

HCCSC Horace Mann Elementary HVAC Replacement

Project # 2025.0014

10-05-2026

ADDENDUM NO. 02

This addendum is issued as a supplement to the plans and specifications and shall be considered an integral part of the same. Acknowledgement of receipt of this addendum is required on the Bid Form.

Item: A-2.1

Location: All Electrical Sheets

Description: ADD a general box note to read: "Electrical Contractor shall disconnect, remove, protect during construction and reinstall light fixtures in all areas where fan-powered VAV units shall be replaced. Refer to the Architectural Reflected Ceiling Plans for additional information".

Item: A-2.2

Location: Sheet ED1.2

Description: Work Description Note #5, CHANGE to read: "Under alternate bid, disconnect existing condensing unit for replacement by others. Remove existing disconnect switch and conduit between switch and condensing unit. Remove existing mounting structure for disconnect switch. Existing conductors between switch and fused switch in MDP shall be removed with existing conduit to remain for re-use. See new electrical plan for additional work. Existing fuses shall be turned over to Owner for salvage."

Item: A-2.3

Location: Sheet ED1.2, Add Work Description Note #7 to Room Electrical B46

Description: Work Description Note #7, CHANGE to read: "Disconnect and remove existing 2x4 lay-in fixtures (2 total) and replace in same location with new. Fixture shall be Columbia #CBT24ALSCSEDD or equal by Cooper or Lithonia, multi-volt, 2x4 led flat panel, switchable lumens and color temp, set at high lumens and 40k color temperature."

Item: A-2.4

Location: Sheet ED1.2, Add Work Description Note #7 to Room Electrical B47

Description: Scope of work: disconnect and remove existing light fixtures (2) total, and replace with new fixture Type L1

Item: A-2.5

Location: Sheet E1.2

Description: Work Description Note #8: CHANGE to read: "Under alternate bid, provide new circuit to ACCU-1 from existing fused switch in MDP. Provide (3) 350A fuses and clips, as required. Circuit shall be (2) 4#3/0,1#3G in existing conduit. Provide new conduit from exterior LB connections to ACCU-1. Existing conduits shall be clean as per spec section 260533 prior to re-use."

Item: A-2.6

Location: Sheet E1.2

Description: Work Description Note #14; CLARIFICATION: Panel B1 is located outside Electrical B45 door, not inside as shown on the drawings.

Item: A-2.7

Location: General

Description: Contractors shall provide their own port-a-john for use by workers. Coordinate location with the school on site.

Item: A-2.8
Location: Specifications: Section 000110 – Table of Contents
Description: DELETE the existing Table of Contents and replace with New Table of Contents.

Item: A-2.9
Location: Specifications
Description: ADD the following specification: SECTION 019113 General Commissioning Requirements.

Item: A-2.10
Location: Specifications
Description: ADD the following specification: SECTION 220719 – Plumbing Piping Insulation.

Item: A-2.11
Location: Specifications
Description: ADD the following specification: SECTION 230719 – HVAC Piping Insulation.

Item: A-2.12
Location: Specifications: Section 230900 – Instrumentation and Control for HVAC
Description: Clarification: It is the intent of this project that the existing JCI temperature control system front end within the school is to be removed completely and a new Niagara 4 Distech Controls system is to be provided and installed by Two Cubed Solutions. It is the intent of this project that all existing HVAC units that are not being replaced shall be integrated into the new building automation system as well as all new HVAC equipment for a complete and fully functioning system. Temperature Controls Contractor shall provide and install all required valves, controllers, components, VFD's, relays, wiring, programing, graphics, ect.

Item: A-2.13
Location: Specifications: Section 230923 – BAS Direct Digital control system
Description: DELETE the existing section in its entirety and replace new attached section into the project manual.

Item: A-2.14
Location: Specifications: Section 230993 – Sequence of Operations for HVAC Controls
Description: DELETE the existing section in its entirety and replace new attached section into the project manual.

Item: A-2.15
Location: Mechanical Drawings: MD1.1A
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet MD1.1A.

Item: A-2.16
Location: Mechanical Drawings: MD1.1B
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet MD1.1B.

Item: A-2.17
Location: Mechanical Drawings: MD1.1C
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet MD1.1C.

