTHERWISE NOTED. PATCH ALL FLOOR, WALL AND ROOF OPENINGS THAT ARE NOT REUSED TO MATCH ADJACENT CONSTRUCTION.
G. DIVISION 23 CONTRACTOR IS RESPONSIBLE TO REMOVE EXISTING CEILINGS TO DO WORK ABOVE THE CEILINGS AND REINSTALL THOSE CEILINGS AFTER COMPLETION OF WORK. IF ANY CEILING PADS OR GRIDS ARE DAMAGED, THIS CONTRACTOR SHALL REPLACE WITH NEW TO MATCH EXISTING.

MECHANICAL ROOF PLAN NOTES

(X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
M21	ROOF MOUTED KITCHEN EQUIPMENT BY KITCHEN EQUIPMENT CONTRACTOR. COORDINATE LOCATES WITH ALL TRADES.

VERIFICATION NOTE

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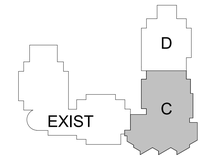
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KEY PLAN

N

BID DOCUMENTS

MARK Z. HOSE
REGISTERED
No.
PE 12000001
STATE OF
INDIANA
PROFESSIONAL ENGINEER

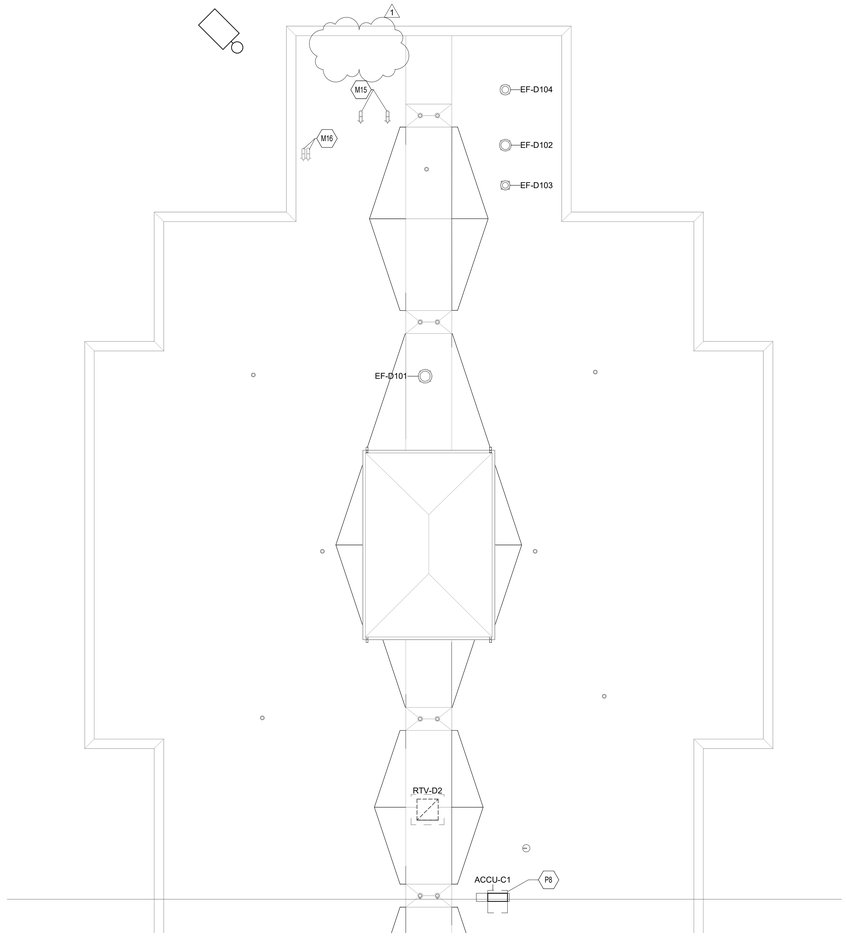
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MECHANICAL ROOF PLAN - UNIT C

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MECHANICAL ROOF PLAN - UNIT D

SCALE: 3/32" = 1'-0"

MECHANICAL ROOF PLAN GENERAL NOTES

A. THE DIVISION 23 CONTRACTOR SHALL VISIT THE PROJECT AND DETERMINE THE EXACT EXTENT OF THE DEMOLITION
B. WHERE BUILDING SURFACES ARE DAMAGED BY THE REMOVAL OF OLD WORK, SAME SHALL BE PATCHED TO MATCH THE ADJACENT SURFACES BY THIS CONTRACTOR.
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F. ALL FLOOR, WALL AND ROOF CUTTING WORK TO BE DONE BY DIVISION 23-HVAC CONTRACTOR UNLESS OTHERWISE NOTED. PATCH ALL FLOOR, WALL AND ROOF OPENINGS THAT ARE NOT REUSED TO MATCH ADJACENT CONSTRUCTION.
G. DIVISION 23 CONTRACTOR IS RESPONSIBLE TO REMOVE EXISTING CEILINGS TO DO WORK ABOVE THE CEILINGS AND REINSTALL THOSE CEILINGS AFTER COMPLETION OF WORK. IF ANY CEILING PADS OR GRIDS ARE DAMAGED, THIS CONTRACTOR SHALL REPLACE WITH NEW TO MATCH EXISTING.

MECHANICAL ROOF PLAN NOTES (X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
M15	AL-29-4C FLUE PIPE SYSTEM FROM THE BOILER CONNECTION ROUTED UP AND TERMINATED THOUGH THE ROOF. FLUE PIPE SIZE AND INSTALLATION PER MANUFACTURERS REQUIREMENTS.
M16	SINGLE WALL STAINLESS STEEL INTAKE PIPE FROM THE BOILER CONNECTION TERMINATED THOUGH THE ROOF. INTAKE PIPE SIZE AND INSTALLATION PER MANUFACTURERS REQUIREMENTS.
P8	CONDENSING UNIT ROOF MOUNTED ON EQUIPMENT SUPPORT RAILS.

VERIFICATION NOTE

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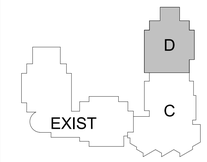
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KEY PLAN N

BID DOCUMENTS



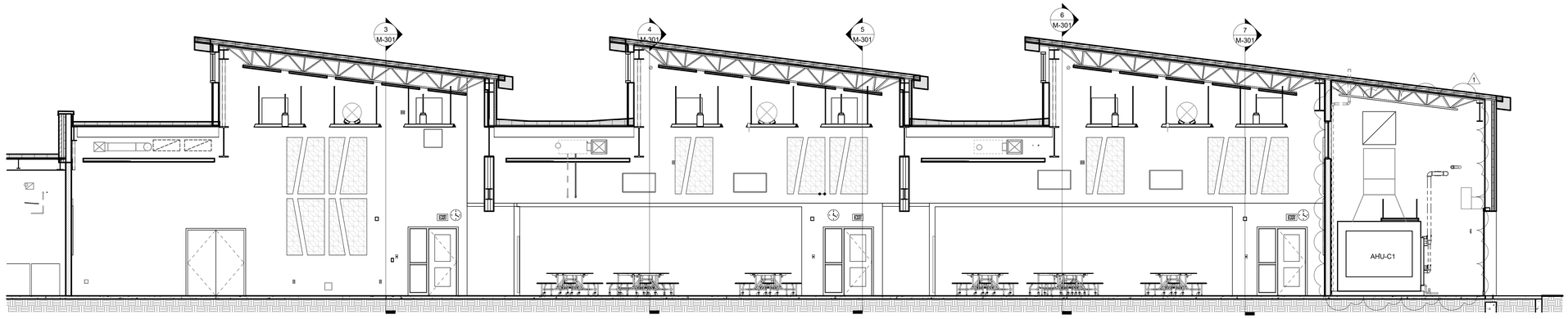
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REV. NO.	DESCRIPTION	DATE
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MECHANICAL ROOF PLAN - UNIT D

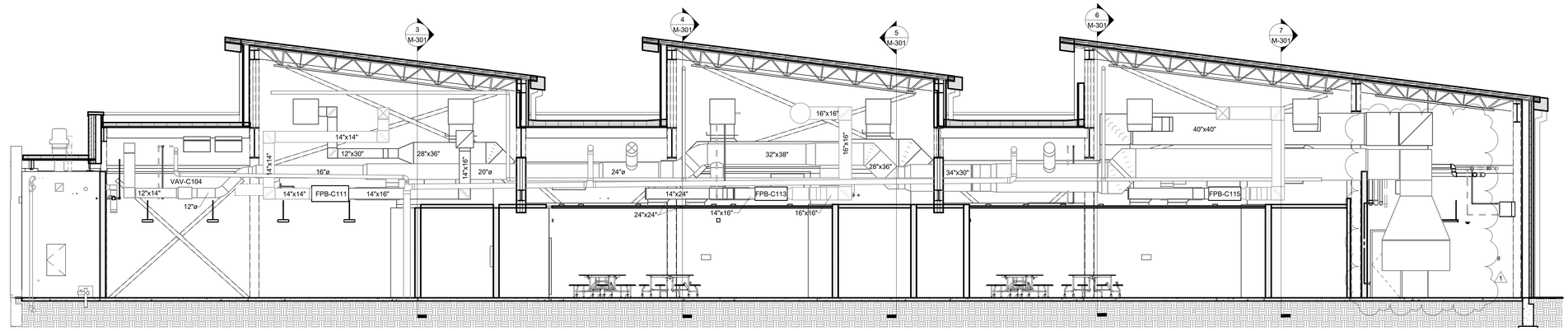
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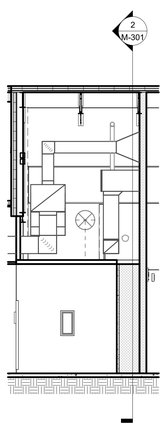
1 MECHANICAL SECTION 1

SCALE: 3/16" = 1'-0"



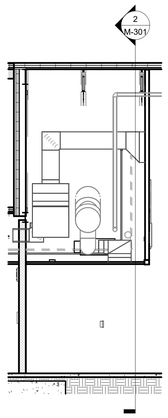
2 MECHANICAL SECTION 2

SCALE: 3/16" = 1'-0"



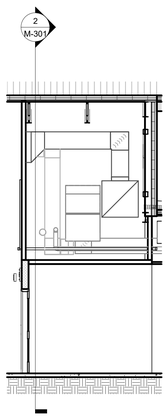
3 MECHANICAL SECTION 3

SCALE: 3/16" = 1'-0"



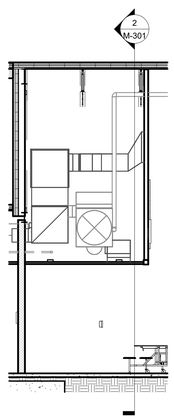
4 MECHANICAL SECTION 4

SCALE: 3/16" = 1'-0"



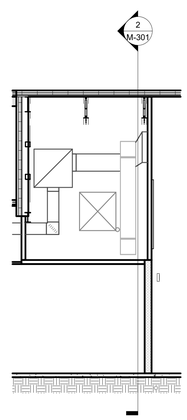
5 MECHANICAL SECTION 5

SCALE: 3/16" = 1'-0"



6 MECHANICAL SECTION 6

SCALE: 3/16" = 1'-0"



7 MECHANICAL SECTION 7

SCALE: 3/16" = 1'-0"

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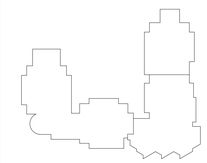
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BID DOCUMENTS

MARK Z. HOFF REGISTERED No. PE 12005001 STATE OF INDIANA PROFESSIONAL ENGINEER

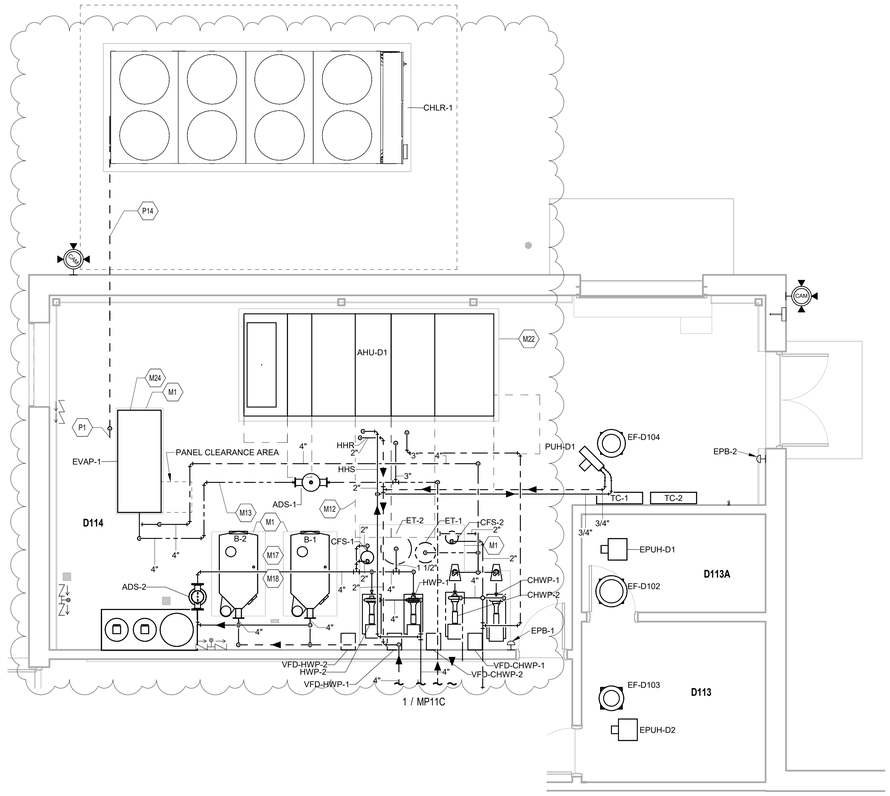
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DRAWN BY: Author
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

MECHANICAL SECTIONS

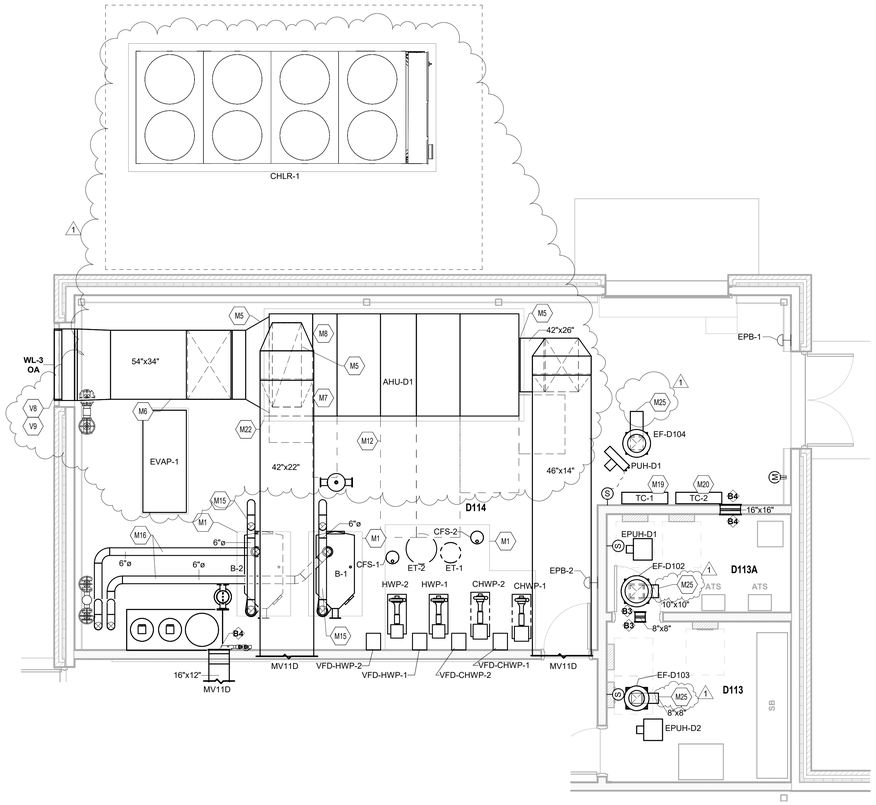
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1 ENLARGED EAST MECHANICAL ROOM PIPING PLAN

SCALE: 1/4" = 1'-0"
NOTE: SOME ELEMENTS HIDDEN FOR CLARITY



2 ENLARGED EAST MECHANICAL ROOM A VENTILATION PLAN

SCALE: 1/4" = 1'-0"
NOTE: SOME ELEMENTS HIDDEN FOR CLARITY

MECHANICAL ROOM PLAN GENERAL NOTES

A. ALL DUCTWORK, PIPING AND VALVES SHALL BE CONCEALED ABOVE THE CEILING AND WITHIN WALLS, UNLESS OTHERWISE NOTED.
B. REFER TO THE SPECIFICATIONS FOR REQUIREMENTS RELATED TO EQUIPMENT QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
C. ARRANGE DUCTWORK, PIPING, ETC. TO ALLOW FOR EASY ACCESS TO COILS, VALVES, DAMPERS AND CONTROLS. KEEP AREAS ADJACENT TO ACCESS PANELS FREE AND CLEAR OF ANY OBSTRUCTIONS.
D. SEAL DUCT PENETRATIONS THROUGH THE FLOOR AND/OR WALLS IN ACCORDANCE WITH MECHANICAL CODE AND SMACNA REQUIREMENTS. SEAL DUCT PENETRATIONS THROUGH FIRE RATED FLOORS AND/OR WALLS WITH A MATERIAL HAVING SAME FIRE RATING AS THE WALL AND/OR FLOOR.
E. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR HIS RESPECTIVE WORK FOR REPAIRING AND PATCHING TO MATCH EXISTING SURFACES, SIDEWALKS, STREETS, FLOORS, WALLS, ROOFS, CEILING AND PAVEMENT.
F. ALL RECTANGULAR SHEET METAL DUCT SIZES SHOWN ARE INSIDE FREE AREA DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
G. PROVIDE BALANCING DAMPER AT EACH DUCT BRANCH, SERVING DIFFUSER, GRILLE AND REGISTER.
H. INSTALL WALL THERMOSTATS, TEMPERATURE SENSORS, HUMIDISTATS, ETC. 44", FROM BOTTOM OF DEVICE, ABOVE THE FINISH FLOOR IN ACCORDANCE WITH ADA REQUIREMENTS.
I. COORDINATE ALL REQUIRED WALL, ROOF AND FLOOR OPENINGS (BOTH DIMENSIONS AND LOCATIONS) WITH ALL OTHER TRADES.
J. COORDINATE MECHANICAL SYSTEM INSTALLATION WITH STRUCTURE, FIRE PROTECTION AND LIGHTING LAYOUT.
K. PROVIDE ALL NECESSARY TRANSITIONS TO EQUIPMENT FROM SIZES SHOWN ON PLAN.
L. HYDRONIC SUPPLY AND RETURN PIPING SHALL BE THE SAME SIZE UNLESS OTHERWISE NOTED.
M. ALL RETURN/EXHAUST AIR DUCT ABOVE LOCKERS/SHOWER AREAS SHALL BE MADE OF ALUMINUM IN ACCORDANCE WITH SMACNA REQUIREMENTS.
N. UNLESS OTHERWISE INDICATED, ALL ABOVE CEILING SPACE(S) SHALL BE CONSIDERED PART OF THE RETURN PLENUM, THEREFORE ALL PIPE, DUCT, CONTROL DEVICES, WIRING, AND EQUIPMENT SHALL BE RATED AND ACCEPTABLE FOR INSTALLATION IN THE PLENUM SPACE.