Item: A-2.18
Location: Mechanical Drawings: MD1.1D
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet MD1.1D.

Item: A-2.19
Location: Mechanical Drawings: M1.1A
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet M1.1A.

Item: A-2.20
Location: Mechanical Drawings: M1.1A
Description: Revision: Revise the mechanical ductwork to add the duct static pressure sensor as shown on the attached revised sheet M1.1A.

Item: A-2.21
Location: Mechanical Drawings: M1.1B
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet M1.1B.

Item: A-2.22
Location: Mechanical Drawings: M1.1B
Description: Revision: Revise the mechanical ductwork as shown on the attached revised sheet M1.1B

Item: A-2.23
Location: Mechanical Drawings: M1.1C
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet M1.1C.

Item: A-2.24
Location: Mechanical Drawings: M1.1D
Description: Revision: Revise the mechanical piping as shown on the attached revised sheet M1.1D.

Item: A-2.25
Location: Mechanical Drawings: M5.1
Description: Revision: Revise the Series Fan Powered VAV Box Detail as shown on the attached revised sheet M5.1. It is the intent of this project that a working clearance for the VAV control panel be maintained. All piping, ductwork, conduit, and accessories are to be installed in a manner as to not have any control panel interference from its 90° door swing or below.

Item: A-2.26
Location: Mechanical Drawings: All
Description: Revision: Refer to attached documents and refer to answers to (RFI) questions.

Questions and Answers:

Question 1: All of the VAV heating valves are rated for 180 deg inlet temp. This building has HE boilers that are most efficient at 140 deg and below. Should these valves be re-worked for 140 deg inlet?

Response 1: No, Hydronic Hot water system and all hot water coils in the building have been sized for 180° F entering water temp.

Question 2: FPVAV-B9 schedule shows 4.0 GPM the drawing shows 1/2" lines to B9. Shouldn't the line size be 1"?

Response 2: Yes, change pipe size to 1 inch.

Question 3: FPVAV-B10 schedule shows 10.0 GPM the drawing shows 1" lines to B10. Shouldn't the line size be 1-1/4"?

Response3: Yes, change the pipe size to 1-1/4 inch.

Question 4: FPVAV-B11 schedule shows 10.0 GPM the drawing shows 3/4" lines to B11. Shouldn't the line size be 1-1/4"?

Response 4: Yes, change the pipe size to 1-1/4".

- Question 5:** The Air Terminal section in the Spec is ambiguous concerning who is to provide the control transformer, the factory or TCC. Can this be clearly stated?
- Response 5:** Provided by Factory.
- Question 6:** Can the original building prints be made available?
- Response 6:** Yes, see attached in Addendum 03.
- Question 7:** Point lists are indicating Boiler and Pumps work.
- Response 7:** Existing boiler and pumps are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system.
- Question 8:** Point list indicates electric reheat for both style of VAVs.
- Response 8:** VAV's are to be provided with hot water coils.
- Question 9:** Point list indicates CUH work. (these are currently controlled by the old JCI BAS)
- Response 9:** Existing CUH's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system
- Question 10:** Point list indicates UH work.
- Response10:** Existing UH's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system.
- Question 11:** Point list indicates Radiant Panel work.
- Response 11:** Existing Radiant Panel's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system.
- Question 12:** Point list indicates Exh Fans work, beyond the Alternate Bid.
- Response 12:** Existing Exhaust Fan's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system
- Question 13:** Drawings indicate TCC will do all ceiling grid and ceiling grid work. MG-1.0
- Response 13:** Refer to Addendum 01.
- Question 14:** Drawings indicate four locations for TCC panels. Will Div. 26 provide a 120 VAC circuit in these location for TCC use?
- Response 14:** TCC is to provide 120 VAC power to the control panels per the Controls Contractor Responsibility Matrix on sheet.
- Question 15:** Point list indicate the AHU will have two airflow stations. If this is correct, TCC will provide it?
- Response 15:** TCC is to provide a single air flow station for the air handler. Refer to the Air Handler Schedule for additional information.

SECTION 000110 - TABLE OF CONTENTS

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NOT APPLICABLE

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NOT APPLICABLE

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NOT APPLICABLE

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NOT APPLICABLE

END OF SECTION 000110

SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED WORK

- A. Division 23 - HVAC

1.2 REFERENCES

- A. Drawings and general provisions of contract, including general and supplementary conditions, general mechanical provisions and Division 01 Specification sections, apply to work of this section.
- B. AABC Commissioning (ACG) Guideline.
- C. ASHRAE Guideline 0 and 1.1

1.3 DESCRIPTION OF WORK

- A. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the Owner's Project Requirements (OPR) and construction documents. Commissioning is intended to achieve the following (but not limited to) specific objectives according to the Contract Documents
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that operating and maintenance (O&M) documentation is complete
 - 4. Verify that the Owner's operating personnel are adequately trained.

1.4 COMMISSIONING AUTHORITY

- A. The Commissioning Authority and/or agency is selected and employed by the Architect. The Commissioning Authority shall be experienced in the commissioning of mechanical and electrical systems of the type installed on this project. Experience in construction process, direct digital control systems, test and balance, LEED and ASHRAE Guidelines 1.1 & 0 is mandatory. The Commissioning Authority shall not be associated with or employed by any contractor, or equipment supplier providing services on this project. The Architectural firm has directly contracted an independent third-party commissioning agency (TechComm, Inc.) as the Commissioning Authority for this project. The Commissioning Authority will be representing the owner, Huntington County Community School Corporation through the commissioning process.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 SYSTEMS AND EQUIPMENT INCLUDED IN THE COMMISSIONING PROCESS

MECHANICAL

- A. Air handling units (100%)
- B. AHU return fans (100%)
- C. Variable Air Volume units (VAVs) (100%)
- D. DDC temperature control systems (BAS) (General review during functional testing.)

3.2 COMMISSIONING PLAN

A. Commissioning Team:

1. The Commissioning Team (CT) shall consist of key parties involved in design, construction, and testing of this facility. It is necessary for each agency to appoint team members that will have long-term commitments to this project. Switching team members during the project will reduce the ability of the CT to provide continuity and acceptable results to the building owner. Team members must maintain an ongoing supervisory position on this project. At least one team member shall be provided by each of the parties listed below:
 - a. Owner – Huntington County Community School Corporation
 - b. Commissioning Authority (CxA) – TechComm, Inc.
 - c. Design Team (DT)
 - Architect – Viridian Architectural Design, Inc.
 - Mechanical/Plumbing Engineer – SCO Engineering
 - Electrical Engineer – CHI Engineering
 - d. General Contractor (GC)
 - e. Mechanical Contractor (MC)
 - f. Sheet Metal Contractor (SM)
 - g. Temperature Control Contractor (CC)
 - h. Test and Balance Contractor (TAB)
 - i. Electrical Contractor (EC)

B. Commissioning Meetings:

1. Commissioning meetings will be held in conjunction with progress meetings whenever possible. The CxA will be on site for the Cx meetings. Commissioning meetings will be used to address any problems that alter the design intent or affect the commissioning process. These meetings provide an open forum for exchange of ideas between contractors, vendors, designers, users, and owners.

C. Resolution Tracking Form (RTF):

1. The use of the Resolution Tracking Form (RTF) will be employed by the CxA to monitor and record problems, their causes, and solutions. The use of these lists promotes communication between the installing contractors, design team, commissioning agent, and owner in order to expedite their resolution in a timely manner.

D. Start-Up:

1. During start-up, the installing contractor is responsible for completing the equipment manufacturer's start-up checklists. These lists must be completed by the installing contractor and submitted to the CxA for inclusion in the final commissioning report.
2. Start-up of major HVAC systems will be monitored by the CxA. The appropriate contractors and/or manufacturers' representatives will be required on site to perform start-up. No system will be started until the appropriate SIC's have been completed. No system is to be started until the manufacturers' checklists have been completed. Start-up will be performed according to the manufacturers' recommended procedures. The CxA will visit the site to review completeness of installation in conjunction with progress meetings prior to starting HVAC equipment.
3. Commissioning Team members involved in installation, fabrication, manufacture, control, or design of equipment are required to be present as needed at the time of start-up. A factory-authorized technician is to be on site to start equipment when required by the specifications. This will minimize delays in bringing equipment online and expedite acceptable functional performance in accordance with the construction documents.