MECHANICAL ROOM PLAN NOTES (X)

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
M1	INSTALL EQUIPMENT ON 3-1/2" HIGH CONCRETE HOUSEKEEPING PAD. COORDINATE SIZE OF HOUSEKEEPING PAD WITH EQUIPMENT TO BE PROVIDED.
M5	TRANSITION DUCTWORK AS REQUIRED TO MAKE FINAL CONNECTION TO AIR HANDLING UNIT.
M6	MECHANICAL CONTRACTOR SHALL INSTALL AN ACCESS DOOR IN DUCTWORK TO ACCESS THE AIRFLOW MEASURING STATION. INSTALL GASKETING AROUND THE DOOR FOR AIR-TIGHT INSTALLATION. PROVIDE CONTINUOUS HINGE. REINFORCE DUCTWORK AS REQUIRED.
M7	OUTSIDE AIR CONTROL DAMPERS FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED AND INSTALLED BY TEMPERATURE CONTROL CONTRACTOR.
M8	RETURN AIR CONTROL DAMPERS FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED AND INSTALLED BY TEMPERATURE CONTROL CONTRACTOR.
M12	CLEARANCE REQUIRED FOR AIR HANDLING UNIT COIL AND HEAT WHEEL PULLS.
M13	FLOW SWITCH PROVIDED BY TEMPERATURE CONTROL CONTRACTOR AND INSTALLED BY MECHANICAL CONTRACTOR. WIRING AND TERMINATIONS BY TEMPERATURE CONTROL CONTRACTOR.
M15	AL-29-4C FLUE PIPE SYSTEM FROM THE BOILER CONNECTION ROUTED UP AND TERMINATED THOUGH THE ROOF. FLUE PIPE SIZE AND INSTALLATION PER MANUFACTURERS REQUIREMENTS.
M16	SINGLE WALL STAINLESS STEEL INTAKE PIPE FROM THE BOILER CONNECTION TERMINATED THOUGH THE ROOF. INTAKE PIPE SIZE AND INSTALLATION PER MANUFACTURERS REQUIREMENTS.
M17	PRESSURE RELIEF VALVE. REFER TO BOILER MANUFACTURER FOR RECOMMENDED LOCATION. PIPE FULL SIZE TO FLOOR DRAIN. SUPPORT PIPING INDEPENDENTLY OF VALVE TO PREVENT STRESS AND TO ALLOW PROPER OPERATION.
M18	CONDENSATE DRAIN WITH TRAP PIPED FROM BOILER TO FLOOR DRAIN FULL SIZE. EACH BOILER TO BE PROVIDED WITH INDEPENDENT ACID NEUTRALIZATION BASIN. REFER TO DETAIL.
M19	APPROXIMATE LOCATION OF AIR HANDLING UNIT CONTROL PANEL. COORDINATE EXACT LOCATION WITH ALL TRADES.
M20	APPROXIMATE LOCATION OF BOILER AND CHILLER CONTROL PANELS. COORDINATE EXACT LOCATION WITH ALL TRADES.
M22	INSTALL EQUIPMENT ON 6" HIGH CONCRETE HOUSEKEEPING PAD.
M24	MECHANICAL EQUIPMENT TO BE INSULLATED PER 23 07 00.
M25	END OF DUCT OPEN TO PLENUM SPACE ABOVE CEILING. OPENING TO BE PROTECTED WITH BIRDSCREEN.
P1	APPROXIMATE CONNECTION LOCATION. COORDINATE WITH CONTRACTOR ON-SITE FOR EQUIPMENT CONNECTION LOCATION.
P14	ALL REFRIGERANT PIPING ON THE EXTERIOR OF THE BUILDING SHALL BE WRAPPED WITH INSULATION AND THEN COVERED WITH A PVC JACKET PER THE PROJECT MANUAL. PIPING IS SIZED PER MANUFACTURER RECOMMENDATIONS. PROVIDE PIPE SUPPORTS PER MANUFACTURERS RECOMMENDATIONS.
V8	PAINT AIR DEVICES TO COLOR SELECTED BY ARCHITECT.
V9	INSTALL DRIP PAN UNDER WALL LOUVER. PAN SHALL BE SEALED WATER TIGHT. DRIP PAN TO EXTEND A MINIMUM OF 6" BEYOND DUCTWORK.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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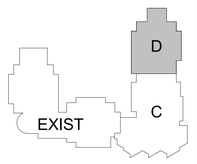
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KEY PLAN

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BID DOCUMENTS

MARK Z. HOSE
REGISTERED
No.
PE 12005101
STATE OF
INDIANA
PROFESSIONAL ENGINEER

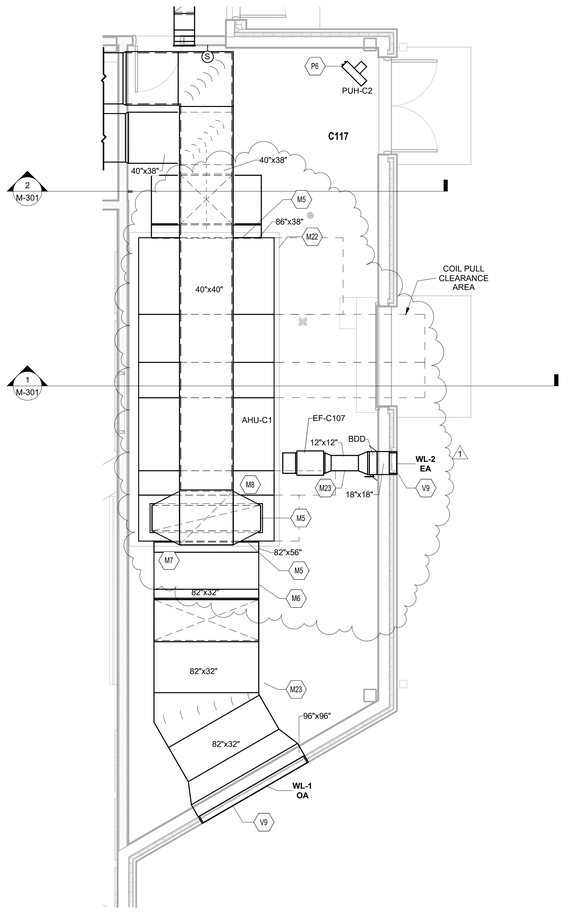
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PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

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1	ADDENDUM #2	03/26/2026

MECHANICAL ROOM

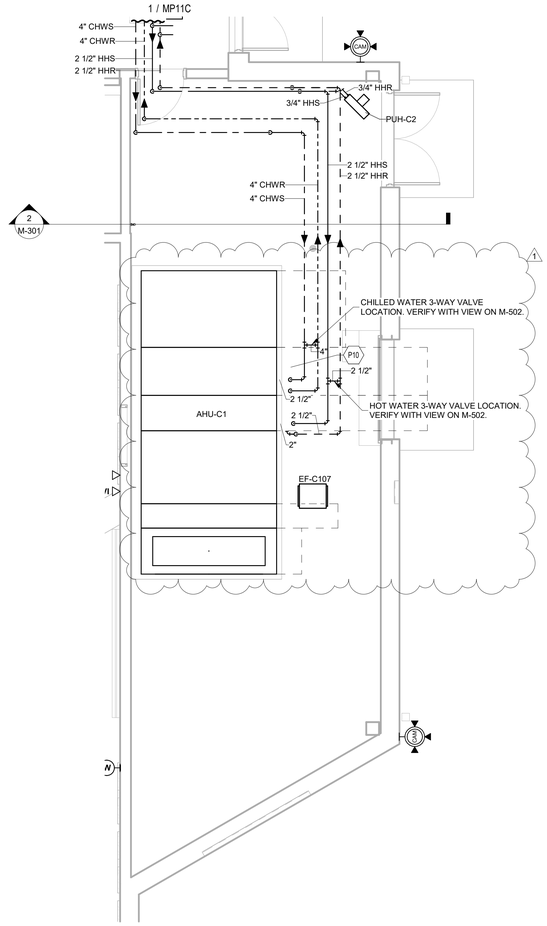
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1 ENLARGED WEST MECHANICAL ROOM B VENTILATION PLAN

SCALE: 1/4" = 1'-0"



2 ENLARGED WEST MECHANICAL ROOM B PIPING PLAN

SCALE: 1/4" = 1'-0"

MECHANICAL ROOM PLAN GENERAL NOTES

A. ALL DUCTWORK, PIPING AND VALVES SHALL BE CONCEALED ABOVE THE CEILING AND WITHIN WALLS, UNLESS OTHERWISE NOTED.
B. REFER TO THE SPECIFICATIONS FOR REQUIREMENTS RELATED TO EQUIPMENT QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
C. ARRANGE DUCTWORK, PIPING, ETC. TO ALLOW FOR EASY ACCESS TO COILS, VALVES, DAMPERS AND CONTROLS. KEEP AREAS ADJACENT TO ACCESS PANELS FREE AND CLEAR OF ANY OBSTRUCTIONS.
D. SEAL DUCT PENETRATIONS THROUGH THE FLOOR AND/OR WALLS IN ACCORDANCE WITH MECHANICAL CODE AND SMACNA REQUIREMENTS. SEAL DUCT PENETRATIONS THROUGH FIRE RATED FLOORS AND/OR WALLS WITH A MATERIAL HAVING SAME FIRE RATING AS THE WALL AND/OR FLOOR.
E. MECHANICAL CONTRACTOR IS RESPONSIBLE FOR HIS RESPECTIVE WORK FOR REPAIRING AND PATCHING TO MATCH EXISTING SURFACES, SIDEWALKS, STREETS, FLOORS, WALLS, ROOFS, CEILING AND PAVEMENT.
F. ALL RECTANGULAR SHEET METAL DUCT SIZES SHOWN ARE INSIDE FREE AREA DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
G. PROVIDE BALANCING DAMPER AT EACH DUCT BRANCH, SERVING DIFFUSER, GRILLE AND REGISTER.
H. INSTALL WALL THERMOSTATS, TEMPERATURE SENSORS, HUMIDISTATS, ETC. 44", FROM BOTTOM OF DEVICE, ABOVE THE FINISH FLOOR IN ACCORDANCE WITH ADA REQUIREMENTS.
I. COORDINATE ALL REQUIRED WALL, ROOF AND FLOOR OPENINGS (BOTH DIMENSIONS AND LOCATIONS) WITH ALL OTHER TRADES.
J. COORDINATE MECHANICAL SYSTEM INSTALLATION WITH STRUCTURE, FIRE PROTECTION AND LIGHTING LAYOUT.
K. PROVIDE ALL NECESSARY TRANSITIONS TO EQUIPMENT FROM SIZES SHOWN ON PLAN.
L. HYDRONIC SUPPLY AND RETURN PIPING SHALL BE THE SAME SIZE UNLESS OTHERWISE NOTED.
M. ALL RETURN/EXHAUST AIR DUCT ABOVE LOCKERS/SHOWER AREAS SHALL BE MADE OF ALUMINUM IN ACCORDANCE WITH SMACNA REQUIREMENTS.
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MECHANICAL ROOM PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

NO.	DESCRIPTION
M5	TRANSITION DUCTWORK AS REQUIRED TO MAKE FINAL CONNECTION TO AIR HANDLING UNIT.
M6	MECHANICAL CONTRACTOR SHALL INSTALL AN ACCESS DOOR IN DUCTWORK TO ACCESS THE AIRFLOW MEASURING STATION. INSTALL GASKETING AROUND THE DOOR FOR AIR-TIGHT INSTALLATION. PROVIDE CONTINUOUS HINGE. REINFORCE DUCTWORK AS REQUIRED.
M7	OUTSIDE AIR CONTROL DAMPERS FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED AND INSTALLED BY TEMPERATURE CONTROL CONTRACTOR.
M8	RETURN AIR CONTROL DAMPERS FACTORY MOUNTED IN AIR HANDLING UNIT. DAMPER OPERATORS PROVIDED AND INSTALLED BY TEMPERATURE CONTROL CONTRACTOR.
M22	INSTALL EQUIPMENT ON 6" HIGH CONCRETE HOUSEKEEPING PAD.
M23	WRAP DUCTWORK WITH INSULATION FROM AIR HANDLING UNIT TO WALL LOUVER.
P6	SUPPORT UNIT HEATER FROM STRUCTURE ABOVE OR ADJACENT WALL WITH SUPPLEMENTAL STEEL AND THREADED ROD WITH VIBRATION ISOLATORS AS REQUIRED.
P10	CONDENSATE PIPING TURNED DOWN TO DRAIN. END OF PIPE TO BE CUT AT 45 DEGREE ANGLE.
V9	INSTALL DRIP PAN UNDER WALL LOUVER. PAN SHALL BE SEALED WATER TIGHT. DRIP PAN TO EXTEND A MINIMUM OF 6" BEYOND DUCTWORK.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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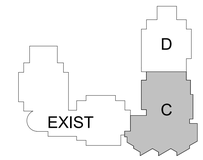
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KEY PLAN

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BID DOCUMENTS

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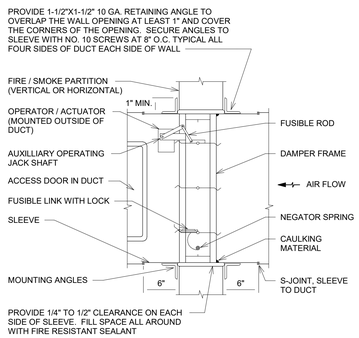
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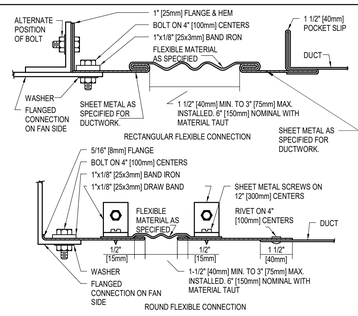
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1	ADDENDUM #2	03/26/2026

MECHANICAL ROOM

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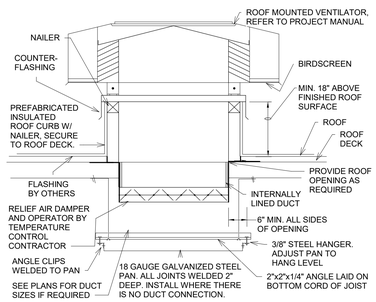
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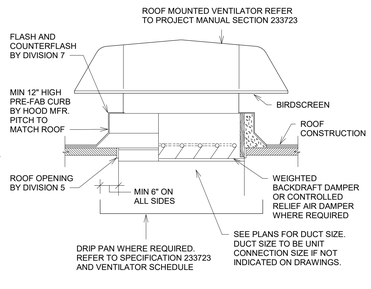
FLEXIBLE DUCT CONNECTIONS

SCALE: 3/8" = 1'-0"



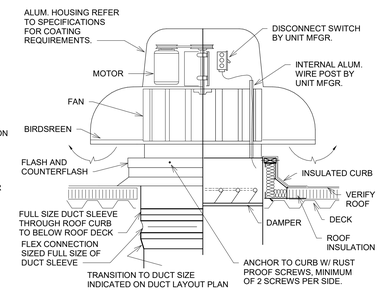
RELIEF AIR HOOD INSTALLATION DETAIL

SCALE: 1/8" = 1'-0"



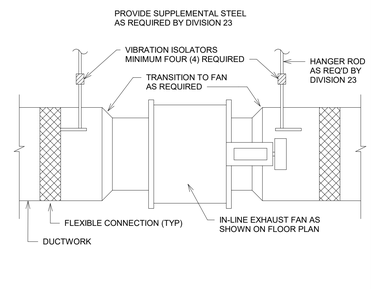
ROOF MOUNTED VENTILATOR DETAIL

SCALE: 1/8" = 1'-0"



DOWNBLAST CENTRIFUGAL FAN DETAIL

SCALE: 1/8" = 1'-0"



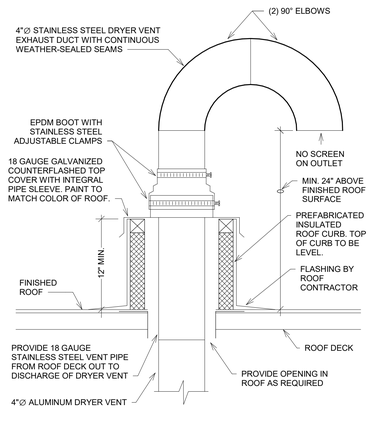
IN-LINE EXHAUST FAN MOUNTING DETAIL

SCALE: 1/8" = 1'-0"

NOTE:
THIS DETAIL ILLUSTRATES GENERAL REQUIREMENTS ONLY. THE MANUFACTURER'S INSTALLATION INSTRUCTIONS AND DETAILS (AS TESTED AND APPROVED BY U.L.) MUST BE USED FOR THE ACTUAL INSTALLATION.

FIRE/SMOKE DAMPER INSTALLATION DETAIL

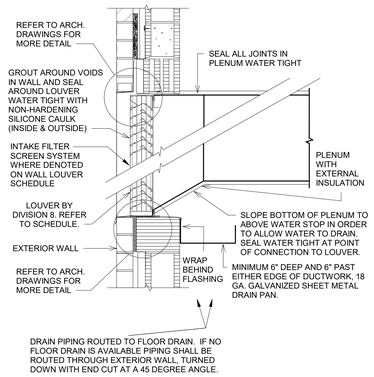
SCALE: 1/8" = 1'-0"



NOTES:
1. IF ROOF IS SLOPED, CURB TO BE SLOPED TO ALLOW FOR VERTICAL DISCHARGE

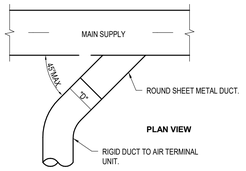
GOOSENECK DRYER VENT DETAIL

SCALE: 1/8" = 1'-0"



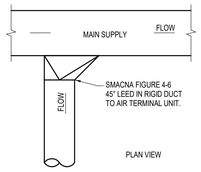
WALL LOUVER DUCT CONNECTION DETAIL

SCALE: 1/8" = 1'-0"



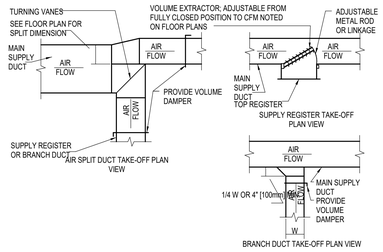
SUPPLY DUCT TAKEOFF - AIR TERMINAL UNIT

SCALE: 3/8" = 1'-0"



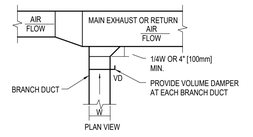
ALTERNATE SUPPLY DUCT TAKEOFF - AIR TERMINAL UNITS

SCALE: 3/8" = 1'-0"



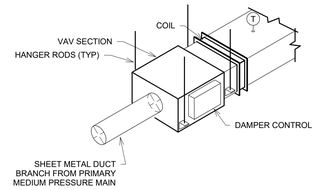
SUPPLY DUCTWORK TAKE-OFFS

SCALE: 3/8" = 1'-0"



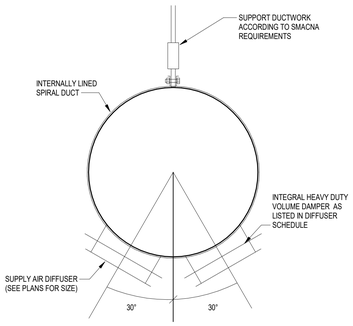
EXHAUST OR RETURN BRANCH DUCTWORK

SCALE: 3/8" = 1'-0"



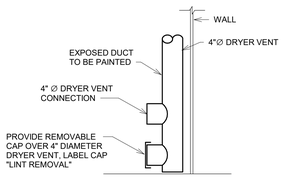
VVR TERMINAL INSTALLATION DETAIL

SCALE: 1/8" = 1'-0"



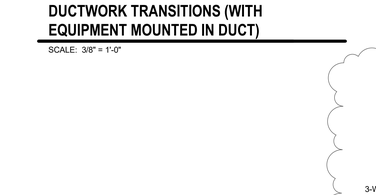
SUPPLY AIR DUCT DETAIL (DOUBLE) ANGLED

SCALE: 1/8" = 1'-0"



DRYER VENT CONNECTION (EXPOSED) DETAIL

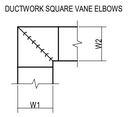
SCALE: 1/8" = 1'-0"



NOTE:
UNLESS OTHERWISE INDICATED ON PLANS, MAXIMUM ANGLES SHOWN SHALL APPLY.

DUCTWORK TRANSITIONS (WITH EQUIPMENT MOUNTED IN DUCT)

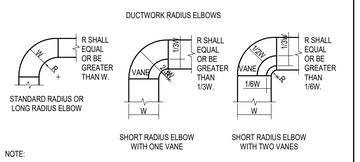
SCALE: 3/8" = 1'-0"



NOTE:
1. ALL VANE ELBOWS SHALL BE CONSTRUCTED AND INSTALLED AS DETAILED BY SMACNA.
2. WHEN W1 DOES NOT EQUAL W2, VANE SHALL BE SINGLE THICKNESS VANE TYPE REGARDLESS OF W DIMENSION.
3. ALL SINGLE THICKNESS VANES SHALL HAVE A 2" [50mm] RADIUS, 1 1/2" [40mm] MAXIMUM SPACE BETWEEN VANES AND A 3/4" [20mm] TRAILING EDGE.
4. WHEN W EQUALS W2 AND W1 IS GREATER THAN 20" [500mm] VANES SHALL BE DOUBLE VANE TYPE.

DUCTWORK SQUARE VANE ELBOWS

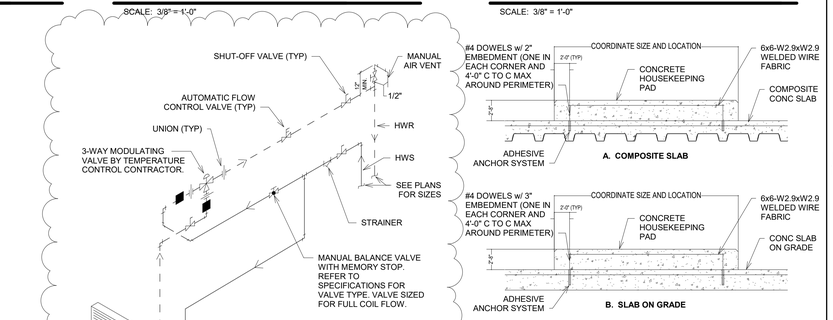
SCALE: 3/8" = 1'-0"



NOTE:
1. THE INTERIOR SURFACE OF ALL RADIUS ELBOWS SHALL BE MADE ROUND.
2. ALL STANDARD RADIUS ELBOWS CAN BE SUBSTITUTED WITH SHORT RADIUS ELBOWS. ALL SHORT RADIUS ELBOWS SHALL HAVE VANES. VANES SHALL BE CONSTRUCTED, SUPPORTED AND FASTENED AS RECOMMENDED BY SMACNA.

DUCTWORK RADIUS ELBOWS

SCALE: 3/8" = 1'-0"



NOTES:
1. INSTALL ALL PIPING TO CLEAR FILTER ACCESS AND ALL OTHER ACCESS POINTS.
2. COORDINATE NUMBER OF COILS WITH UNIT MANUFACTURER.