E. Test and Balance (TAB):

1. In order to assure that the final TAB report format and content is acceptable, the TAB procedures and sample test forms will be reviewed by the CxA prior to the beginning of field TAB work.
2. TAB work will be monitored so that any problems that prevent or hinder proper air and water balance can be addressed and corrected with minimal delays. By addressing these problems as quickly as possible, we can assure that functional performance testing and owner training will take place on schedule.
3. A pencil copy of the TAB report is to be submitted to the CxA and Design Team for their review prior to conducting Functional Performance Testing. The CxA will be available during the TAB process in order to assist the TAB contractor in the effective completion of their scope of work.

F. Functional Performance Tests (FPT):

1. The CxA will write FPT's based on the Basis of Design and Construction Documents. These tests will be created for HVAC systems and sub-systems. See "Systems and equipment included in the commissioning process" above.
2. Each system and sub-system will be tested by the CxA in the presence of entire Commissioning Team. This testing will be coordinated by the CxA. Witnessing the FPT's can serve as a compliment to the O&M Training.
3. No FPT's will be performed until the system and related sub-systems have been started, a preliminary TAB report has been submitted and reviewed, and the completion of the control system has been documented through point-to-point verification checklists and/or other "checklist" type documentation verifying all components, sensors, meters, etc. are connected and functioning properly.
4. The Functional Performance Tests shall include HVAC and related equipment as defined in "Systems and equipment included in the commissioning process" above.
 - a. Equipment and system will be tested in all designed operating modes. Proper operation will be verified in automatic control and all other applicable modes, safeties, and interlocks will also be tested for proper operation as necessary to achieve Basis of Design conformance.
5. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and documented using either Resolution Tracking Form or through Field Reports.

- a. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution may or may not be documented.
 - b. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues.
 6. As tests progress and a deficiency is identified, the CxA will discuss the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - (a) The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the Sub corrects the deficiency, written notification is required indicating the equipment is ready to be retested.
 - (b) The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency
 - (a) The deficiency shall be documented with the subcontractor's response and a copy given to the Cx Team and to the contractor's representative assumed to be responsible.
 - (b) Resolutions are first made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E.
 - (c) The CxA documents the resolution process.
 - (d) Once the interpretation and resolution have been determined, the appropriate party corrects the deficiency, written notification is required indicating the equipment is ready to be retested. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 7. Cost of Retesting.
 - a. The cost to retest a failed functional performance test due to incomplete work or inadequate prerequisite checkout shall be the responsibility of the sub-contractor responsible for the deficiency. These costs may include labor, travel expenses, lodging, and any other expenses incurred due to the failed test.
 8. Off-season mode testing will be implemented as necessary to assure conformance with the BOD and construction documents. Installing contractors will be expected to participate as required by the project specifications.
- G. Building Turn-Over / Owner Orientation / User Training:
1. The CxA will review as-built drawings, working closely with each contractor to achieve specificity and completeness.
 2. Owner training will be organized, scheduled, and led by the CxA. The training will be provided by the installing contractor or manufacturer's representative and monitored by the CxA. This training should include both classroom training and hands-on operational training. The owner may choose to videotape this training for future use.
 3. The CxA will assist the owner/user with warranty issues.
 4. The CxA will assist in the coordination of off-season testing, calibrating, and servicing as specified in the contract documents.
 5. The CxA will submit a Commissioning Report.