VAV/UH/HWC COIL 3-WAY (AUTO) PIPING DIAGRAM

SCALE: 1/8" = 1'-0"

HOUSEKEEPING PADS

SCALE: 1/8" = 1'-0"

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NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

7839 NEW AUGUSTA RD,
INDIANAPOLIS, IN 46268

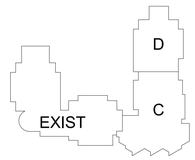
MSD OF PIKE TOWNSHIP

ARCHITECT

FANNING HOWEY

317-848-0966 WWW.FHAI.COM

350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



KEY PLAN

N

BID DOCUMENTS

MARK Z. HOSF REGISTERED No. PE 12000301 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW
DRAWN BY: CMS
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

MECHANICAL DETAILS

M-501

Autodesk Docs://Nathaniel Jones ELC - Add_Renov/R2025_MECH_223216.00.rvt
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NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

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INDIANAPOLIS, IN 46268

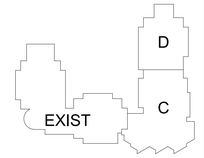
MSD OF PIKE TOWNSHIP

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KEY PLAN

N

BID DOCUMENTS



PROJECT MANAGER: PW

DRAWN BY: CMS

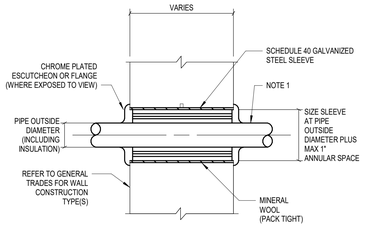
PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

MECHANICAL DETAILS

M-502

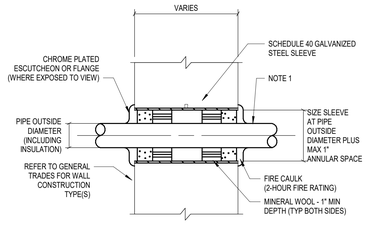


NOTES:

1. PIPE INSULATION SHALL BE CONTINUOUS THROUGH PENETRATIONS.

PIPE PENETRATION INTERIOR WALL

SCALE: 12" = 1'-0"

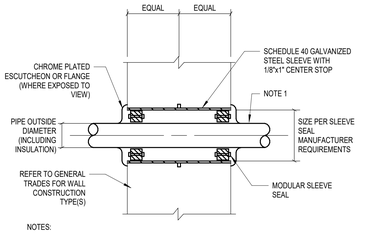


NOTES:

1. PIPE INSULATION SHALL BE CONTINUOUS THROUGH PENETRATIONS.

PIPE PENETRATION FIRE WALL

SCALE: 12" = 1'-0"

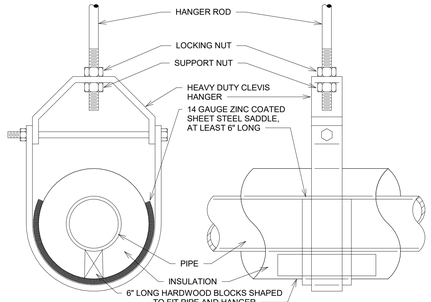


NOTES:

1. PIPE INSULATION SHALL BE CONTINUOUS THROUGH PENETRATIONS. PROVIDE RIGID THERMAL HANGAR SHIELD INSERT AT MODULAR SLEEVE SEALS.

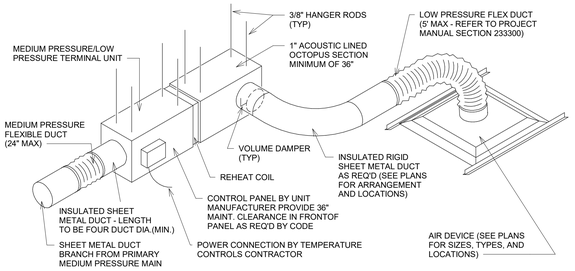
PIPE PENETRATION EXTERIOR WALL

SCALE: 12" = 1'-0"



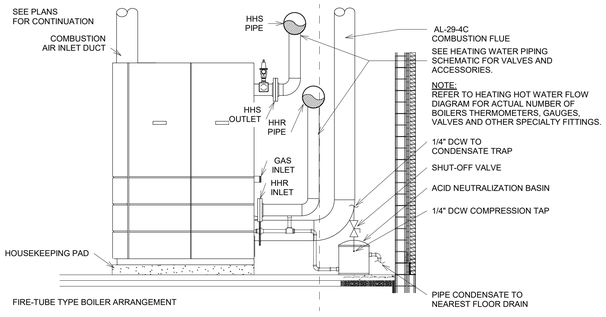
PIPE HANGER (6" AND SMALLER) DETAIL

SCALE: 1/8" = 1'-0"



TERMINAL REHEAT UNIT INSTALLATION DETAIL

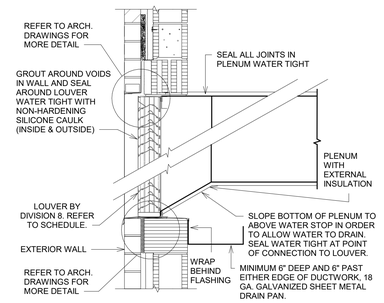
SCALE: 1/8" = 1'-0"



FIRE-TUBE TYPE BOILER ARRANGEMENT

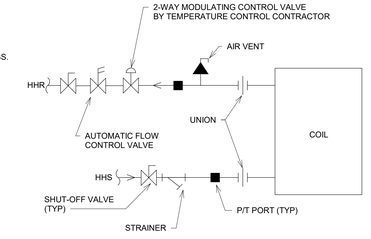
HEATING HOT WATER CONDENSING BOILER INSTALLATION DETAIL (ELEVATION)

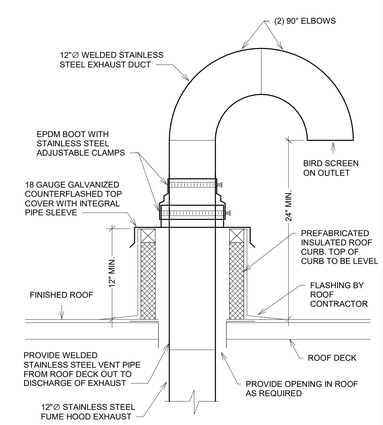
SCALE: 1/8" = 1'-0"



WALL LOUVER DUCT CONNECTION DETAIL

SCALE: 1/8" = 1'-0"

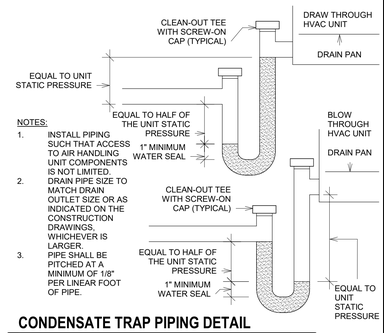




(NOTE: ROOF IS SLOPED. CURB TO BE SLOPED TO ALLOW FOR VERTICAL DISCHARGE)

GOOSENECK EXHAUST VENT DETAIL

SCALE: 1/8" = 1'-0"

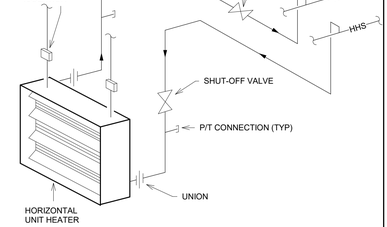


NOTES:

1. INSTALL PIPING SUCH THAT ACCESS TO AIR HANDLING UNIT COMPONENTS IS NOT LIMITED.
2. DRAIN PIPE SIZE TO MATCH DRAIN OUTLET SIZE OR AS INDICATED ON THE CONSTRUCTION DRAWINGS, WHICHEVER IS LARGER.
3. PIPE SHALL BE PITCHED AT A MINIMUM OF 1/8" PER LINEAR FOOT OF PIPE.

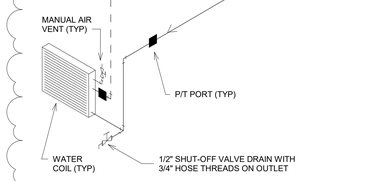
CONDENSATE TRAP PIPING DETAIL

SCALE: 1/8" = 1'-0"



PROP. UNIT HEATER PIPING DETAIL

SCALE: 1/8" = 1'-0"

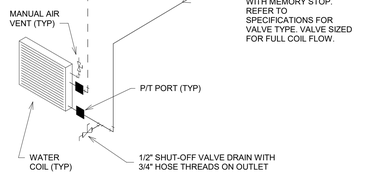


NOTES:

1. INSTALL ALL PIPING TO CLEAR FILTER ACCESS, DRIVE BELTS, AND ALL ACCESS POINTS.
2. COORDINATE NUMBER OF COILS WITH UNIT MANUFACTURER.

AHU CHW (1) COIL 3-WAY PIPING DIAGRAM (AHU-D1)

SCALE: 1/8" = 1'-0"

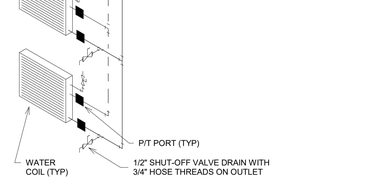


NOTES:

1. INSTALL ALL PIPING TO CLEAR FILTER ACCESS, DRIVE BELTS, AND ALL ACCESS POINTS.
2. COORDINATE NUMBER OF COILS WITH UNIT MANUFACTURER.

AHU HHW (1) COIL 3-WAY PIPING DIAGRAM (AHU-D1)

SCALE: 1/8" = 1'-0"

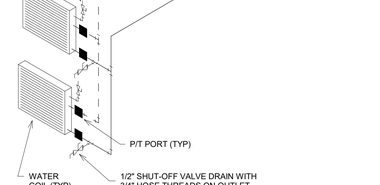


NOTES:

1. INSTALL ALL PIPING TO CLEAR FILTER ACCESS, DRIVE BELTS, AND ALL ACCESS POINTS.
2. COORDINATE NUMBER OF COILS WITH UNIT MANUFACTURER.

AHU HHW (2) COIL PIPING DIAGRAM (AHU-C1)

SCALE: 1/8" = 1'-0"



NOTES:

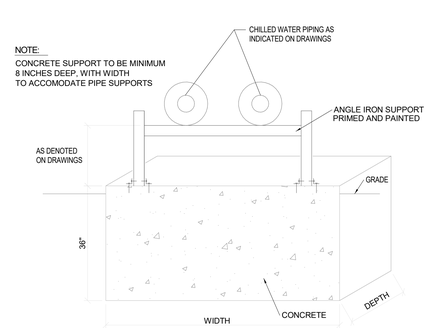
1. INSTALL ALL PIPING TO CLEAR FILTER ACCESS, DRIVE BELTS, AND ALL ACCESS POINTS.
2. COORDINATE NUMBER OF COILS WITH UNIT MANUFACTURER.

AHU CHW (2) COIL 3-WAY PIPING DIAGRAM (AHU-C1)

SCALE: 1/8" = 1'-0"

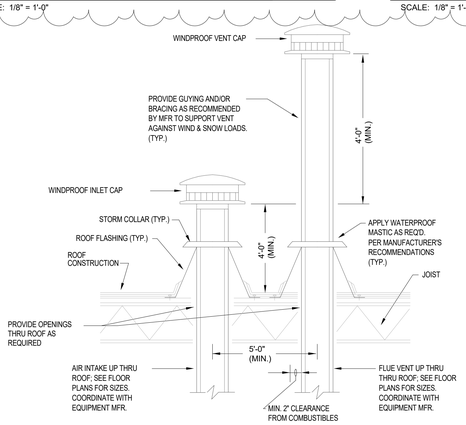
TERMINAL COIL PIPING DIAGRAM

SCALE: 1/8" = 1'-0"



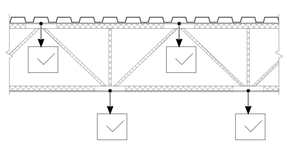
OUTDOOR PIPING SUPPORT DETAIL

NO SCALE



BOILER FLUE INSTALLATION

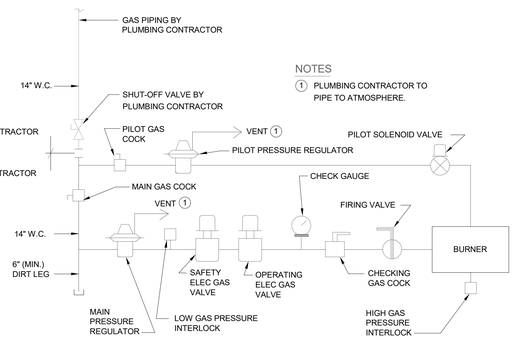
NO SCALE



1. ALL LOADS IN EXCESS OF 100 LBS MAY ONLY BE HUNG FROM THE STEEL JOISTS AT THE LOCATIONS INDICATED WITH A CHECK MARK.
2. LOADS IN EXCESS OF 100 LBS ARE NOT TO BE HUNG FROM THE CROSS-HATCHED REGIONS UNLESS ADDITIONAL WEB REINFORCING MEMBERS ARE INSTALLED PER THE STRUCTURAL DRAWINGS.
3. THIS SECTION APPLIES TO LOADS HUNG FROM BOTH NEW JOISTS AND FROM EXISTING JOISTS.
4. SPACE HANGERS OUT SO THAT NOT ALL HANGERS ARE ATTACHED TO THE SAME JOIST.

ACCEPTABLE LOCATION TO HANG LOADS FROM STEEL JOISTS

NO SCALE



BOILER GAS TRAIN PIPING DIAGRAM

(FM APPROVED) NO SCALE

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23.73.13 - AIR HANDLING UNIT SCHEDULE

IDENTITY			SUPPLY FAN	SUPPLY FAN						ELECTRICAL			COOLING									CHILLED WATER COIL				HEATING						HOT WATER COIL				PREFILTER	FILTER	UNIT SIZE (IN)			OPER.	
								MOTOR																																		
MARK	MFG	AREA SERVED	EQUIPMENT NOMINAL (CFM)	MIN OSA (CFM)	TOTAL SP (IN-WG)	FAN RPM	DRIVE	BHP	HP	VFD	VOLT.	PH	FLA	TOT. CAP. (BTU/H)	SENS. CAP. (BTU/H)	EAT DB (°F)	EAT WB (°F)	LAT DB (°F)	LAT WB (°F)	ROWS	FPI	APD (IN-WG)	FACE VEL. (FPM)	EWT (°F)	LWT (°F)	WPD (FT-WG)	FLOW (GPM)	CAP. (BTU/H)	EAT DB (°F)	LAT DB (°F)	ROWS	APD (IN-WG)	FACE VEL. (FPM)	EWT (°F)	LWT (°F)	WPD (FT-WG)	FLOW (GPM)	MERV	MERV	L	W	H	WT (LB)	NOTES
AHU-C1	TRANE	C-BLOCK/CAFETERIA	22310	10040	6.69	21970	DIRECT	35.3	20x2	Yes	460 V	3	55.30	1025390	684260	82	68	54	54	6	9	0.62	490	42	57	15.76	134.0	1096040	40	85	2	0.18	490	140	100	2.83	54.9	8	13	237	106	89	8736	SEE NOTES
AHU-D1	TRANE	D-BLOCK	9900	4455	5.80	1916	DIRECT	13.6	15	Yes	460 V	3	22.30	467750	314560	82	68	53	53	6	10	0.67	484	42	57	15.22	62.2	486370	40	85	2	0.17	476	140	100	5.88	24.4	8	13	191	80	53	3646	SEE NOTES

NOTES:
1. REFER TO PROJECT MANUAL SECTION 237313 FOR ADDITIONAL REQUIREMENTS.
2. REFER TO PLANS & SCHEMATIC SHEETS FOR UNIT LAYOUT DETAILS.
3. PROVIDE FACTORY MOUNTED CONVENIENCE OUTLETS AND INTERNAL LIGHTS AT EACH ACCESS DOOR. PROVIDE CONVENIENCE OUTLET AND LIGHTS ON SEPARATE CIRCUIT.
4. MAXIMUM COIL FACE VELOCITY SHALL BE 500 FPM.
5. MAXIMUM PRE FILTER AND PRIMARY FILTER FACE VELOCITY SHALL BE 500 FPM.
6. INCLUDE FACTORY MOUNTED RETURN AND OUTSIDE AIR DAMPERS.
7. HEATING WATER COIL SHALL BE IN A PREHEAT POSITION.
8. FACTORY MOUNTED VARIABLE FREQUENCY CONTROLLER (VFC) SHALL BE PROVIDED ON SUPPLY FAN.
9. COOLING COIL SHALL BE SELECTED WITH 100% WATER.
10. PROVIDE FACTORY MOUNTED DISCONNECT
11. SINGLE POINT ELECTRICAL CONNECTION TO UNITS.
12. SUMMER DESIGN CONDITIONS: INDOOR 74°db, 50% RH, OUTDOOR 91.3°db/75°wb
13. WINTER DESIGN CONDITIONS: INDOOR 70°db, OUTDOOR 2.6°db
14. UNIT SHALL INCLUDE FACTORY MOUNTED BELMOUTH FITTINGS.
15. PROVIDE WITH SCCR RATING OF 65KAIC.

23.37.13 - DIFFUSERS, REGISTERS, AND GRILLES SCHEDULE

IDENTITY DATA									
MARK	DESCRIPTION	MANUFACTURER	MODEL	NECK SIZE	FACE SIZE (W x L)	MAX CORE/ NECK VELO.	AIR FLOW MAX	MAX N.C.	FRAME/ MOUNTING
A1	STEEL PLAQUE FACE DIFFUSER	TITUS	OMNI	4"ø	12" x 12"	600 FPM	50	20	REFER TO REFLECTED CEILING PLAN
A2	STEEL PLAQUE FACE DIFFUSER	TITUS	OMNI	6"ø	24" x 24"	600 FPM	125	20	REFER TO REFLECTED CEILING PLAN
A3	STEEL PLAQUE FACE DIFFUSER	TITUS	OMNI	8"ø	24" x 24"	700 FPM	250	20	REFER TO REFLECTED CEILING PLAN
A4	STEEL PLAQUE FACE DIFFUSER	TITUS	OMNI	10"ø	24" x 24"	750 FPM	400	20	REFER TO REFLECTED CEILING PLAN
B1	ALUMINUM LOUVERED RETURN	TITUS	350FL	32"x32"	32" x 32"	400 FPM	2,500	20	REFER TO REFLECTED CEILING PLAN
B2	ALUMINUM LOUVERED RETURN	TITUS	350FL	22"x22"	22" x 22"	400 FPM	1,500	20	REFER TO REFLECTED CEILING PLAN
B3	ALUMINUM LOUVERED RETURN	TITUS	350FL	8"x8"	8" x 8"	500 FPM	185	20	SURFACE
B4	ALUMINUM LOUVERED RETURN	TITUS	350FL	16"x16"	16" x 16"	500 FPM	800	20	SURFACE
B5	ALUMINUM LOUVERED RETURN	TITUS	350FL	18"x12"	18" x 12"	500 FPM	675	20	SURFACE
B6	ALUMINUM LOUVERED RETURN	TITUS	350FL	14"x14"	14" x 14"	500 FPM	610	20	SURFACE
C1	ALUMINUM EGGCRATE	TITUS	50F	8"x8"	8" x 8"	400 FPM	150	20	REFER TO REFLECTED CEILING PLAN
C2	ALUMINUM EGGCRATE	TITUS	50F	10"x10"	10" x 10"	400 FPM	225	20	REFER TO REFLECTED CEILING PLAN
C3	ALUMINUM EGGCRATE	TITUS	50F	12"x12"	12" x 12"	400 FPM	350	20	REFER TO REFLECTED CEILING PLAN
C5	ALUMINUM EGGCRATE	TITUS	50F	16"x16"	16" x 16"	400 FPM	650	20	REFER TO REFLECTED CEILING PLAN
C6	ALUMINUM EGGCRATE	TITUS	50F	24"x24"	24" x 24"	400 FPM	1,500	20	REFER TO REFLECTED CEILING PLAN
D1	STEEL DOUBLE DEFLECTION SUPPLY GRILLE	TITUS	300RS	18"x14"	18" x 14"	500 FPM	795	20	REFER TO REFLECTED CEILING PLAN
E1	HIGH CAPACITY DRUM LOUVER	TITUS	S-DL	18"x6"	18" x 6"	500 FPM	333	20	DUCT
F1	Architectural Linear Diffuser	Titus HVAC	FL-10	-	3"x48"		100	20	HIGH-THROW W/INSULATED PLENUM - 1" SLOT WIDTH, TOTAL 1 SLOT, SUSPENDED
F2	Architectural Linear Diffuser	Titus HVAC	FL-20	-	9"x48"		290	21	HIGH-THROW W/INSULATED PLENUM - 2" SLOT WIDTH, TOTAL 2 SLOTS, SURFACE MOUNTED
F3	Architectural Linear Diffuser	Titus HVAC	FL-30	-	13"x48"		510	20	HIGH-THROW W/INSULATED PLENUM - 3" SLOT WIDTH, TOTAL 2 SLOTS, SURFACE MOUNTED

23.34.23 - HVAC POWER VENTILATOR SCHEDULE

IDENTITY DATA					LOCATION			DESCRIPTION	PERFORMANCE DATA				ELECTRICAL DATA						
MARK	MANUFACTURER	MODEL	WEIGHT (LBS)	TYPE	LOCATION	AREA SERVED	SYSTEM SERVED	DRIVE	CFM	RPM	ESP (IN-WG)	MOTOR HP	ELECTRICAL	VOLTS	PH	FREQ	DISCONNECT	CONTROLS	NOTES
EF-C101	Greenheck	G-100-VG	54	CENTRIFUGAL DOWNBLAST	ROOF C	C-BLOCK/CAFETERIA	RESTROOM EXHAUST	DIRECT	675	1141	0.39	0.25	115 V-1-60	115 V	1	60	YES	A	1,2,3,4,5
EF-C102	Greenheck	G-070-VG	36	CENTRIFUGAL DOWNBLAST	ROOF C	C-BLOCK/CAFETERIA	CUSTODIAL EXHAUST	DIRECT	220	1557	0.33	0.06	115 V-1-60	115 V	1	60	YES	C	1,2,3,4,5
EF-C103	Greenheck	G-099-VG	54	CENTRIFUGAL DOWNBLAST	ROOF C	C-BLOCK/CAFETERIA	ELECTRICAL EXHAUST	DIRECT	490	626	0.23	0.25	115 V-1-60	115 V	1	60	YES	B	1,2,3,4,5
EF-C104	Greenheck	G-099-VG	54	CENTRIFUGAL DOWNBLAST	ROOF C	C-BLOCK/CAFETERIA	RESTROOM EXHAUST	DIRECT	750	1442	0.58	0.25	115 V-1-60	115 V	1	60	YES	A	1,2,3,4,5
EF-C105	Greenheck	G-080-VG	40	CENTRIFUGAL DOWNBLAST	ROOF C	C-BLOCK/CAFETERIA	RESTROOM EXHAUST	DIRECT	225	1266	0.29	0.1	115 V-1-60	115 V	1	60	YES	A	1,2,3,4,5
EF-C106	Greenheck	G-099-VG	54	CENTRIFUGAL DOWNBLAST	ROOF C	C-BLOCK/CAFETERIA	RESTROOM EXHAUST	DIRECT	545	1072	0.33	0.25	115 V-1-60	115 V	1	60	YES	A	1,2,3,4,5
EF-C107	Greenheck	SQ-120-VG	61	INLINE	C117	C-BLOCK/CAFETERIA	MECHANICAL EXHAUST	DIRECT	550	776	0.25	0.5	115 V-1-60	115 V	1	60	YES	B	1,2,3,5
EF-D101	Greenheck	G-140-VG	68	CENTRIFUGAL DOWNBLAST	ROOF D	D-BLOCK	RESTROOM EXHAUST	DIRECT	1,200	1073	0.63	0.5	120 V-1-60	120 V	1	60	YES	A	1,2,3,4,5
EF-D102	Greenheck	G-099-VG	54	CENTRIFUGAL DOWNBLAST	ROOF D	D-BLOCK	ELECTRICAL EXHAUST	DIRECT	490	916	0.22	0.25	115 V-1-60	115 V	1	60	YES	B	1,2,3,4,5
EF-D103	Greenheck	G-070-VG	36	CENTRIFUGAL DOWNBLAST	ROOF D	D-BLOCK	ELECTRICAL EXHAUST	DIRECT	240	1557	0.3	0.06	115 V-1-60	115 V	1	60	YES	B	1,2,3,4,5
EF-D104	Greenheck	G-090-E	54	CENTRIFUGAL DOWNBLAST	ROOF D	D-BLOCK	MECHANICAL EXHAUST	DIRECT	450	1315	0.29	0.1	115 V-1-60	115 V	1	60	YES	B	1,2,3,4,5

NOTES:
1. INCLUDE FACTORY MOUNTED DISCONNECT SWITCH.
2. INCLUDE BACKDRAFT DAMPER.
3. REFER TO SPECIFICATION SECTION 233423 FOR ADDITIONAL REQUIREMENTS.
4. MOUNT ON 12" HIGH ROOF CURB, UNLESS OTHERWISE NOTED.
5. INCLUDE FACTORY MOUNTED SPEED CONTROLLER.