3.4 ROLES AND RESPONSIBILITIES OF THE COMMISSIONING AUTHORITY (CxA)

- A. Commissioning Authority (CxA): The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance or deficiencies, but ultimately that responsibility resides with the General Contractor and the Design Team. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance that systems are functioning in accordance with the documented owner's requirements and in accordance with the Contract Documents. The Contractors participating in the commissioning will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified monitoring or testing equipment used by the CxA.
1. The primary point of responsibility of the CxA is to inform the construction manager, the owner and design team on the status, integration, and performance of HVAC systems within the facility.
 2. The CxA shall function as a catalyst and initiator to disseminate information and assist the design and construction teams in implementing completion of the construction process. This shall include verification of system installation, functional performance testing, and conformance with the intended design of each system. Services include: documenting construction observations, installation verification and functional performance testing, and documenting proper distribution of operating information to the owners O&M staff.
 3. The CxA is to assist the responsible parties in maintaining a high-quality level of installation by meeting or exceeding prevailing standards and specifications.
 4. The CxA shall observe and coordinate testing as required to assure system performance meets the design intent.
 5. The CxA shall document the results of the performance testing directly and/or assure that the appropriate technicians document testing.
 6. The CxA shall provide technical expertise to oversee and verify the correction of deficiencies found during the commissioning process.
 7. The CxA is to remain an independent party with specific HVAC knowledge of the project.
 8. The CxA shall investigate the scope and extent of construction issues and facilitate communication to help determine responsibilities and resolutions. The CxA shall monitor resolution for conformance with design intent and prevailing industry standards.
 9. The CxA shall document the date of acceptance as determined by the construction manager, owner and design team. Pre-Functional Checklists and Functional Performance Test results may be used in determining the start of the warranty period for HVAC systems and subsystems.
 10. The CxA will review phasing plans as provided by the CM relating to temporary use of HVAC equipment, O&M considerations, warranty issues, impact of construction sequencing on occupied areas, and interruption of services from the existing equipment.
 11. The CxA will monitor owner training to ensure it complies with the contract specifications.
 12. The CxA shall be an independent third-party agency. The CxA shall not be financially associated with any of the Division 02 through 26 installing contractors on this project to avoid potential conflicts of interest.

3.5 ROLES AND RESPONSIBILITIES OF THE OWNER

- A. Provide the "Owners Project Requirements" (OPR) documentation, if applicable, to the commissioning authority (CxA) for use in developing the Commissioning Plan.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to the following:

1. Commissioning and coordination meetings.
2. Major system and equipment start-up.
3. Demonstration of system operation - Functional Performance Testing.
4. Owner training sessions.

C. Provide utility services required for the commissioning process.

3.6 ROLES AND RESPONSIBILITIES OF THE DESIGN TEAM (DT)

- A. Include commissioning requirements in the mechanical, electrical, and controls contracts, as well as other subcontracts, to assure full cooperation of all parties in the HVAC commissioning process.
- B. Provide the "Basis of Design" (BOD) documentation, if applicable, to the Commissioning Authority (CxA) for use in developing the Commissioning Plan.
- C. Assure acceptable representation with the means and authority to prepare and coordinate execution of the mechanical commissioning program as described in the contract documents.
- D. Assure that the CxA shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings for review and use in development of the commissioning plan.
- E. Coordinate inclusion of commissioning activities in the construction documents.
- F. Facilitate resolution of deficiencies identified by observation or performance testing

3.7 ROLES AND RESPONSIBILITIES OF THE GENERAL CONTRACTOR (GC)

- A. Facilitate the coordination of the commissioning work by the CxA, and with the CxA ensure that commissioning activities are being scheduled into the project construction schedule. Include the cost of all commissioning activities in the contract price.
- B. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.
- C. In each purchase order or subcontract written, include the requirements for submittal data, O&M data, commissioning tasks and training.
- D. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
- E. Designate a representative who shall attend a commissioning kickoff meeting and other necessary meetings scheduled by the CxA to facilitate the Commissioning process.
- F. Assist with the coordinating the training of Owner operations and User personnel.
- G. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
- H. Ensure that Subcontractors execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

- I. Ensure that Subcontractors correct items of non-compliance and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