NOTES:
- A AUTOMATIC OCCUPIED OPERATION BY LOCAL TEMPERATURE CONTROL ZONE
- B AUTOMATIC OPERATION BY REVERSE-ACTING THERMOSTAT
- C 24 HOUR CONTINUOUS OPERATION.

23.36.00 - TERMINAL UNIT (VARIABLE VOLUME) SCHEDULE

IDENTITY DATA			AIRFLOW				HEATING									UNIT		
MARK	MODEL	INLET SIZE	COOLING MAX	MIN FLOW	HEATING MAX	INLET APD (IN-WG)	CAP. (BTU/H)	EAT (°F)	LAT (°F)	EWT (°F)	LWT (°F)	COIL APD (IN-WG)	WPD (FT-WG)	FLOW (GPM)	ROWS	CONTROLS	WT (LB)	NOTES
VAV-C101	TSS	14"	900	450	900	0.68	41.38	55	95	140	108	0.12	0.21	2.7	3	SDC-FL110	56	SEE NOTES
VAV-C102	TSS	10"	400	200	400	0.62	20.29	55	95	140	111	0.10	0.29	1.4	3	SDC-FL110	37	SEE NOTES
VAV-C103	TSS	12"	1200	600	1200	1.12	56.87	55	95	140	113	0.48	1.17	4.3	4	SDC-FL110	50	SEE NOTES
VAV-C104	TSS	12"	870	435	870	0.93	40.11	55	95	140	113	0.21	1.02	3.0	3	SDC-FL110	44	SEE NOTES
VAV-C105	TSS	14"	1520	760	1520	1.1	67.87	55	95	140	96	0.38	0.31	4.5	4	SDC-FL110	65	SEE NOTES
VAV-C106	TSS	14"	1520	760	1520	1.19	67.87	55	95	140	96	0.35	0.31	4.5	4	SDC-FL110	65	SEE NOTES
VAV-D101	TSS	14"	900	450	900	0.78	41.38	55	95	140	108	0.13	0.21	2.7	3	SDC-FL110	56	SEE NOTES

NOTES:
1. REFER TO SPECIFICATION SECTION 233600 FOR ADDITIONAL REQUIREMENTS.
2. UNIT SELECTION MUST ALLOW FOR A MINIMUM 0F 0.50" DOWNSTREAM STATIC PRESSURE.
3. PROVIDE FACTORY MOUNTED DISCONNECT SWITCH.
4. UNITS TO BE PROVIDED WITH FACTORY MOUNTED CONTROL TRANSFORMER FROM 277/1 VOLT TO 24 VOLT. COORDINATE ALL REQUIREMENTS WITH ELECTRICAL CONTRACTOR.
5. NOISE LEVELS NOT TO EXCEED 20 NC.

23.36.00 - TERMINAL UNIT (FAN-POWERED) SCHEDULE

IDENTITY			PRIMARY AIR (CFM)		FAN					SOUND		ELECTRICAL						HEATING									UNIT	
										NC																		
MARK	MODEL	SIZE	MAX FLOW	MIN FLOW	MAX FLOW (CFM)	ESP (IN-WG)	QTY	PWR (HP)	INLET APD (IN-WG)	RAD	DISCH	UNIT POWER (W)	VOLT	FREQ (HZ)	PH	MCA (A)	MOCP (A)	CAP. (BTU/H)	EAT (°F)	LAT (°F)	DESCRIPTION	EWT (°F)	LWT (°F)	APD (IN-WG)	WPD (FT-WG)	FLOW (GPM)	ROWS	WT (LB)	NOTES
FPB-C101	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.44	29	25	246	277	60	1	4.50	15	42.32	61.5	95.00	HOT WATER	140	104	0.35	1.30	2.4	3	225	SEE NOTES
FPB-C102	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.34	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-C104	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.5	29	25	246	277	60	1	4.50	15	42.32	61.5	95.00	HOT WATER	140	104	0.35	1.30	2.4	3	225	SEE NOTES
FPB-C105	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.38	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-C106	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.36	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-C107	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.29	29	25	246	277	60	1	4.50	15	42.32	61.5	95.00	HOT WATER	140	104	0.35	1.30	2.4	3	225	SEE NOTES
FPB-C108	TCSQ	1235E	2350	1175	2350	0.25	1	1/2	0.24	32	26	551	277	60	1	6.53	15	85.82	61.5	95.00	HOT WATER	140	104	0.26	1.02	4.1	3	297	SEE NOTES
FPB-C111	TCSQ	1220E	1800	900	1800	0.25	1	3/4	0.51	36	26	620	277	60	1	6.50	15	67.95	61.5	95.00	HOT WATER	140	112	0.40	0.90	4.9	3	249	SEE NOTES
FPB-C113	TCSQ	1235E	2500	1250	2500	0.25	1	1/2	0.54	34	28	643	277	60	1	6.53	15	67.95	61.5	95.00	HOT WATER	140	97	0.29	1.14	4.3	3	297	SEE NOTES
FPB-C115	TCSQ	1235E	2500	1250	2500	0.25	1	1/2	0.54	34	28	643	277	60	1	6.53	15	67.95	61.5	95.00	HOT WATER	140	97	0.29	1.14	4.3	3	297	SEE NOTES
FPB-D101	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.3	29	25	246	277	60	1	4.50	15	42.32	61.5	95.00	HOT WATER	140	97	0.35	1.30	2.4	3	225	SEE NOTES
FPB-D102	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.45	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-D103	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.34	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-D104	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.53	29	25	246	277	60	1	4.50	15	49.71	55.0	95.00	HOT WATER	140	111	0.35	0.89	3.6	3	225	SEE NOTES
FPB-D105	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.4	29	25	246	277	60	1	4.50	15	42.32	61.5	95.00	HOT WATER	140	104	0.35	1.30	2.4	3	225	SEE NOTES
FPB-D106	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.41	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-D107	TCSQ	1015E	1100	550	1100	0.25	1	1/2	0.39	29	24	228	277	60	1	4.50	15	41.14	61.5	95.00	HOT WATER	140	104	0.32	1.26	2.3	3	225	SEE NOTES
FPB-D108	TCSQ	1015E	1150	575	1150	0.25	1	1/2	0.25	29	25	246	277	60	1	4.50	15	42.32	61.5	95.00	HOT WATER	140	104	0.35	1.30	2.4	3	225	SEE NOTES

NOTES:
1. REFER TO SPECIFICATION SECTION 233600.
2. UNIT FAN SELECTION MUST ALLOW FOR A MINIMUM OF 0.50" DOWNSTREAM STATIC PRESSURE.
3. UNITS TO BE PROVIDED WITH FACTORY MOUNTED CONTROL TRANSFORMER FROM 277/1 VOLT TO 24 VOLT. COORDINATE ALL REQUIREMENTS WITH ELECTRICAL CONTRACTOR.
4. UNITS 2,000 CFM AND OVER TO HAVE SMOKE DETECTORS PROVIDED BY DIVISION 26. COORDINATE SIZE AND LOCATION WITH DIVISION 26 CONTRACTOR.
5. PROVIDE WITH FACTORY MOUNTED DISCONNECT

23.34.33 - HEATED ELECTRIC AIR CURTAIN SCHEDULE

IDENTITY DATA					LOCATION		FAN DATA				HEATING PERFORMANCE				
MARK	MFG	MODEL	WEIGHT (LBS)	TYPE	# NAME	AREA SERVED	CFM	DRIVE	QTY	HP	HEAT SOURCE	CAPACITY (KW) (BTUH)	EAT (°F)	LAT (°F)	ELECTRICAL DATA
AFC-101	Mars Air, Inc	STD284-2EHN-OB	205	HOT WATER HEATED AIR CURTAIN	C103E KITCHEN VESTIBULE	C-BLOCK/CAFETERIA	2,300	DIRECT	2	0.5	ELECTRIC	24	60	92.8	460 V-3-60

23.37.23 - HVAC GRAVITY VENTILATOR SCHEDULE

IDENTITY DATA								
MARK	MANUFACTURER	MODEL	TYPE	AREA SERVED	CFM	MAX CORE VELOCITY (FPM)	THROAT SIZE W	THROAT SIZE L	WEIGHT (LBS)	NOTES
RTV-C1	Greenheck	FGR	RELIEF	C-BLOCK/CAFETERIA	14410	741	56"	50"	302	SEE NOTES
RTV-C2	Greenheck	FGR	RELIEF	C-BLOCK/CAFETERIA	7650	736	34"	44"	169	SEE NOTES
RTV-D2	Greenheck	FGR	RELIEF	D-BLOCK	9650	718	44"	44"	222	SEE NOTES

NOTE:
1. REFER TO SPECIFICATION SECTION 233723.
2. TEMPERATURE CONTROL CONTRACTOR TO PROVIDE RELIEF CONTROL DAMPER FOR ALL ROOFTOP VENTILATORS UNLESS NOTED OTHERWISE.
3. DRIP PAN TO EXTEND A MINIMUM OF 6" ON EACH SIDE OF THE HOOD THROAT.
4. PROVIDE BACKDRAFT DAMPER.
5. PROVIDE HOODS WITH A HINGED BASE.
6. HOODS TO BE MOUNTED ON 18" HIGH ROOF CURB.

NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

7839 NEW AUGUSTA RD, INDIANAPOLIS, IN 46268

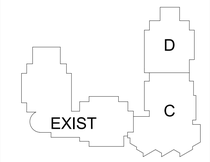
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KEY PLAN

N

BID DOCUMENTS



PROJECT MANAGER: PW

DRAWN BY: CMS

PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 03-26-2026

REV. NO.	DESCRIPTION	DATE
1	ADDENDUM #2	03/26/2026

MECHANICAL SCHEDULES

M-601

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23.21.13 - EXPANSION TANK SCHEDULE

IDENTITY DATA				LOCATION		APPROX. NEW SYSTEM VOLUME (GAL.)	SYSTEM TEMP. RANGE		PRV FILL PRESSURE AT TANK (PSIG)	MAX. OPERATING PRESSURE (PSIG)		MIN. TANK VOLUME (GAL)	WEIGHT (LBS)	
MARK	MANUFACTURER	MODEL	TYPE	# NAME	SYSTEM		MIN	MAX		RELIEF VALVE	AT EXP. TANK			NOTES
ET-1	Bell & Gossett	D40	EXPANSION TANK	D123 MECHANICAL	CHILLED WATER	619	40	90	15	30	22	25	292	SEE NOTES
ET-2	Bell & Gossett	D120	EXPANSION TANK	D123 MECHANICAL	HOT WATER	789	40	160	15	30	24	70	842	SEE NOTES

NOTES
1 REFER TO SPECIFICATION 232113.
2 EXPANSION TANKS SHALL BE SELECTED WITH 100% WATER.

23.21.23 - HYDRONIC PUMP SCHEDULE

IDENTITY DATA					LOCATION		PERFORMANCE DATA							
MARK	MANUFACTURER	MODEL	WEIGHT (LBS)	TYPE	# NAME	SYSTEM SERVED	FLOW RATE (GPM)	HEAD (ftH20)	NPSH	BHP	HP	PUMP η (%)	ELECTRICAL	NOTES
CHWP-1	Bell & Gossett	1.5 AD 213T-S	190	Base Mounted End Suction High Efficiency Pump	D123 MECHANICAL	CHILLED WATER	200	90	10	6.4	10	69.1	460 V-3-60	1,2,3,4,5
CHWP-2	Bell & Gossett	1.5 AD 213T-S	190	Base Mounted End Suction High Efficiency Pump	D123 MECHANICAL	CHILLED WATER	200	90	10	6.4	10	69.1	460 V-3-60	1,2,3,4,5
HWP-1	Bell & Gossett	1.5 BC 184T-S	140	Base Mounted End Suction High Efficiency Pump	D123 MECHANICAL	HEATING HOT WATER	130	70	8	3.7	5	60.8	460 V-3-60	1,2,3,4,5
HWP-2	Bell & Gossett	1.5 BC 184T-S	140	Base Mounted End Suction High Efficiency Pump	D123 MECHANICAL	HEATING HOT WATER	130	70	8	3.7	5	60.8	460 V-3-60	1,2,3,4,5

NOTES:
1 SINGLE POINT POWER CONNECTION, 460/3. PUMP DISCONNECT AND WIRING BETWEEN PUMP AND VFC BY DIVISION 26.
2 MOUNT ON 3-1/2" CONCRETE HOUSEKEEPING PAD.
3 REFER TO PROJECT MANUAL SECTION 232123.
4 PUMP CONTROLLED BY VARIABLE FREQUENCY CONTROLLER.
5 PUMPS WILL OPERATE LEAD/STANDBY (N+1).

23.81.26 - SPLIT SYSTEM AIR CONDITIONER SCHEDULE

IDENTITY			ELECTRICAL			FAN MOTOR OUTPUT WATTS	ELECTRICAL MOCP	EER	ELECTRICAL SCCR	EVAPORATIVE COOLING UNIT SCHEDULE	COOLING						UNIT SIZE (IN)			
										SUPPLY FAN	EVAPORATOR COIL				COMPRESSOR					
MARK	MFG	MODEL	VOLT.	PH	HZ					SYSTEM DEMAND (CFM)	TOT. CAP. (BTU/H)	EAT DB (°F)	EAT WB (°F)	LAT DB (°F)	LAT WB (°F)	REFRIG.	TYPE	W	D	H	NOTES
ACCU-C1	Mitsubishi Electric	PUY-AK12NL	208 V	1	60 Hz	51	27.00 A	14.8	5 kA	1590	12000	95.0	0.0	0.0	-459.7	454B	ROTORY	35.00	12.00	25.00	SEE NOTES
SSCU-C1	Mitsubishi Electric	PKA-AL12NL	208 V	1	60 Hz	30				215, 255, 320, 375	12000	90.0	73.0	69.0	59.0	454B		36.00	10.00	12.00	SEE NOTES

NOTES:
1 WALL MOUNTED UNIT.
2 ELECTRICAL SERVICE TO BE SUPPLIED TO EACH UNIT BY ELECTRICAL CONTRACTOR.
3 PROVIDE QUICK CONNECTS AT INDOOR UNIT.
4 UNIT MANUFACTURER SHALL PROVIDE REQUIRED HANGING BRACKETS TO PROPERLY SUPPORT UNIT.
5 LIQUID REFRIGERANT LINES TO BE COMPLETE WITH SERVICE BALL VALVES PER CIRCUIT.
6 ALL REFRIGERANT LINES TO BE INSULATED FROM OUTDOOR UNIT TO INDOOR TERMINAL UNIT.
7 UNIT PROVIDED WITH DECORATIVE PANEL
8 REFRIGERANT CONTROL UNIT TO BE PROVIDED FOR INDOOR UNIT. UNIT TO BE INSTALLED AND PROVIDED WITH ELECTRICAL SERVICE PER MANUFACTURERS REQUIREMENTS.
9 UNIT MANUFACTURER TO PROVIDE WALL MOUNTED THEROSTAT.
10 INSTALL UNIT PER MANUFACTURERS REQUIREMENTS.
11 OUTDOOR UNIT TO INCLUDE CASE HEATER.
12 OUTDOOR UNIT TO BE PLACED AT GROUND LEVEL ON 4" CONCRETE PAD.

23.52.00 - HEATING BOILER SCHEDULE

IDENTITY DATA					LOCATION		UNIT DIMENSIONS			HEATING WATER FLOW					HEATING CAPACITY			ELECTRICAL		
MARK	MANUFACTURER	MODEL	WEIGHT (LBS)	TYPE	# NAME	SYSTEM SERVED	W	D	H	DESIGN (GPM)	EWT (°F)	LWT (°F)	ΔT (°F)	WPD (ftH2O)	INPUT	OUTPUT	EFF. η	FLA	ELECTRICAL DATA	NOTES
B-1	Lochinvar	FBN1501	2,307	CREST Condensing Boiler	D123 MECHANICAL	HOT WATER	30"	68"	78"	72	100	140	40	7.3	1,500	1,443	96.4	10	120 V-1-60	SEE NOTES
B-2	Lochinvar	FBN1501	2,307	CREST Condensing Boiler	D123 MECHANICAL	HOT WATER	30"	68"	78"	72	100	140	40	7.3	1,500	1,443	96.4	10	120 V-1-60	SEE NOTES

NOTES
1 HIGH-EFFICIENT CONDENSING HEATING WATER BOILER. NATURAL GAS, FM COMPLIANT GAS TRAIN, LOW NOx BELOW 30 PPM ALL FIRING RATES.
2 MINIMUM WATER FLOW: 25 GPM, MAXIMUM WATER FLOW: 350 GPM. DESIGN FLOW RATE: 72 GPM
3 ANY VARIATION DUE TO MANUFACTURER'S EQUIPMENT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR.
4 CONTROL PANEL PROVIDED BY UNIT MANUFACTURER.
5 MOUNT ON 3-1/2" CONCRETE HOUSEKEEPING PAD.
6 REFER TO SPECIFICATION SECTION 235216.

NOTES
7 UNIT MANUFACTURER SHALL INCLUDE CONTROL VOLTAGE TRANSFORMER. DISCONNECT BY DIVISION 26.
8 PROVIDE AND INSTALL EMERGENCY GAS SHUTOFF VALVE EQUAL TO ASCO 'REDHAT' 2/2 SERIES 8214 (200), 2-1/2" SIZE OR APPROVED EQUAL.
9 EMERGENCY GAS SHUTOFF VALVE PUSHBUTTON, FOR CONTROL OF THE EMERGENCY GAS SHUTOFF VALVE, SHALL BE SAFETY TECHNOLOGY SS2 SERIES STOPPER STATION OR APPROVED EQUAL

23.64.26 - AIR-COOLED CHILLER SCHEDULE

IDENTITY DATA				LOCATION		PERFORMANCE DATA					EVAPORATOR		CONDENSER			COMPRESSOR												
						REFRIG.		CAPACITY		FLV	EWT	LWT	EAT	FANS					MIN OA DB	ELECTRICAL							WEIGHT	
MARK	MANUFACTURER	MODEL	TYPE	LOCATION	SYSTEM SERVED	TYPE	LBS.	(TONS)	EER	(kW/TON)	(°F)	(°F)	(°F)	QTY	HP	TYPE	QTY	TEMP (°F)	kW	MCA	MOCP	V	PH	HZ	STARTER TYPE	(LBS)	NOTES
CHLR-1	TRANE	ACSA	140 NOMINAL TON AIR COOLED SCROLL CHILLER	MECHANICAL YARD	CHILLED WATER	R-454B	100	128.2	10.95	1.095	57	42	95.0 °F	8	13.24	SCROLL	4	95.0 °F	145.5	287	350	460 V	3	60 Hz	ACROSS-THE-LINE	7,897	SEE NOTES

23.64.26 - AIR-COOLED CHILLER SCHEDULE CONT.

EVAPORATOR DRUM

Mark	EWT	LWT	FLOW (GPM)	WPD	Notes
EVAP-1	57.0 °F	42.0 °F	200.0 GPM	5.60 Feet	SEE NOTES

NOTES
1 REFER TO SPECIFICATION SECTION 236423.
2 MOUNT ON REINFORCED CONCRETE SUPPORT PAD. COORDINATE EXACT PAD SIZE WITH UNIT MANUFACTURER.
3 SCCR Rating of 65kA@480V
4 PROVIDE SINGLE POINT ELECTRICAL CONNECTION TO UNIT
5 PROVIDE FACTORY MOUNTED AND WIRED DISCONNECT
6 SOUND BLANKETS TO BE PLACED ON COMPRESSORS. AMBIENT SOUND LEVEL TO BE <95dB

23.82.39 - UNIT HEATER SCHEDULE

IDENTITY DATA					LOCATION		FAN DATA					HEATING PERFORMANCE			HW COIL				ELECTRICAL	
MARK	MFG	MODEL	WEIGHT (LBS)	TYPE	# NAME	AREA SERVED	CFM	DRIVE	QTY	HP	CONTROL	HEAT SOURCE	CAPACITY (MBH)	EAT (°F)	LAT (°F)	FLOW (GPM)	EWT (°F)	LWT (°F)	WPD (FT)	DATA	NOTES
CUH-C1	RAYWALL	RC/W-420-06	125	HOT WATER CEILING	C200 VESTIBULE	C-BLOCK/CAFETERIA	350	DIRECT	1	0.06	THERMOSTAT	HOT WATER	16.3	60	102.2	1.7	140	120	0.5	120 V-1-60	1,2,3,6
CUH-C2	RAYWALL	RC/W-420-06	130	HOT WATER WALL	C500 CORRIDOR	C-BLOCK/CAFETERIA	620	DIRECT	1	0.06	THERMOSTAT	HOT WATER	36.6	60	113.6	3.7	140	120	10.1	120 V-1-60	1,2,4,6,7
CUH-C3	RAYWALL	RC/W-420-06	125	HOT WATER CEILING	C500 CORRIDOR	C-BLOCK/CAFETERIA	350	DIRECT	1	0.06	THERMOSTAT	HOT WATER	16.3	60	102.2	1.7	140	120	0.5	120 V-1-60	1,2,3,6
CUH-D1	RAYWALL	RC/W-420-06	125	HOT WATER CEILING	D580 CORRIDOR	D-BLOCK	350	DIRECT	1	0.06	THERMOSTAT	HOT WATER	16.3	60	102.2	1.7	140	120	0.5	120 V-1-60	1,2,3,6
PUH-C1	RITTLING	RH-47	50	HORIZONTAL HOT WATER	C119 MAINTENANCE	C-BLOCK/CAFETERIA	565	DIRECT	1	0.06	THERMOSTAT	HOT WATER	15.8	60	85.3	1.6	140	120	0.1	120 V-1-60	1,2,3,4,5
PUH-C2	RITTLING	RH-86	63	HORIZONTAL HOT WATER	C117 MECHANICAL	C-BLOCK/CAFETERIA	1,040	DIRECT	1	0.1	THERMOSTAT	HOT WATER	29	60	85.2	2.9	140	120	0.2	120 V-1-60	1,2,3,4,5
PUH-C3	RITTLING	RH-18	37	HORIZONTAL HOT WATER	C100A STORAGE	C-BLOCK/CAFETERIA	310	DIRECT	1	0.03	THERMOSTAT	HOT WATER	6.1	60	77.7	0.6	140	120	0.1	120 V-1-60	1,2,3,4,5
PUH-C4	RITTLING	RH-18	37	HORIZONTAL HOT WATER	C100B CHAIR STORAGE	C-BLOCK/CAFETERIA	310	DIRECT	1	0.03	THERMOSTAT	HOT WATER	6.1	60	77.7	0.6	140	120	0.1	120 V-1-60	1,2,3,4,5
PUH-D1	RITTLING	RH-86	63	HORIZONTAL HOT WATER	D123 MECHANICAL	D-BLOCK	1,340	DIRECT	1	0.1	THERMOSTAT	HOT WATER	35.3	60	83.8	3.5	140	120	0.3	120 V-1-60	1,2,3,4,5

NOTES
1 REFER TO SPECIFICATION 238239.
2 FACTORY MOUNTED DISCONNECT SWITCH.
3 SUPPORT HEATER FROM STRUCTURE ABOVE WITH MINIMUM OF FOUR (4), 3/8" DIAMETER THREADED RODS AND VIBRATION ISOLATION.
4 UNIT FURNISHED WITH ADJUSTABLE LOUVER FIN DIFFUSERS TO PROVIDE FOUR-DIRECTION AIR FLOW CONTROL.
5 MOUNT BOTTOM OF UNIT AT 9'-0" AFF.
6 STANDARD COLOR TO BE SELECTED BY ARCHITECT/ENGINEER.
7 HORIZONTAL DUSCHARGE UNIT.

23.82.39 - ELECTRIC UNIT HEATER SCHEDULE

IDENTITY DATA					LOCATION		FAN DATA				HEATING PERFORMANCE						
MARK	MFG	MODEL	WEIGHT (LBS)	TYPE	# NAME	AREA SERVED	CFM	DRIVE	QTY	CONTROL	HEAT SOURCE	HEAT (kW)	CAPACITY (BTUH)	EAT (°F)	LAT (°F)	ELECTRICAL DATA	NOTES
EPUH-D1	RAYWALL	5100	25	HORIZONTAL ELECTRIC	D113A EMERGENCY ELECTRICAL	D-BLOCK	400	DIRECT	1	THERMOSTAT	ELECTRIC	3.3	11.1	60	85.5	277 V-1-60	SEE NOTES
EPUH-D2	RAYWALL	5100	25	HORIZONTAL ELECTRIC	D113 ELECTRICAL	D-BLOCK	400	DIRECT	1	THERMOSTAT	ELECTRIC	3.3	11.1	60	85.5	277 V-1-60	SEE NOTES

NOTES
1 REFER TO SPECIFICATION 238239.
2 FACTORY MOUNTED DISCONNECT SWITCH.
3 HORIZONTAL DISCHARGE UNIT.
4 SUPPORT HEATER FROM STRUCTURE ABOVE WITH MINIMUM OF FOUR(4), 3/8" DIAMETER THREADED RODS AND VIBRATION ISOLATION.
5 UNIT FURNISHED WITH ADJUSTABLE LOUVER FIN DIFFUSERS TO PROVIDE FOUR-DIRECTION AIR FLOW CONTROL.

HVAC WATER TREATMENT EQUIPMENT SCHEDULE

IDENTITY DATA				LOCATION	TANK					
MARK	MANUFACTURER	MODEL	TYPE	SYSTEM SERVED	TYPE	VOL	DIA.	HT.	WEIGHT (LBS)	NOTES
CFS-1	Wessels Company	CPFTA-5	HEATING WATER CHEMICAL SHOT FEEDER	HOT WATER	CHEMICAL POT FEEDER	5	10"	23"	23	SEE NOTES
CFS-2	Wessels Company	CPFTA-5	HEATING WATER CHEMICAL SHOT FEEDER	HOT WATER	CHEMICAL POT FEEDER	5	10"	23"	23	SEE NOTES

NOTES:
1 HEATING WATER CHEMICAL SHOT FEEDER, 5 GALLON CAPACITY.
2 MOUNT ON 3-1/2" CONCRETE HOUSEKEEPING PAD.
3 INCLUDE LEG SUPPORT.
4 REFER TO PROJECT MANUAL SECTION 232500.

23.29.23 - VARIABLE-FREQUENCY MOTOR CONTROLLER SCHEDULE

IDENTITY DATA	LOCATION	MOTOR	INTEGRAL	ELECTRICAL
MARK	# NAME	HP	BYPASS	DATA
VFD-CHWP-1	D123 MECHANICAL	10	Yes	480 V-3-vHZ
VFD-CHWP-2	D123 MECHANICAL	10	Yes	480 V-3-vHZ
VFD-HWP-1	D123 MECHANICAL	5	Yes	480 V-3-vHZ
VFD-HWP-2	D123 MECHANICAL	5	Yes	480 V-3-vHZ

NOTES:
1 DRIVE PROVIDED AND INSTALLED BY THE DIVISION 23 - HVAC CONTRACTOR.
2 DIVISION 26 - ELECTRICAL CONTRACTOR TO PROVIDE POWER WIRING TO VFC AND FROM VFC TO MOTOR(S).
3 TEMPERATURE CONTROL CONTRACTOR SHALL PROVIDE ALL TEMPERATURE CONTROL WIRING.
4 REFER TO SPECIFICATION SECTION 232923.

23.21.13 - COMBINATION AIR DIRT SEPARATOR SCHEDULE

MARK	MAX FLOW	MAX WPD (FT)	SIZE (IN.)	SYSTEM
ADS-2	295 GPM	0.7	4	HOT WATER
ADS-1	293 GPM	1.23	5	CHILLED WATER

23.37.13 - EXTERIOR LOUVER SCHEDULE

IDENTITY DATA						MIN FREE AREA			FREE AREA VELO.	STATIC PD			
MARK	DESCRIPTION	Location	MFG	APPLICATION	Air Flow	(SF)	Size	Depth	(FPM)	(IN-WC)	LOUVER TYPE	MATERIAL/ FINISH	NOTES
WL-1 OA	5" WIND DRIVEN RAIN	C117	GREENHECK	INTAKE	22,060	29.5	96"x96"	5"	747 FPM	0.08	STATIONARY - DRAINABLE BLADE	6065-T5 ALUMINUM	SEE NOTES
WL-2 EA	5" WIND DRIVEN RAIN	C117	GREENHECK	EXHAUST	550	0.7	18"x18"	5"	840 FPM	0.14	STATIONARY - DRAINABLE BLADE	6065-T5 ALUMINUM	SEE NOTES
WL-3 OA	5" WIND DRIVEN RAIN	D114	GREENHECK	INTAKE	9,650	10.7	56"x64"	5"	898 FPM	0.12	STATIONARY - DRAINABLE BLADE	6065-T5 ALUMINUM	SEE NOTES

NOTES
1 REFER TO SPECIFICATION SECTION 089119.
2 SEAL ALL AROUND WITH SILICONE.
3 REFER TO INSTALLATION DETAILS ON SHEET M-501 AND ARCHITECTURAL DRAWINGS.
4 CUSTOM COLOR TO BE SELECTED BY THE ARCHITECT/ENGINEER.
5 COORDINATE SIZE AND LOCATION WITH ALL TRADES AND ARCHITECTURAL ELEVATIONS.

NATHANIEL JONES EARLY LEARNING CENTER ADDITION & EXPANSION

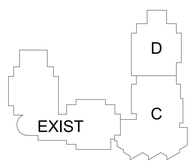
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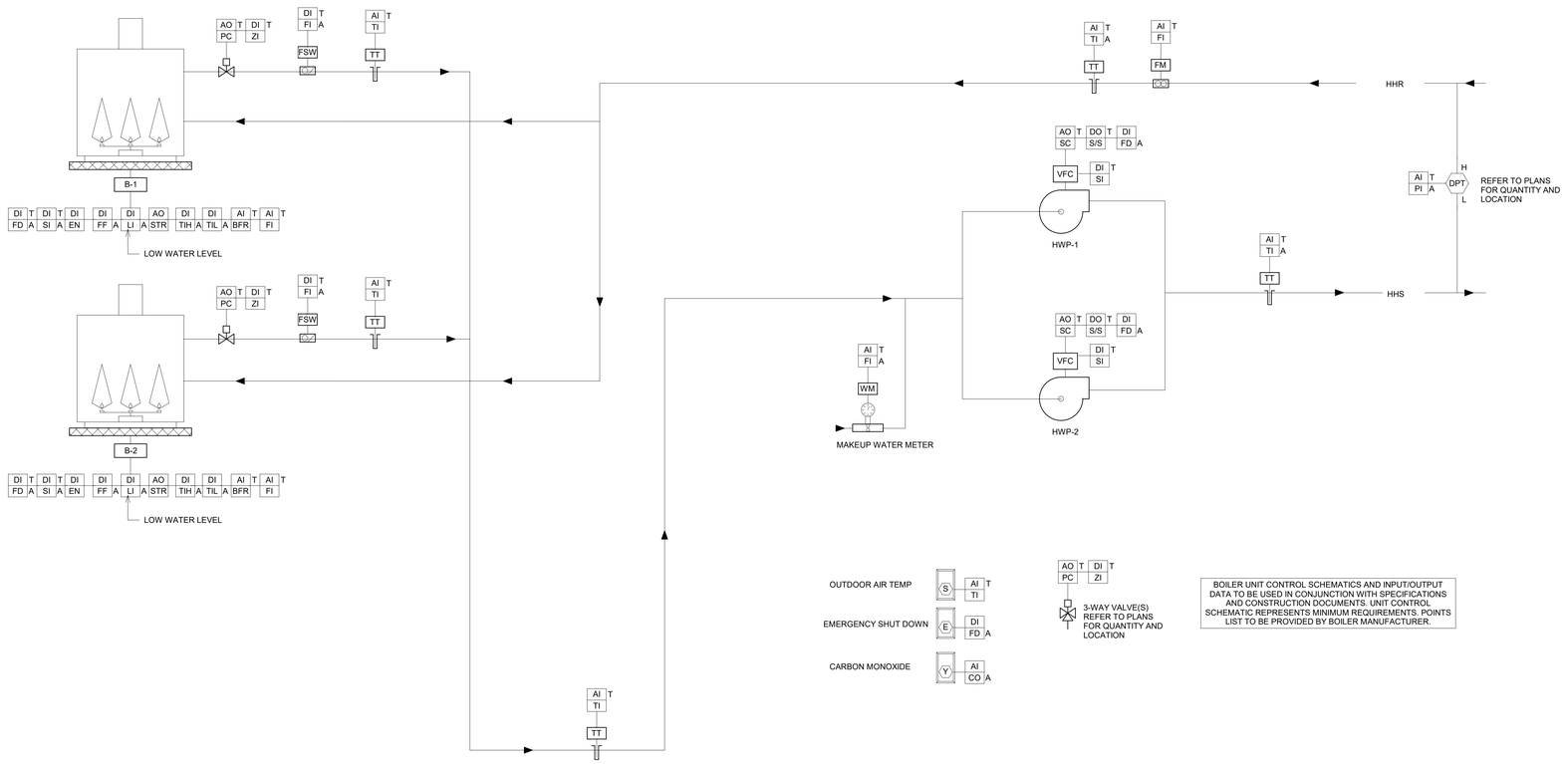
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DRAWN BY: CMS
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

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MECHANICAL SCHEDULES

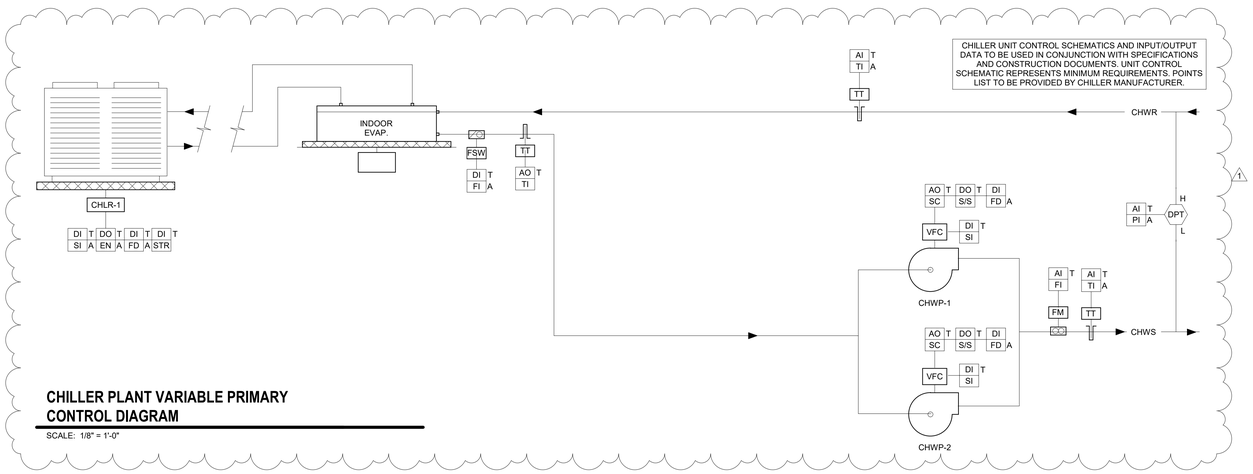
M-602

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HEATING PLANT VARIABLE PRIMARY CONTROL DIAGRAM

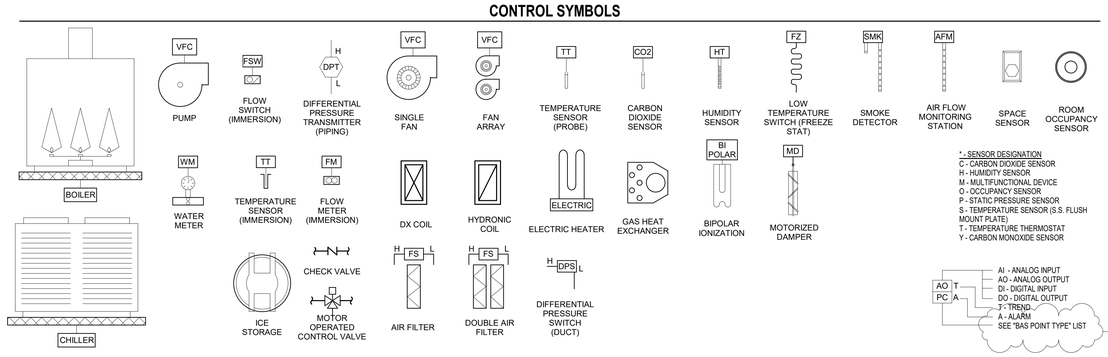
SCALE: 1/8" = 1'-0"



CHILLER PLANT VARIABLE PRIMARY CONTROL DIAGRAM

SCALE: 1/8" = 1'-0"

CONTROL SYMBOLS



TEMPERATURE CONTROL SYMBOLS & ABBREVIATIONS

CONTROL ABBREVIATIONS

AFM - AIR FLOW MONITORING STATION
BSP - BUILDING STATIC PRESSURE
CO2 - CO2 LEVEL TRANSMITTER
CO - CO LEVEL TRANSMITTER
DPS - DIFFERENTIAL PRESSURE SWITCH
DPT - DIFFERENTIAL PRESSURE TRANSMITTER
FM - FLOW METER
FS - FILTER STATUS
FSW - FLOW SWITCH
FT - FLOW TRANSMITTER
FZ - FREEZESTAT
GCV - GAS CONTROL VALVE
HT - HUMIDITY TRANSMITTER
HTG - HEATING ELEMENT
LT - LEVEL TRANSMITTER
M - MOTOR
MD - MOTORIZED DAMPER
OCC - OCCUPANCY SENSOR
PKG - PACKAGED EQUIPMENT CONTROLLER
SMK - SMOKE DETECTOR
SNW - SNOW/ICE SENSOR
TCV - TEMPERATURE CONTROL VALVE
TT - TEMPERATURE TRANSMITTER
WM - WATER METER
VFC - VARIABLE FREQUENCY CONTROLER

BAS POINT TYPE

BFR - BOILER FIRE RATE %
CAP - EQUIPMENT CAPACITY SIGNAL
CO2 - CARBON DIOXIDE LEVEL
CO - CARBON MONOXIDE LEVEL
EN - EQUIPMENT ENABLE
FF - FLAME FAILURE
FI - FLOW INDICATE
FD - FAULT DETECTOR OR ALARM
HI - HUMIDITY INDICATE
LI - LEVEL INDICATE
MS - MOTION SENSOR
O/C - OPEN/CLOSE (DAMPER/VALVE)
OI - OCCUPIED/UNOCCUPIED INDICATE
PC - POSITION CONTROL (DAMPER/VALVE)
PI - PRESSURE INDICATE
RV - REVERSE VALVE
SC - SPEED CONTROL
SI - STATUS INDICATOR
SD - SMOKE DETECTOR
SNW - SNOW/ICE INDICATE
SO - SPACE OVERRIDE (OCCU./UNOCCU.)
SPT - SETPOINT SIGNAL
S/S - START/STOP
STR - SETPOINT RESET
TI - TEMPERATURE INDICATE
TIH - HIGH TEMPERATURE INDICATE
TIL - LOW TEMPERATURE INDICATE
TS - TIMER SWITCH
ZI - POSITION INDICATE

* - SENSOR DESIGNATION
C - CARBON DIOXIDE SENSOR
H - HUMIDITY SENSOR
M - MULTIFUNCTIONAL DEVICE
O - OCCUPANCY SENSOR
P - STATIC PRESSURE SENSOR
S - TEMPERATURE SENSOR (S.S. FLUSH MOUNT PLATE)
T - TEMPERATURE THERMOSTAT
Y - CARBON MONOXIDE SENSOR

AO T PC A
AI - ANALOG INPUT
AO - ANALOG OUTPUT
DI - DIGITAL INPUT
DO - DIGITAL OUTPUT
T - TREND
A - ALARM
SEE "BAS POINT TYPE" LIST

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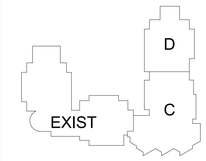
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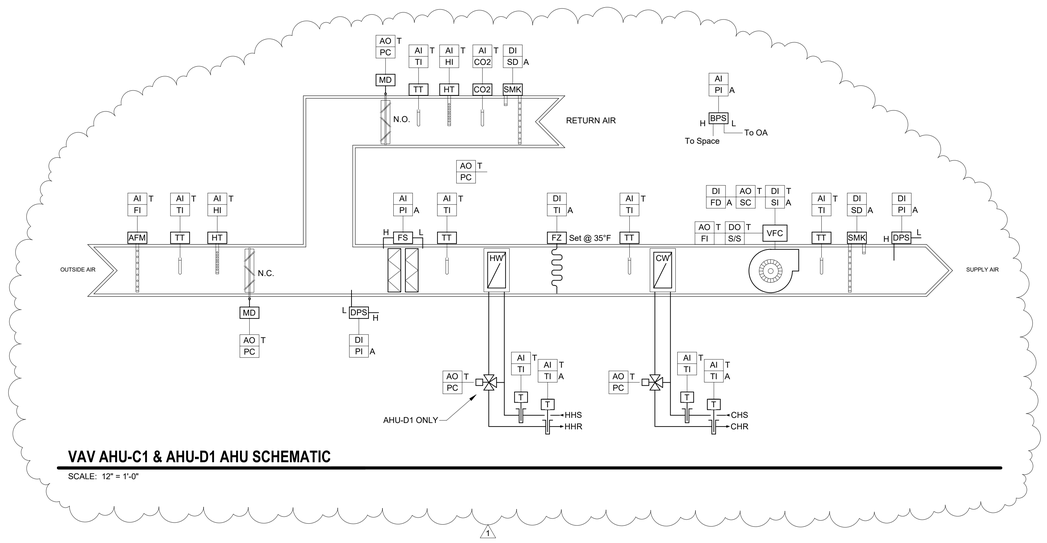
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DRAWN BY: CMS
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-26-2026