3.8 ROLES AND RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR (MC)

- A. Each contractor in this division shall include in their quote the cost of participating in the commissioning process.
- B. Include requirements for submittal data (including partial load data), O&M data, and training in each purchase order or sub-contract.
- C. Assure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, and water treatment in commissioning activities.
- D. Assure participation of major equipment manufacturers in appropriate startup, training, and testing activities.
- E. Attend commissioning meetings scheduled by the CxA.
- F. Assist the CxA in system verification and performance testing.
- G. Perform all pipe and duct system testing, flushing and cleaning as required by project specifications and codes. These tests must be completed by the installing contractor and test results submitted to the CxA for inclusion in the final commissioning report and/or O&M manual.
- H. Complete Pre-Functional Checklists and manufacturers pre-start checklists prior to scheduling startup of HVAC equipment.
- I. Monitor and respond to Cx Issues Log generated by the CxA in order to expedite corrective actions necessary to achieve design intent.
- J. Notify the CxA a minimum of two weeks in advance of scheduled system start-up.
- K. Update drawings to as-built condition and review with the CxA throughout the construction process.
- L. Schedule vendor and subcontractor provided training sessions as required by project specifications.
- M. Provide written notification to the DT and the CxA that the following work has been completed in accordance with the project specifications, and that the equipment, systems, and sub-systems are operating in accordance with design intent and are ready for Functional Performance Testing.
 - 1. HVAC equipment including fans, air handling units, dehumidification units, ductwork, dampers, terminal devices, etc.
 - 2. Fire detection and smoke detection devices furnished under other divisions as they affect the operation of the HVAC systems.
 - 3. That the Building Automation Systems are functioning in accordance to the design intent.
- N. Participate in the Functional Performance Tests as needed to achieve design intent.
- O. Participate in the off-season mode testing as needed to achieve design intent.

- P. Participate in O&M Training as required by project specifications.
- Q. Provide a complete set of as-built drawings and O&M manuals for review. The CxA shall review the as-built drawings and O&M manuals concurrently with the design team.

3.9 ROLES AND RESPONSIBILITIES OF THE TEST AND BALANCE CONTRACTOR (TAB)

- A. Include cost for commissioning requirements in the contract price.
- B. Attend commissioning meetings scheduled by the CxA.
- C. Submit the TAB procedures and sample TAB forms to the CxA for review at least two weeks prior to beginning TAB work.
- D. Notify the CxA a minimum of two weeks in advance of scheduled TAB work.
- E. Monitor and respond to Cx Issues Log generated by the CxA in order to expedite corrective actions necessary to achieve design intent.
- F. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the CxA for verification or diagnostic purposes.
- G. Participate in the Functional Performance Tests as needed to achieve design intent.
- H. Participate in the off-season mode testing as needed to achieve design intent.
- I. Participate in O&M Training as required by project specifications.

3.10 ROLES AND RESPONSIBILITIES OF THE TEMPERATURE CONTROL CONTRACTOR (CC)

- A. Include cost for commissioning requirements in the contract price.
- B. Review control sequence and component selection for conformance with design intent.
 - 1. Verify that specified safeties and interlocks have been selected.
 - 2. Verify proper selection of control valves and actuators based on design parameters.
 - 3. Verify proper selection of control dampers and actuators based on design parameters.
 - 4. Verify that sensor selection conforms to design intent.
- C. Attend commissioning meetings scheduled by the CxA.
- D. Provide the following submittals for use by the CxA:
 - 1. Hardware and software submittals.
 - 2. Control panel construction shop drawings.
 - 3. Narrative description of control sequences for each HVAC system and sub-system.
 - 4. Schematics showing all control points, sensor locations, point names, actuators, controllers, and where necessary, points of access.
 - 5. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.

6. A complete listing of all software routines employed in operating the control system. Also provide a program narrative that describes the logic flow of the software and the functions of each routine and sub-routine. The narrative should also explain individual math or logic operations that are not clear from reading the software listing.
 7. Hardware operation and maintenance manuals.
 8. Application software and project applications code manuals.
 9. Panel and equipment insert documents.
- E. Verify that specified interfaces provided by others are compatible with BAS (Building Automation System) hardware and software.
 - F. Coordinate installation and programming of BAS with construction and commissioning schedules.
 - G. Complete Pre-Functional Checklists and manufacturers' pre-start checklists prior to scheduling startup of HVAC equipment.
 - H. Submit point-to-point verification checklists and/or other "checklist" type documentation documenting that all control devices are calibrated and are installed and are operating as specified.
 - I. Provide control system technician to assist during equipment startup.
 - J. Monitor and respond to Cx Issues Log generated by the CxA in order to expedite corrective actions necessary to achieve design intent.
 - K. Provide a control system technician to assist during verification and performance testing.
 - L. Provide system modifications to achieve system operation as defined by the design intent.
 - M. Provide the CxA with on-site and remote access to the DDC control system.
 - N. Provide support and coordination for TAB contractor. Provide all devices, such as portable operator terminals and all software for the TAB to use in completing TAB procedures.
 - O. Provide written notification to the DT and the CxA that the TCC scope of work has been completed in accordance with the project specifications and that the equipment, systems, and sub-systems are operating in accordance with design intent, sensors have been calibrated, and that BAS is functioning in accordance with design intent and that systems are ready for Functional Performance Testing.
 - P. Participate in the Functional Performance Tests as required to achieve design intent. Provide all devices, such as portable operator terminals and all software for the CxA to use in completing the Functional Performance Tests.
 - Q. Submit as-built control drawings and sequences of operation that reflect the final installed conditions.
 - R. Participate in the off-season mode testing as required to achieve design intent.
 - S. Participate in O&M Training as required by project specifications. Include training on hardware operations and programming.
- 3.11 ROLES AND RESPONSIBILITIES OF THE SHEET METAL CONTRACTOR (SM)
- A. Include cost for commissioning requirements in the contract price.