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MECHANICAL SCHEMATICS

M-701

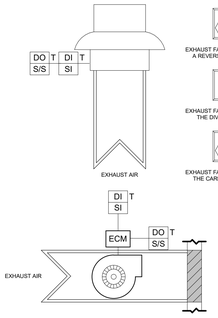
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VAV AHU-C1 & AHU-D1 AHU SCHEMATIC

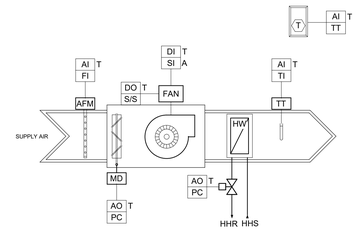
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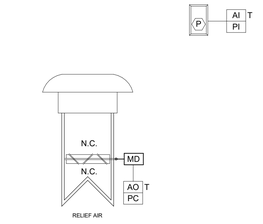
EXHAUST FAN SCHEMATIC

SCALE: 12" = 1'-0"



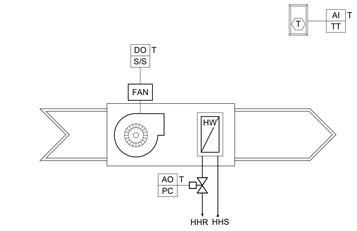
FAN POWERED VAV BOX SCHEMATIC

SCALE: 12" = 1'-0"



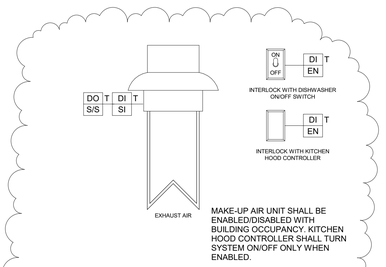
ROOFTOP RELIEF VENTILATOR SCHEMATIC

SCALE: 12" = 1'-0"



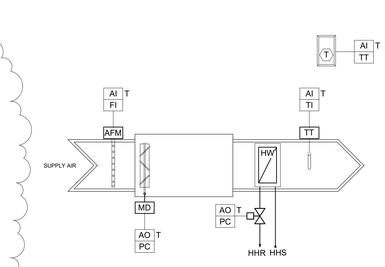
HYDRONIC CABINET / PROPELLER UNIT HEATER SCHEMATIC

SCALE: 12" = 1'-0"



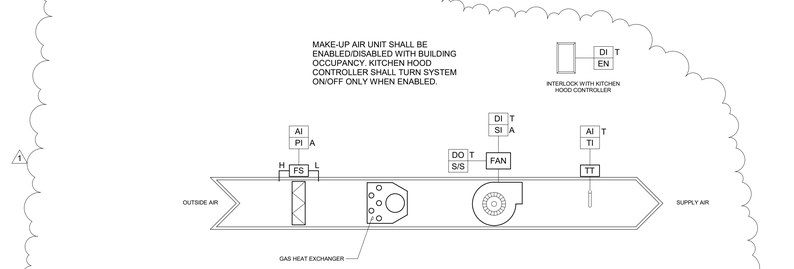
KITCHEN / DISHWASHER EXHAUST FAN SCHEMATIC

SCALE: 12" = 1'-0"



VAV REHEAT BOX SCHEMATIC

SCALE: 12" = 1'-0"



MAKE UP AIR UNIT SCHEMATIC

SCALE: 12" = 1'-0"

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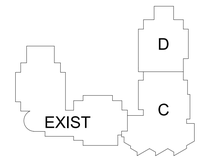
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MARK Z. HOOF REGISTERED No. PE 12200301 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: CMS

PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 03-26-2026

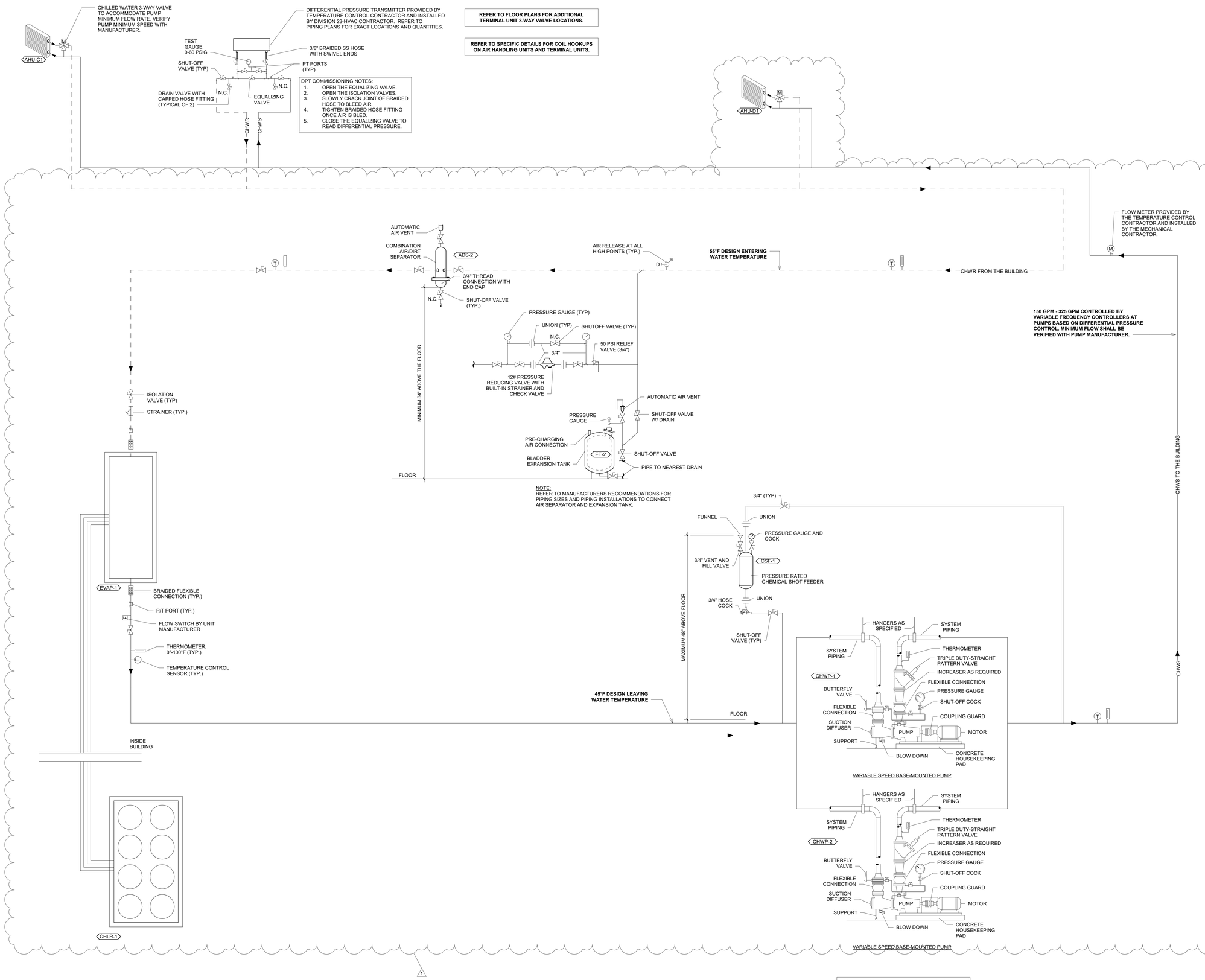
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MECHANICAL SCHEMATICS

M-702

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CHW PLANT SCHEMATIC - VARIABLE PRIMARY

SCALE: 3/32" = 1'-0"

SCHEMATICS TO BE USED IN CONJUNCTION WITH SPECIFICATIONS AND CONSTRUCTION DOCUMENTS. SUBMITTALS TO BE APPROVED BEFORE THE START OF INSTALLATION.

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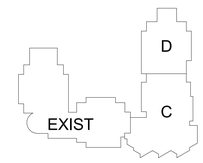
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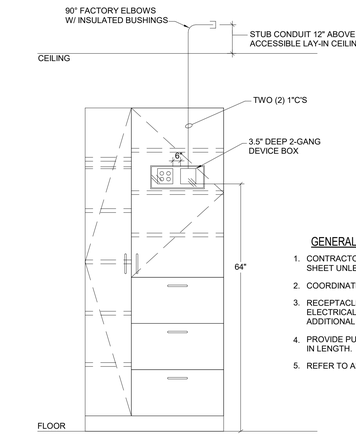
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CHW PLANT SCHEMATICS

M-704

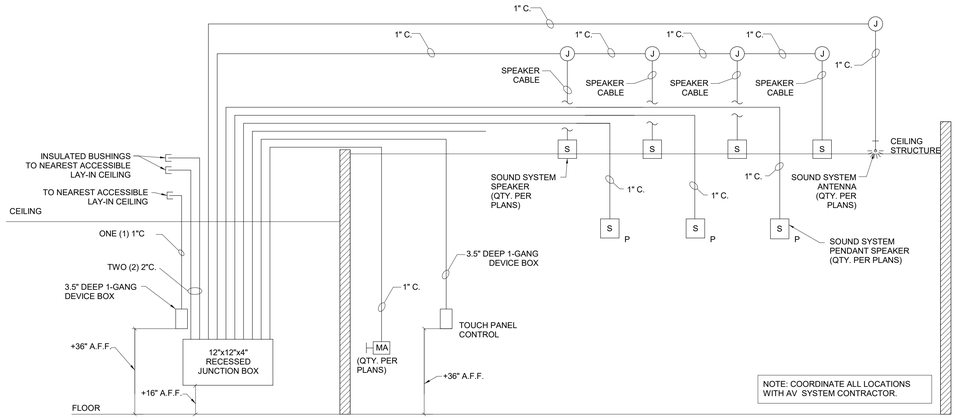
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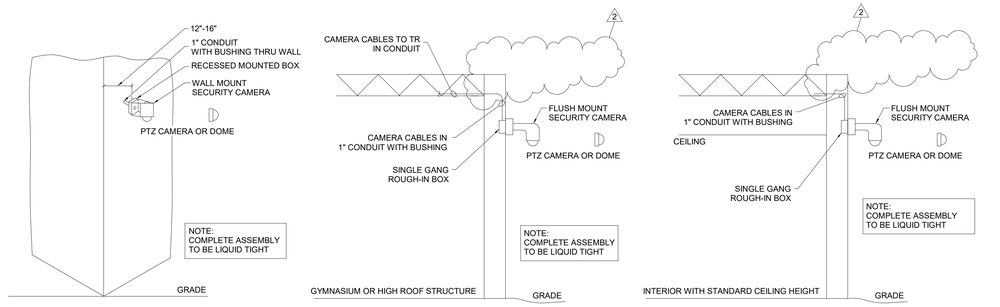
GENERAL NOTES:

1. CONTRACTOR TO FOLLOW MOUNTING HEIGHTS AS LISTED ON THIS SHEET UNLESS NOTED DIFFERENTLY ON DRAWINGS.
2. COORDINATE ROUGH-IN AND RECEPTACLES WITH CASEWORK CONTRACTOR.
3. RECEPTACLES ARE SHOWN FOR COORDINATION ONLY. REFER TO ELECTRICAL DRAWINGS FOR SIZE, CIRCUITING, MOUNTING, AND ADDITIONAL REQUIREMENTS.
4. PROVIDE PULL STRINGS IN CONDUIT RUNS GREATER THAN 10' IN LENGTH.
5. REFER TO ARCHITECTURAL DRAWINGS FOR MORE INFORMATION.

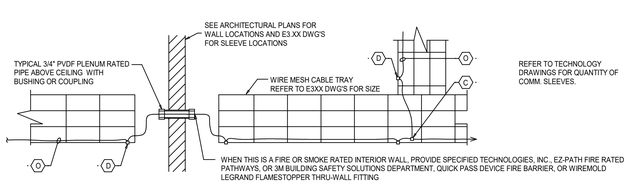
6 TYPICAL CLASSROOM SOUND SYSTEM ROUGH-IN DETAIL
NOT TO SCALE



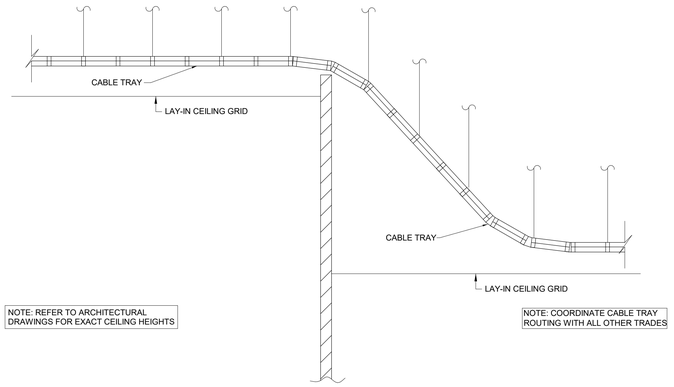
5 MULTIPURPOSE ROOM SOUND SYSTEM CONDUIT RISER DIAGRAM
NOT TO SCALE



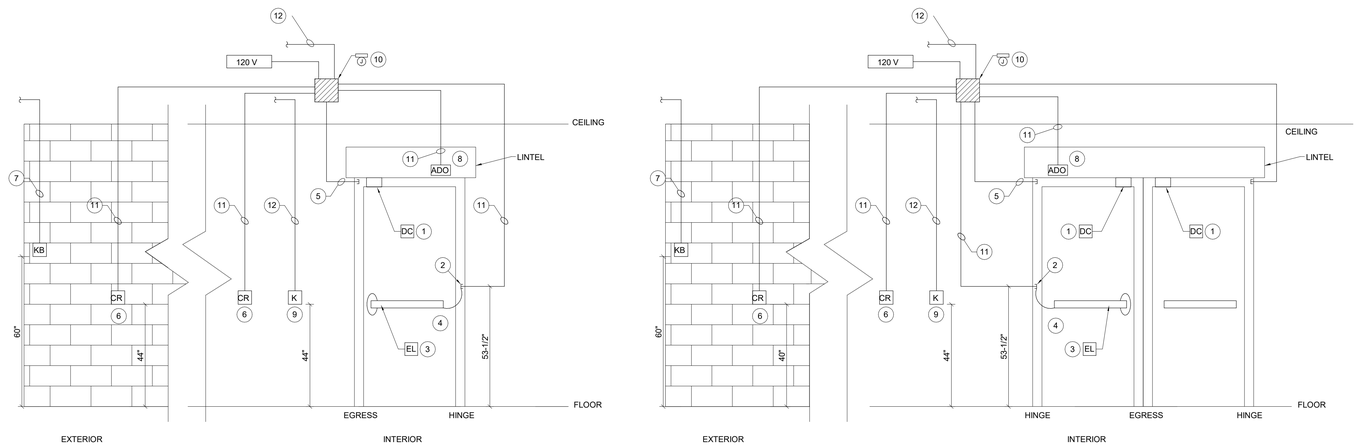
4 SURVEILLANCE SYSTEM ROUGH-IN DETAIL
NOT TO SCALE



3 CABLE TRAY GROUNDING AT WALL (PLAN VIEW)
NOT TO SCALE



2 CABLE TRAY SECTION WITH MULTIPLE CEILING HEIGHTS DETAIL
NOT TO SCALE



DOOR SECURITY ROUGH-IN LEGEND

1. ROUGH-IN FOR RECESSED MOUNTED DOOR CONTACT.
2. ROUGH-IN FOR THROUGH WIRE HINGE OR ELECTRONIC POWER TRANSFER. THROUGH WIRE HINGE OR ELECTRONIC POWER TRANSFER BY HARDWARE CONTRACTOR. (VERIFY EXACT ROUGH-IN LOCATION WITH DOOR HARDWARE CONTRACTOR.)
3. ELECTRIC LATCH OR RETRACTABLE PANIC EXIT DEVICE. BY HARDWARE CONTRACTOR.
4. ARMORED CABLE LOOP. EXISTING DOOR AND FRAME CONDITION ONLY.
5. 1/2" FLEX CONDUIT IN DOOR FRAME TO SECURITY JUNCTION BOX ABOVE CEILING.
6. 2 GANG JUNCTION BOX, 3 1/2" DEEP, FOR CARD READER.
7. 2 GANG BOX, 3 1/2" DEEP FOR KEY BOX WITH 1" CONDUIT TO NEAREST ACCESSIBLE LAY-IN CEILING.
8. ROUGH-IN FOR AUTOMATIC DOOR OPERATOR (ADO).
9. 2 GANG JUNCTION BOX, 3 1/2" DEEP FOR KEY PAD.
10. HINGED SECURITY JUNCTION BOX (24"X24"X6"), MOUNTED ABOVE CEILING TO HOUSE ACCESS CONTROL DOOR CONTROLLER.
11. 1" CONDUIT TO JUNCTION BOX ABOVE CEILING.
12. 1" CONDUIT TO CABLE TRAY.

NOTE: TYPICAL DOOR ROUGH-IN DETAILS. REFER TO FLOOR PLANS FOR EXACT QUANTITIES AND CONFIGURATIONS. ACCESS CONTROL HARDWARE AND CABLING PROVIDED BY SECURITY SYSTEM CONTRACTOR.

1 DOOR SECURITY ROUGH-IN DETAIL
NOT TO SCALE

PIKE MSD/NATHANIEL JONES ELC EXPANSION

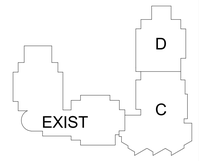
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KEY PLAN N

BID DOCUMENTS

BRIAN W. BUTLER REGISTERED No. PE19900026 STATE OF PROFESSIONAL ENGINEER

PROJECT MANAGER: PW
DRAWN BY: Author
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

TECHNOLOGY ROUGH-IN DETAILS

ET502

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COMMUNICATIONS SYMBOLS LEGEND

SYMBOL	DESCRIPTION	WIRING DETAIL(S) UNLESS NOTED OTHERWISE
	WALL MOUNTED COMMUNICATIONS OUTLET. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	1/T-001
VI	WALL MOUNTED COMMUNICATIONS OUTLET AT VIDEO INPUT LOCATION. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	SEE AV WIRING DETAILS
MON	WALL MOUNTED MONITOR COMMUNICATIONS OUTLET. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	1/T-503
CS	WALL MOUNTED COMMUNICATIONS OUTLET. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	1/T-502
VP	CEILING MOUNTED PROJECTOR. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	SEE AV WIRING DETAILS
VP	WALL MOUNTED PROJECTOR. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	-
W	CEILING MOUNTED WIRELESS ACCESS POINT. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	CAT6A
W	WALL MOUNTED WIRELESS ACCESS POINT. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	-
	CABLE TRAY	-
	LADDER TRAY	-
	CONDUIT SLEEVES BETWEEN WALLS	2/T-001
	2 (TWO) 4" CONDUIT SLEEVES BETWEEN FLOORS	-
	TELEPHONE TERMINATION BOARD	-
	TECHNOLOGY EQUIPMENT RACK	-
	TECHNOLOGY EQUIPMENT CABINET	-
	4-POST TECHNOLOGY EQUIPMENT RACK	-
CAM	OVERHEAD DOCUMENT CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	-

ACCESS CONTROL SYMBOLS LEGEND

SYMBOL	DESCRIPTION	WIRING DETAIL(S) UNLESS NOTED OTHERWISE
ACP	ACCESS CONTROL PANEL	-
CR	CARD READER	T-503/1
EL	ELECTRONIC LATCH SET WITH ELECTRONIC POWER TRANSFER	-
	AUTOMATIC DOOR PUSHBUTTON	-
J	CEILING MOUNTED DOOR ACCESS CONTROLLER JUNCTION BOX. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	-
	PUSH TO RELEASE BUTTON	-
ADO	AUTOMATIC DOOR OPERATOR	-
LD	LOCKDOWN BUTTON	-
DI	DOOR INTERCOM	-
REX	REQUEST TO EXIT SWITCH (LOCATED IN EXIT DOOR HARDWARE)	-

PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

SYMBOL	DESCRIPTION	WIRING DETAIL(S) UNLESS NOTED OTHERWISE
	ANTENNA	SEE AV WIRING DETAILS
S	CLASSROOM SOUND REINFORCEMENT SPEAKER - CEILING MOUNTED	2/T-502
S	MULTI-PURPOSE ROOM SOUND SYSTEM SPEAKER - CEILING MOUNTED	SEE AV WIRING DETAILS
S P	MULTI-PURPOSE ROOM SOUND SYSTEM SPEAKER - PENDANT	SEE AV WIRING DETAILS
S	CLASSROOM SOUND REINFORCEMENT SPEAKER - WALL MOUNTED	-
M	CEILING MICROPHONE	-
	RECESSED JUNCTION BOX FOR SOUND SYSTEM	-
MA	WALL MOUNTED MICROPHONE/AUXILIARY INPUT	-
SUB	SUBWOOFER	-

INTERCOMMUNICATIONS AND PROGRAM SYSTEMS SYMBOLS LEGEND

SYMBOL	DESCRIPTION	WIRING DETAIL(S) UNO
IC	CALL-IN SWITCH.	-
VC	VOLUME CONTROL	-
C	RECESSED CEILING SPEAKER	-
C VC	RECESSED CEILING SPEAKER - WITH VOLUME CONTROL	-
IC	WALL MOUNTED WEATHERPROOF HORN SPEAKER	-
C	SURFACE MOUNTED SPEAKER	-
C S	SURFACE MOUNTED CEILING SPEAKER	-

INTERIOR VIDEO SURVEILLANCE CAMERA SYMBOLS LEGEND

SYMBOL	DESCRIPTION	WIRING DETAIL(S) UNLESS NOTED OTHERWISE
CAM	CEILING MOUNTED VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF CAT6 COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A
CAM	CEILING MOUNTED VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF CAT6 COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A
CAM	CEILING MOUNTED VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF CAT6 COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A
CAM	CEILING MOUNTED VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF CAT6 COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A
CAM	FISH-EYE CEILING MOUNTED VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF CAT6 COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A

EXTERIOR VIDEO SURVEILLANCE CAMERA SYMBOLS LEGEND

SYMBOL	DESCRIPTION	WIRING DETAIL(S) UNLESS NOTED OTHERWISE
3	WALL MOUNTED WEATHERPROOF VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A
3	WALL MOUNTED VIDEO SURVEILLANCE CAMERA. WHEN INDICATED WITH C-x, x = THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLING, IN ADDITION TO OTHER CABLES NOTED.	2/T-501 CAT6A

TECHNOLOGY ABBREVIATIONS

ABBREVIATIONS USED ON DRAWINGS IN GENERAL ARE LISTED BELOW.

AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
B	BLANK
C	CONDUIT
CATV	CABLE ANTENNA TELEVISION
J	JUNCTION BOX
MC/ER / MDF	MAIN CROSS-CONNECT/EQUIPMENT ROOM / MAIN DISTRIBUTION FRAME
+N	INDICATES MOUNTING HEIGHT (N) TO BOTTOM OF DEVICE FROM FINISH FLOOR UNLESS NOTED OTHERWISE
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
TCP	TEMPERATURE CONTROL PANEL
TR / IDF	TELECOMMUNICATIONS ROOM / INTERMEDIATE DISTRIBUTION FRAME
T.T.B.	TELEPHONE TERMINATION BOARD
TV	TELEVISION
UNO	UNLESS NOTED OTHERWISE
VIF	VERIFY IN FIELD
VC	VOLUME CONTROL
W	WALL MOUNTED
V.I.	VIDEO INPUT LOCATION
D	DEMO TABLE
WG	WIRE GUARD
R	RELEASE
DF	DUAL FACE
WP	WEATHER PROOF
VO	VIDEO OUTPUT
PTZ	PAN TILT ZOOM
ETR	EXISTING TO REMAIN
VP	VIDEO PROJECTOR
S	SURFACE MOUNTED

TECHNOLOGY GENERAL NOTES

A. THE COMMUNICATIONS CABLING CONTRACTOR(S) IS/ARE RESPONSIBLE FOR ANY ADDITIONAL CONDUIT SLEEVES, OUTLET/JUNCTION BOXES, SURFACE RACEWAY, CABLE TRAY, DOUBLE GANG SQUARE PLASTER MUD RINGS, ETC.

B. THE COMMUNICATIONS CABLING CONTRACTOR(S) IS/ARE RESPONSIBLE FOR EXTENDING THE ELECTRICAL SERVICE FROM THE ELECTRICAL JUNCTION BOX IN THE SPACE TO ALL THE COMMUNICATIONS RACKS/CABINETS.

C. THE CONTRACTOR(S) SHALL BE RESPONSIBLE FOR REPLACING/REPAIRING DAMAGED CEILING GRID/TILE AS A RESULT OF THEIR INSTALLATION.

D. THE CONTRACTOR SHALL VERIFY THE SURFACE RACEWAY LOCATIONS, ROUTING, OPENINGS, ETC. WITH THE BUILDING ELECTRICAL CONTRACTOR. PROVIDE PROPER COVER PLATES FOR THE DEVICES AS REQUIRED.

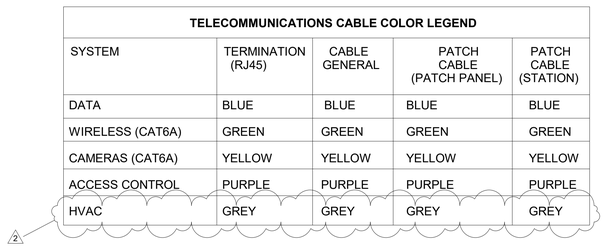
E. THE COMMUNICATIONS CABLING CONTRACTOR SHALL COORDINATE THE EXACT LOCATION OF THE VIDEO PROJECTOR WITH THE AUDIO/VIDEO EQUIPMENT CONTRACTOR AND ELECTRICAL CONTRACTOR.

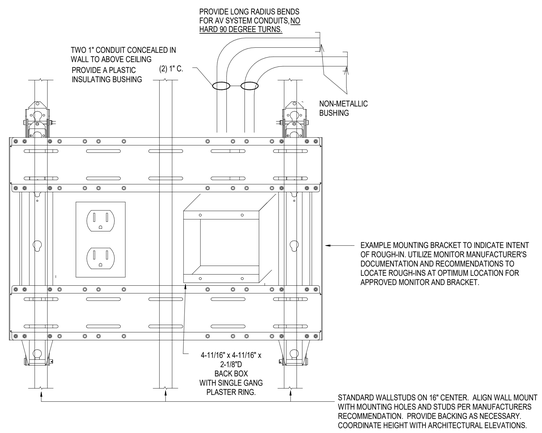
CONTRACTOR-OWNER RESPONSIBILITY MATRIX

	CONTRACTOR FURNISH	CONTRACTOR INSTALL	OWNER FURNISH	OWNER INSTALL
ACCESS/SECURITY HARDWARE & CABLING	*YES	*YES	NO	NO
ACCESS/SECURITY ROUGH INS	YES	YES	NO	NO
AV PROJECTOR AND MOUNTS	YES	YES	NO	NO
AV CLASSROOM MISC. CABLING	YES	YES	NO	NO
AV SYSTEM (MPR) EQUIPMENT & CABLING	YES	YES	NO	NO
WIRELESS CLOCKS	YES	YES	NO	NO
FIBER BACKBONE	YES	YES	NO	NO
FIBER TERM AND TEST	YES	YES	NO	NO
FIBER ENCLOSER WITH LC COUPLER PANEL	YES	YES	NO	NO
NETWORK SWITCHES (OWNER WILL CONFIGURE)	NO	YES	YES	NO
NETWORK SFP	NO	NO	YES	YES
IDF/TR RACK AND UPS EQUIPMENT	YES	YES	NO	NO
SOUND REINFORCEMENT CLASSROOMS	YES	YES	NO	NO
SURVEILLANCE CAMERAS	YES	YES	NO	NO
SURVEILLANCE CAMERAS CABLING	YES	YES	NO	NO
WIRELESS ACCESS POINTS (OWNER WILL CONFIGURE)	NO	YES	YES	NO
WIRELESS ACCESS POINTS CAT6A CABLING	YES	YES	NO	NO

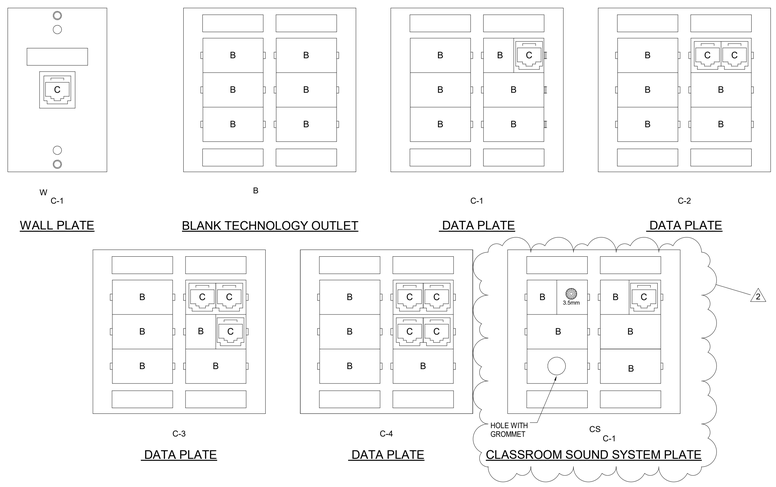
*NOTE - ACCESS/SECURITY HARDWARE & CABLING FURNISH AND INSTALL BY OTHERS. COORDINATE ROUGH INS BEFORE INSTALLATION.

TELECOMMUNICATIONS CABLE COLOR LEGEND				
SYSTEM	TERMINATION (RJ45)	CABLE GENERAL	PATCH CABLE (PATCH PANEL)	PATCH CABLE (STATION)
DATA	BLUE	BLUE	BLUE	BLUE
WIRELESS (CAT6A)	GREEN	GREEN	GREEN	GREEN
CAMERAS (CAT6A)	YELLOW	YELLOW	YELLOW	YELLOW
ACCESS CONTROL	PURPLE	PURPLE	PURPLE	PURPLE
HVAC	GREY	GREY	GREY	GREY





4 TYPICAL MONITOR DETAIL
NOT TO SCALE

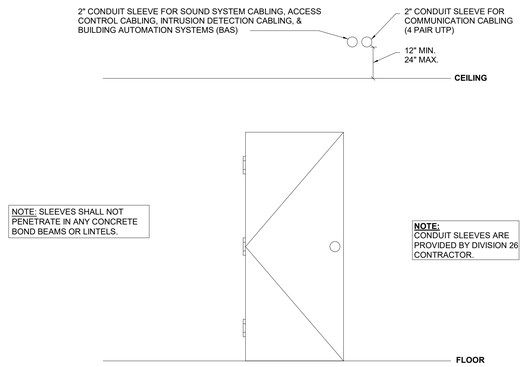


TECHNOLOGY FACEPLATE ABBREVIATIONS

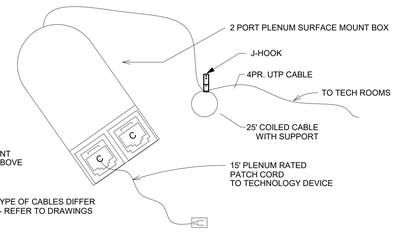
C - RJ45 DATA JACK
B - BLANK INSERT
WB - RJ-45 JACK FOR USB INTERACTIVITY
HD - RJ45 JACK FOR VIDEO
3.5mm - 3.5mm SOLDER JACK
HDMI - HDMI CONNECTOR

NOTE:
REFER TO AV WIRING DETAILS FOR EXACT CONFIGURATIONS OF VIDEO INPUT (VI), CLASSROOM SOUND (CS), AND AV CABINET LOCATIONS.

3 WALL PLATE E CONFIGURATIONS
NOT TO SCALE



2 CONDUIT SLEEVES DETAIL
NOT TO SCALE



1 TYPICAL SURFACE MOUNTED BOX - WIRING DETAIL
NOT TO SCALE

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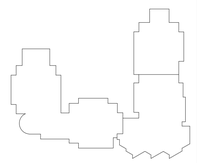
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BID DOCUMENTS

BRIAN W. BUTLER REGISTERED No. PE19800 STATE OF INDIANA PROFESSIONAL ENGINEER

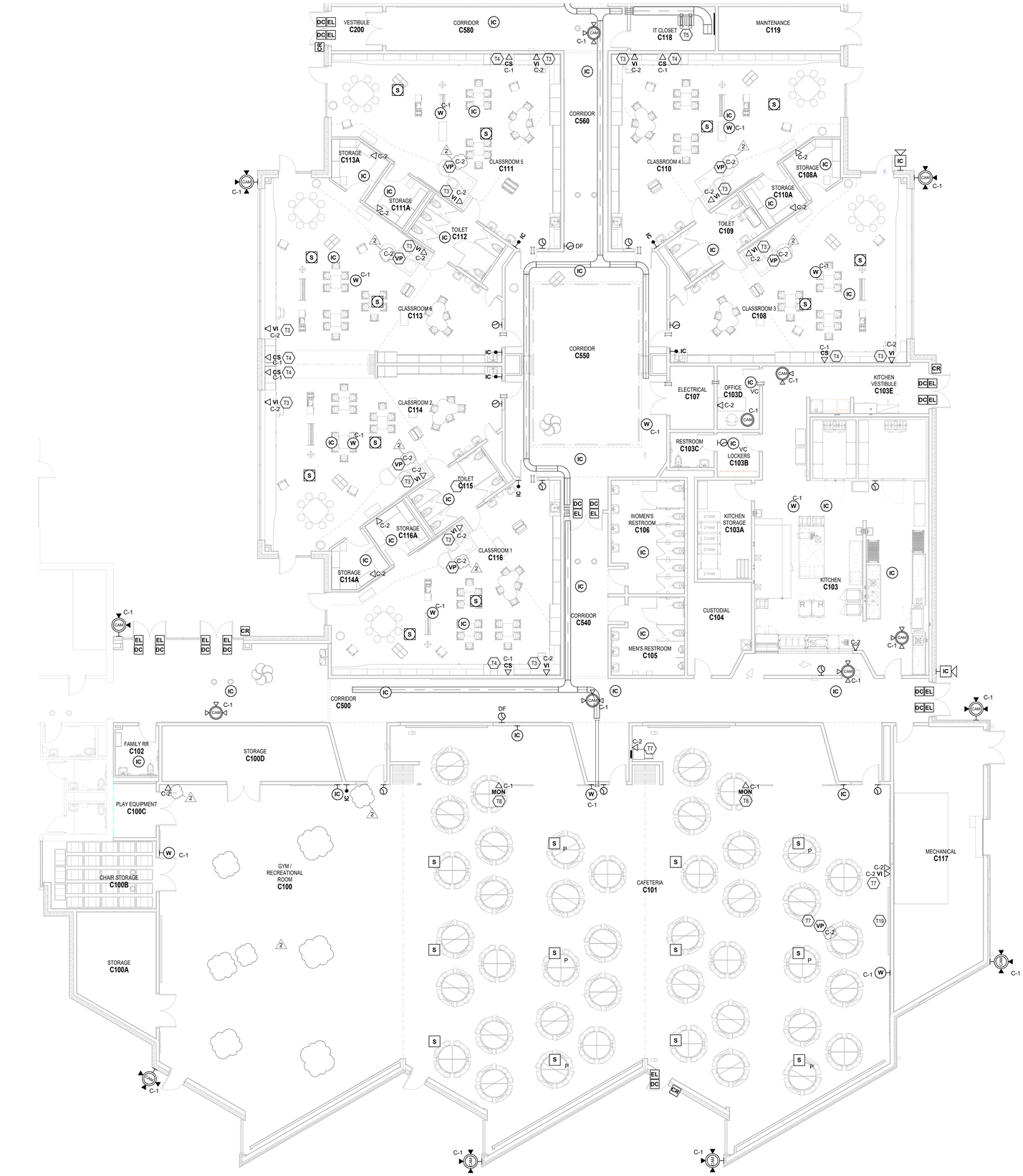
PROJECT MANAGER: PW
DRAWN BY: CD
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

TECHNOLOGY SYMBOLS & ABBREVIATIONS

T-001

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1 FIRST FLOOR TECHNOLOGY PLAN - UNIT C

SCALE: 1/8" = 1'-0"

ROOM LEGEND

ROOM NO.	OWNER ROOM NO.	ROOM NAME	AREA (SF)
FIRST FLOOR			
C100		GYM / RECREATIONAL ROOM	2515 SF
C100A		STORAGE	274 SF
C100B		CHAIR STORAGE	248 SF
C100C		PLAY EQUIPMENT	77 SF
C100D		STORAGE	318 SF
C101		CAFETERIA	5761 SF
C102		FAMILY RR	70 SF
C103		KITCHEN	1515 SF
C103A		KITCHEN STORAGE	177 SF
C103B		LOCKERS	62 SF
C103C		RESTROOM	51 SF
C103D		OFFICE	88 SF
C103E		KITCHEN VESTIBULE	122 SF
C104		CUSTODIAL	220 SF
C105		MEN'S RESTROOM	173 SF
C106		WOMEN'S RESTROOM	258 SF
C107		ELECTRICAL	92 SF
C108		CLASSROOM 3	1090 SF
C108A		STORAGE	79 SF
C109		TOILET	136 SF
C110		CLASSROOM 4	1085 SF
C110A		STORAGE	73 SF
C111		CLASSROOM 5	1085 SF
C111A		STORAGE	73 SF
C112		TOILET	136 SF
C113		CLASSROOM 6	1089 SF
C113A		STORAGE	79 SF
C114		CLASSROOM 2	1089 SF
C114A		STORAGE	79 SF
C115		TOILET	135 SF
C116		CLASSROOM 1	1088 SF
C116A		STORAGE	73 SF
C117		MECHANICAL	771 SF
C118		IT CLOSET	123 SF
C119		MAINTENANCE	178 SF
C200		VESTIBULE	75 SF
C500		CORRIDOR	1838 SF
C540		CORRIDOR	272 SF
C550		CORRIDOR	1218 SF
C560		CORRIDOR	293 SF
C580		CORRIDOR	380 SF

TECHNOLOGY PLAN GENERAL NOTES

A. DEVICES SHALL BE INSTALLED AT LOCATIONS SHOWN ON DRAWINGS. LOCATIONS OF DEVICES SHALL BE COORDINATED WITH OTHER ELECTRICAL DEVICES/ CASEWORK/ ARCHITECTURAL FEATURES AND OTHER TRADES PRIOR TO ROUGH-IN. IF RELOCATION OF DEVICES IS REQUIRED DUE TO LACK OF COORDINATION BETWEEN ELECTRICAL DRAWINGS AND OTHER TRADES, ANY ASSOCIATED COSTS SHALL BE RESPONSIBILITY OF ELECTRICAL CONTRACTOR.

TECHNOLOGY PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

#	NOTE
T3	CLASSROOM AV SYSTEM VIDEO INPUT LOCATION. REFER TO DETAIL 1 ON SHEET T502.
T4	CLASSROOM SOUND REINFORCEMENT SYSTEM TO BE INSTALLED IN TEACHER CASEWORK SHELF. SEE DETAIL 2/T-502.
T5	LOCATION OF TR/TR-C1.1 TELECOMMUNICATION EQUIPMENT ROOM (IDF) WITH RACK, SWITCHES AND UPS ETC. REFERENCE TO DETAILS 3/T1.XX & 4/T1.XX FOR MORE INFORMATION.
T7	SEE DETAIL 1/T-503 FOR MULTIPURPOSE ROOM AV SYSTEM.
T8	SEE DETAIL 4/T-001 FOR MONITOR MOUNTING DETAIL AND 1/T-503 FOR AV SYSTEM DETAIL.
T19	PROVIDE A 1XX" DIAGONAL MOTORIZED PROJECTION SCREEN. SEE DETAIL XXX.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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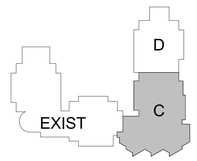
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KEY PLAN

BID DOCUMENTS



PROJECT MANAGER: PW
DRAWN BY: CD
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

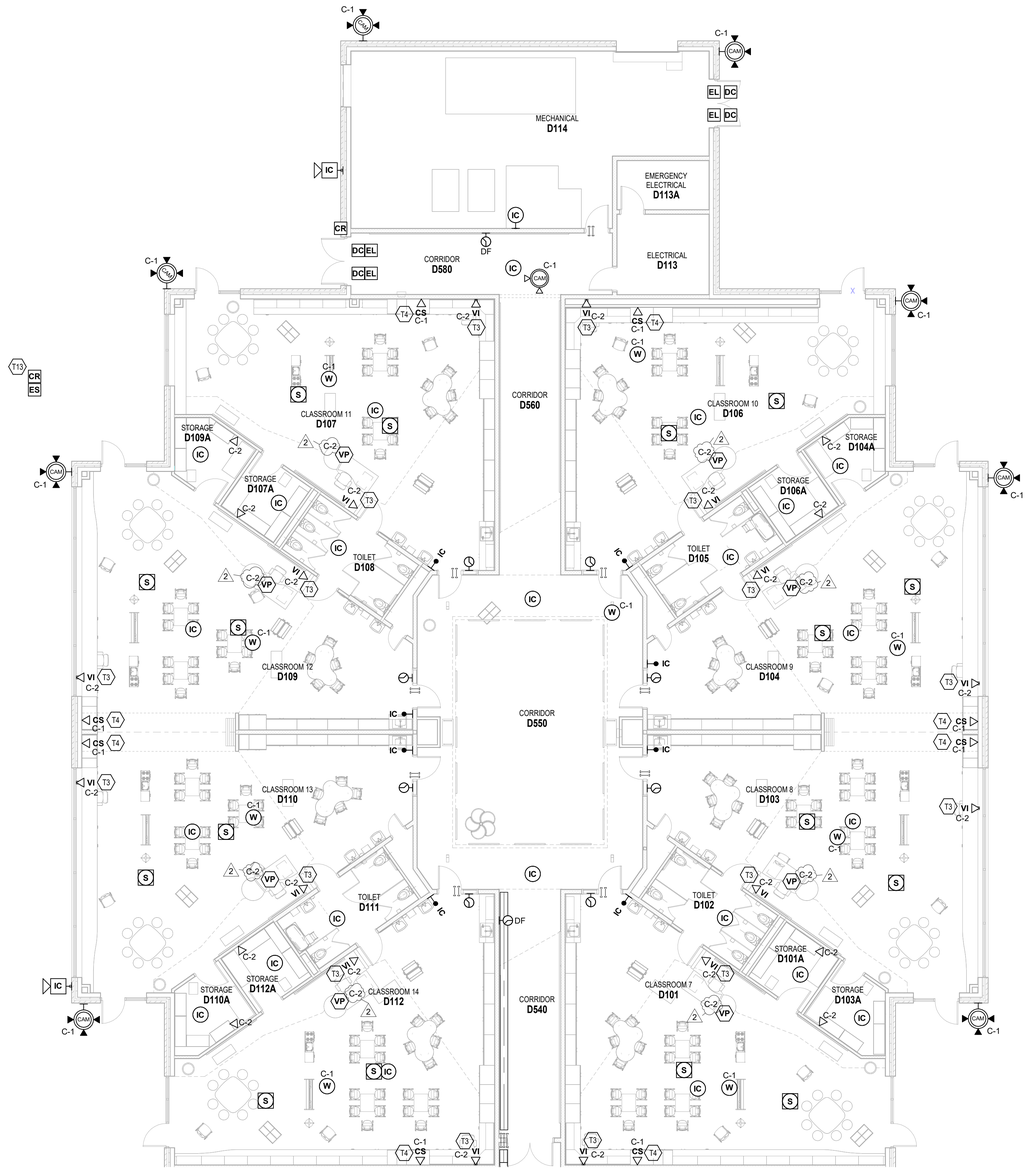
FIRST FLOOR TECHNOLOGY PLAN - UNIT C

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ROOM LEGEND

ROOM NO.	OWNER ROOM NO.	ROOM NAME	AREA (SF)
FIRST FLOOR			
C580		CORRIDOR	380 SF
D101		CLASSROOM 7	1076 SF
D101A		STORAGE	73 SF
D102		TOILET	135 SF
D103		CLASSROOM 8	1089 SF
D103A		STORAGE	83 SF
D104		CLASSROOM 9	1089 SF
D104A		STORAGE	79 SF
D105		TOILET	136 SF
D106		CLASSROOM 10	1045 SF
D106A		STORAGE	73 SF
D107		CLASSROOM 11	1083 SF
D107A		STORAGE	73 SF
D108		TOILET	135 SF
D109		CLASSROOM 12	1089 SF
D109A		STORAGE	79 SF
D110		CLASSROOM 13	1089 SF
D110A		STORAGE	83 SF
D111		TOILET	136 SF
D112		CLASSROOM 14	1076 SF
D112A		STORAGE	73 SF
D113		ELECTRICAL	126 SF
D113A		EMERGENCY ELECTRICAL	77 SF
D114		MECHANICAL	961 SF
D540		CORRIDOR	259 SF
D550		CORRIDOR	1170 SF
D560		CORRIDOR	293 SF
D580		CORRIDOR	273 SF



1 FIRST FLOOR TECHNOLOGY PLAN - UNIT D

SCALE: 1/8" = 1'-0"

TECHNOLOGY PLAN GENERAL NOTES

A. DEVICES SHALL BE INSTALLED AT LOCATIONS SHOWN ON DRAWINGS. LOCATIONS OF DEVICES SHALL BE COORDINATED WITH OTHER ELECTRICAL DEVICES/ CASEWORK/ ARCHITECTURAL FEATURES AND OTHER TRADES PRIOR TO ROUGH-IN. IF RELOCATION OF DEVICES IS REQUIRED DUE TO LACK OF COORDINATION BETWEEN ELECTRICAL DRAWINGS AND OTHER TRADES, ANY ASSOCIATED COSTS SHALL BE RESPONSIBILITY OF ELECTRICAL CONTRACTOR.

TECHNOLOGY PLAN NOTES

(ALL NOTES MAY NOT BE INDICATED ON THIS SHEET)

#	NOTE
T3	CLASSROOM AV SYSTEM VIDEO INPUT LOCATION. REFER TO DETAIL 1 ON SHEET T502.
T4	CLASSROOM SOUND REINFORCEMENT SYSTEM TO BE INSTALLED IN TEACHER CASEWORK SHELF. SEE DETAIL 2/T-502.
T13	PROVIDE ACCESS CONTROL EQUIPMENET FOR DOUBLE GATE ON PLAYGROUND. VERIFY EXACT LOCATION WITH FENCING CONTRACTOR.

VERIFICATION NOTE

CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CLEARANCES AND ALL EXISTING FIELD CONDITIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF CONDITIONS.

SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT THE ARCHITECT BEFORE PROCEEDING WITH WORK.

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PIKE MSD/NATHANIEL JONES ELC EXPANSION

7839 NEW AUGUSTA RD,
INDIANAPOLIS, IN 46268

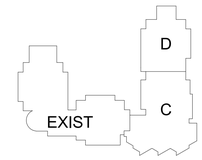
MSD OF PIKE TOWNSHIP

ARCHITECT

FANNING HOWEY

317-848-0966 WWW.FHAI.COM

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KEY PLAN N

BID DOCUMENTS

BRIAN W. BUTLER REGISTERED No. PE10800008 STATE OF PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: CD

PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

FIRST FLOOR TECHNOLOGY PLAN - UNIT D

T-11D

Autodesk Docs://Nathaniel Jones ELC - Add_Renov/2025_TECH_223216.00.rvt
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PIKE MSD/NATHANIEL JONES ELC EXPANSION

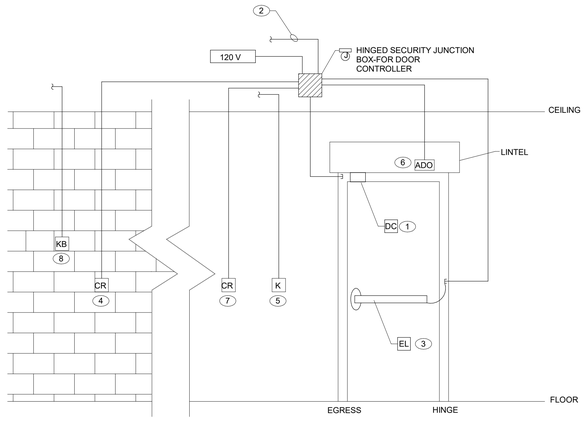
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INDIANAPOLIS, IN 46268

MSD OF PIKE TOWNSHIP

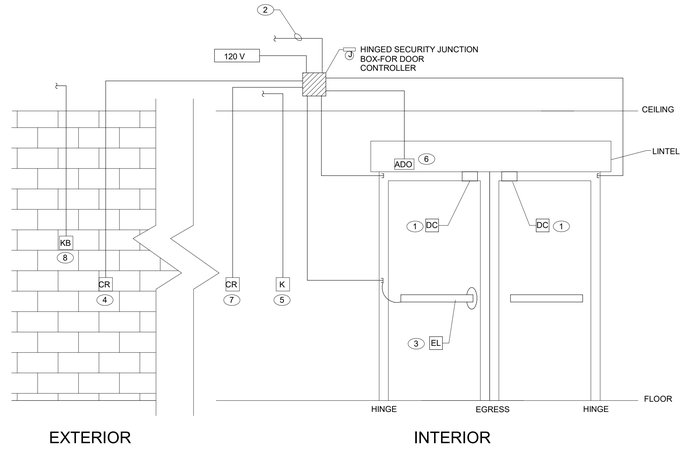
ARCHITECT

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350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



SINGLE DOOR ENTRY



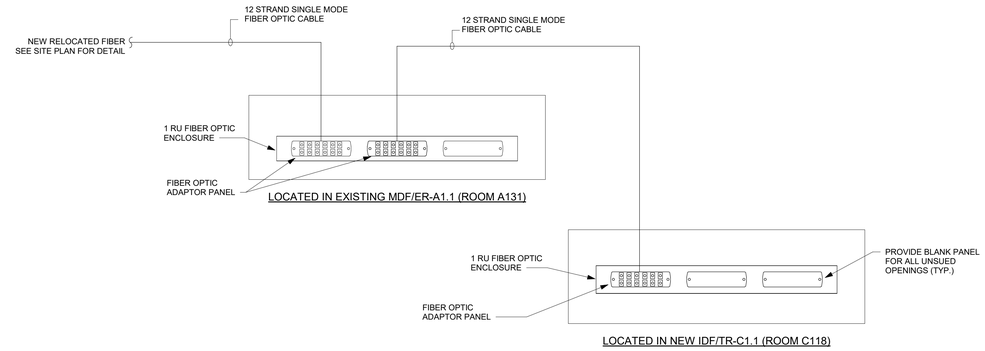
DOUBLE DOOR ENTRY

DOOR SECURITY WIRING LEGEND

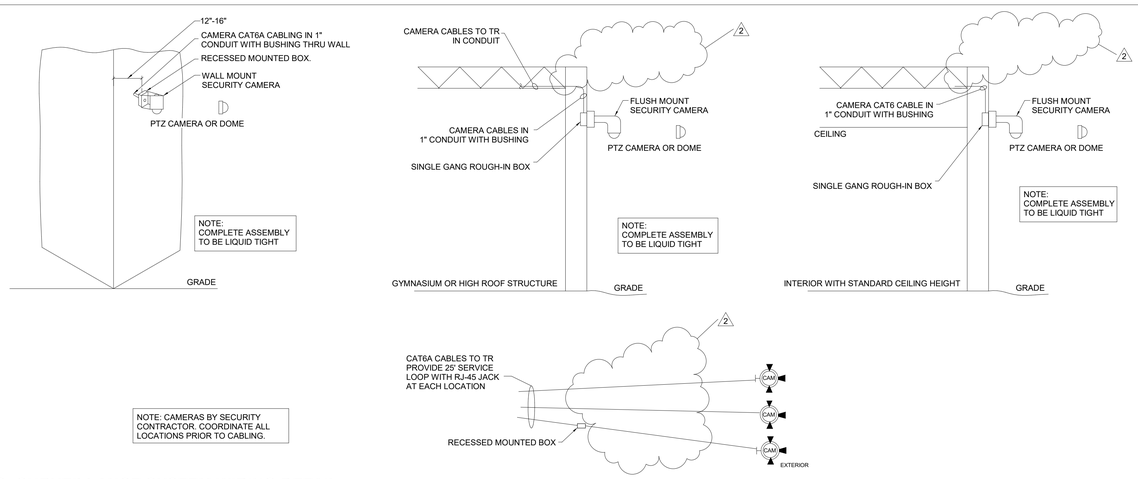
1. PROVIDE 22/2 AWG FOR DOOR CONTACT TO HINGED SECURITY JUNCTION BOX.
2. PROVIDE 4PR UTP FROM HINGED SECURITY JUNCTION BOX TO NEAREST TR OR MC/ER.
3. PROVIDE 18/6 AWG FOR POWER TRANSFER/ELECTRIC LATCH & REQUEST FOR EXIT MICRO SWITCH TO HINGED SECURITY JUNCTION BOX.
4. PROVIDE 22/6 AWG FOR CARD READER TO HINGED SECURITY JUNCTION BOX.
5. PROVIDE 22/6 AWG FOR KEYPAD TO NEAREST TR OR MC/ER.
6. PROVIDE 22/4 AWG FROM ADO OPERATOR TO HINGED SECURITY JUNCTION BOX.
7. PROVIDE 22/6 AWG FOR CARD READER TO HINGED SECURITY JUNCTION BOX. INTERFACE CARD READER WITH INTRUSION DETECTION SYSTEM TO DISABLE ALARM SYSTEM.
8. PROVIDE 22/2 AWG FROM FIRE DEPARTMENT KNOX BOX TO SECURITY SYSTEM IN THE NEAREST TR.

NOTE: TYPICAL DOOR WIRING DETAILS. ACCESS CONTROL SYSTEM AND CABLING PROVIDED BY SECURITY SYSTEM CONTRACTOR.

4 DOOR SECURITY HARDWARE DETAIL
NOT TO SCALE

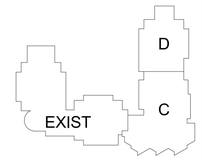


3 FIBER OPTIC BACKBONE DIAGRAM
NOT TO SCALE



2 SURVEILLANCE SYSTEM WIRING DETAIL
NOT TO SCALE

1 ROOM LABELING DETAIL
NOT TO SCALE



KEY PLAN

N

BID DOCUMENTS

BRIAN W. BUTLER REGISTERED No. PE19930008 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW
DRAWN BY: CD
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

TECHNOLOGY DETAILS

T-501

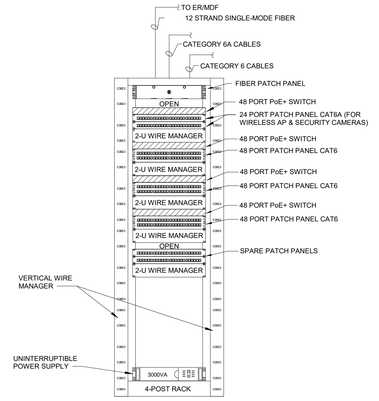
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DEVICE SCHEDULE - DATA DEVICE TOTALS

DEVICE TYPE	COUNT	Data Cables	Mounting Height	Tech Serving Room	Level
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Blank Tech Outlet	1	1	5' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-1 MON	1	1	11' - 8"	TR1-C118	FIRST FLOOR
Data Plate - C-1 MON	1	1	11' - 8"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Data Plate - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance Camera-EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - 45	1	1	12' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - 45	1	1	12' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	12' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	12' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - NS	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - NS	1	1	11' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - NS	1	1	12' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - NS	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Surveillance_Camera - NS	1	1	12' - 0"	TR1-C118	FIRST FLOOR

DEVICE SCHEDULE - DATA DEVICE TOTALS

DEVICE TYPE	COUNT	Data Cables	Mounting Height	Tech Serving Room	Level
Surveillance_Camera - NS	1	1	12' - 0"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Input Location - C-2	1	2	1' - 4"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Video Projector_C-1 - EW	1	2	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point - C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point - C-1 - NS	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point - C-1 - NS	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Wireless Access Point_C-1 - EW	1	1	10' - 0"	TR1-C118	FIRST FLOOR
Grand total	123	186			



IDF/TR-C1.1
IT CLOSET C118

NOTE:
CONTRACTOR TO VERIFY ALL PATCH PANEL QUANTITIES

1 IDF/TR RACK ELEVATION AND RISER
NOT TO SCALE

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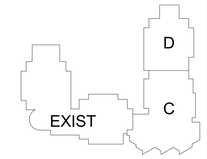
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INDIANAPOLIS, IN 46268

MSD OF PIKE TOWNSHIP

ARCHITECT

FANNING HOWEY

317-848-0966 WWW.FHAI.COM
350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



KEY PLAN N

BID DOCUMENTS

BRIAN W. BUTLER REGISTERED No. PE10800 STATE OF INDIANA PROFESSIONAL ENGINEER

PROJECT MANAGER: PW
DRAWN BY: CD
PROJECT NUMBER: 223216.00
PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

TECHNOLOGY DEVICE SCHEDULES

T-601

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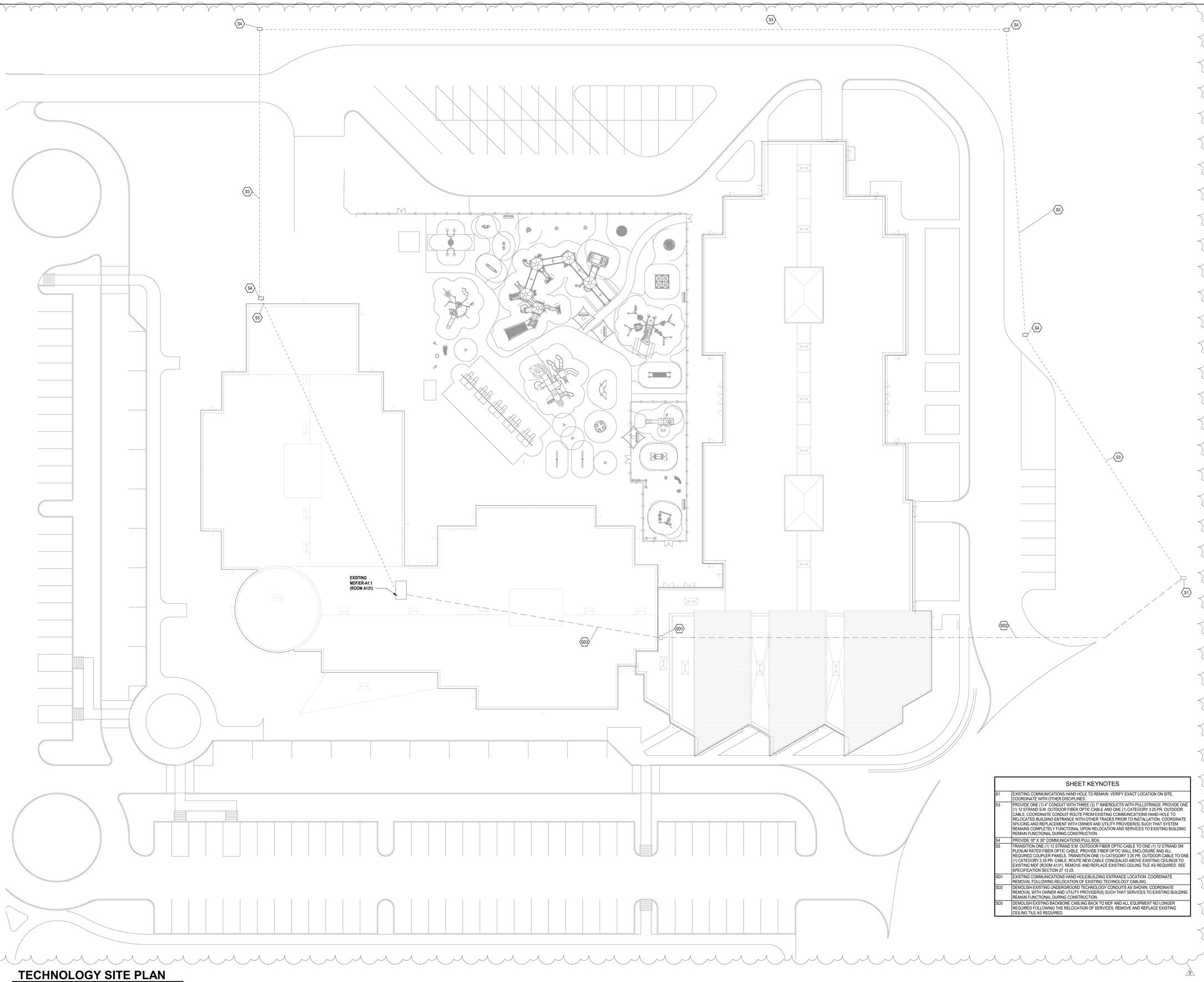
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INDIANAPOLIS, IN 46268

MSD OF PIKE TOWNSHIP

ARCHITECT

FANNING HOWEY

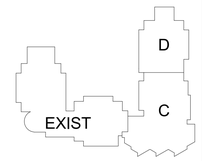
317-848-0966 WWW.FHAI.COM
350 E NEW YORK ST, SUITE 300, INDIANAPOLIS, IN 46204



TECHNOLOGY SITE PLAN

SCALE: 1" = 20'-0"

SHEET KEYNOTES	
S1	EXISTING COMMUNICATIONS HAND HOLE TO REMAIN. VERIFY EXACT LOCATION ON SITE, COORDINATE WITH OTHER DISCIPLINES.
S3	PROVIDE ONE (1) 4" CONDUIT WITH THREE (3) 1" INNERDUCTS WITH PULLSTRINGS. PROVIDE ONE (1) 12 STRAND S.M. OUTDOOR FIBER OPTIC CABLE AND ONE (1) CATEGORY 3 25 PR. OUTDOOR CABLE. COORDINATE CONDUIT ROUTE FROM EXISTING COMMUNICATIONS HAND HOLE TO RELOCATED BUILDING ENTRANCE WITH OTHER TRADES PRIOR TO INSTALLATION. COORDINATE SPLICING AND REPLACEMENT WITH OWNER AND UTILITY PROVIDER(S) SUCH THAT SYSTEM REMAINS COMPLETELY FUNCTIONAL UPON RELOCATION AND SERVICES TO EXISTING BUILDING REMAIN FUNCTIONAL DURING CONSTRUCTION.
S4	PROVIDE 18" X 36" COMMUNICATIONS PULL BOX.
S5	TRANSITION ONE (1) 12 STRAND S.M. OUTDOOR FIBER OPTIC CABLE TO ONE (1) 12 STRAND SM PLENUM RATED FIBER OPTIC CABLE. PROVIDE FIBER OPTIC WALL ENCLOSURE AND ALL REQUIRED COUPLER PANELS. TRANSITION ONE (1) CATEGORY 3 25 PR. OUTDOOR CABLE TO ONE (1) CATEGORY 3 25 PR. CABLE. ROUTE NEW CABLE CONCEALED ABOVE EXISTING CEILINGS TO EXISTING MDF (ROOM A131). REMOVE AND REPLACE EXISTING CEILING TILE AS REQUIRED. SEE SPECIFICATION SECTION 27 13 23.
SD1	EXISTING COMMUNICATIONS HAND HOLE/BUILDING ENTRANCE LOCATION. COORDINATE REMOVAL FOLLOWING RELOCATION OF EXISTING TECHNOLOGY CABLING.
SD2	DEMOLISH EXISTING UNDERGROUND TECHNOLOGY CONDUITS AS SHOWN. COORDINATE REMOVAL WITH OWNER AND UTILITY PROVIDER(S) SUCH THAT SERVICES TO EXISTING BUILDING REMAIN FUNCTIONAL DURING CONSTRUCTION.
SD3	DEMOLISH EXISTING BACKBONE CABLING BACK TO MDF AND ALL EQUIPMENT NO LONGER REQUIRED FOLLOWING THE RELOCATION OF SERVICES. REMOVE AND REPLACE EXISTING CEILING TILE AS REQUIRED.



KEY PLAN

N

BID DOCUMENTS

BRIAN W. BUTLER
REGISTERED
No.
PE19300
STATE OF
INDIANA
PROFESSIONAL ENGINEER

PROJECT MANAGER: PW

DRAWN BY: Author

PROJECT NUMBER: 223216.00

PROJECT ISSUE DATE: 03-13-2026

REV. NO.	DESCRIPTION	DATE
2	Addendum No. 2	03/26/2026

TECHNOLOGY SITE PLAN

TS101

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