- B. Include requirements for submittal data (including partial load data), O&M data, and training in each purchase order or sub-contract.
- C. Perform all duct system testing and cleaning as required by project specifications and codes. These tests must be completed by the installing contractor and submitted to the CxA for inclusion in the final commissioning report and/or O&M manual.
- D. Assure participation of major equipment manufacturers in appropriate startup, training, and testing activities.
- E. Attend commissioning meetings scheduled by the CxA.
- F. Complete Pre-Functional Checklists and manufacturers' pre-start checklists prior to scheduling startup of HVAC equipment.
- G. Monitor and respond to Cx Issues Log generated by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Update drawings to as-built condition and review with the CxA throughout the construction process.
- I. Schedule vendor and subcontractor provided training sessions as required by project specifications.
- J. Participate in the Functional Performance Tests as needed to achieve design intent.
- K. Participate in the off-season mode testing as required to achieve design intent.
- L. Participate in O&M Training as required by project specifications.

END OF SECTION 019113

SECTION 22 07 19 - PLUMBING PIPING INSULATION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Sanitary waste piping exposed to freezing conditions.
 - 5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Johns Manville; Micro-Lok.
- b. Knauf Insulation; 1000-Degree Pipe Insulation.
- c. Manson Insulation Inc.; Alley-K.
- d. Owens Corning; Fiberglas Pipe Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aero seal.
- b. Armacell LLC; Armaflex 520 Adhesive.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
- d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 5. Color: White or gray.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.

3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex.
 - b. Truebro; a brand of IPS Corporation.
 - c. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed or field cut sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install field cut sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install field cut sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 1. NPS 1 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral Fiber: 3/4 inch thick.
 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral Fiber: 1 inch thick.

END OF SECTION 22 07 19

SECTION 23 07 19 - HVAC PIPING INSULATION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:

1. Chilled-water piping, indoors and outdoors.
2. Heating hot-water piping, indoors.
3. DX Refrigerant piping, indoors and outdoors.

- B. Related Sections:

1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 3. Detail removable insulation at piping specialties.
 4. Detail application of field-applied jackets.
 5. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge or expanded rubber materials. Comply with ASTM C 534, Type 1 for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Owens Corning; Fiberglas Pipe Insulation.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-75.
 - d. K-Flex USA; R-373 Contact Adhesive.

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- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.

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- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 7. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: Color-code jackets based on system.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps, and mechanical joints.

D. Metal Jacket:

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
- b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
- c. RPR Products, Inc.; Insul-Mate.

- 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

- a. Factory cut and rolled to size.
- b. Finish and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
- d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Polyguard Products, Inc.; Alumaguard 60.

- F. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.

- G. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Chemical Company (The); Saran 560 Vapor Retarder Film.
- H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- 1. Products: Subject to compliance with requirements, provide one of the following:

-
- a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - 2. Width: 3 inches.
 - 3. Film Thickness: 4 mils.
 - 4. Adhesive Thickness: 1.5 mils.
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets,

- valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using

- adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water, above 40 Deg F:
 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 1. NPS 12 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

- C. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 1 inch thick.
- D. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 2 inches thick.
- E. Refrigerant Liquid Piping:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 2 inches thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 2 inches thick.
- D. Refrigerant Liquid Piping:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 2 inches thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. PVC: 30 mils thick.
2. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION 23 07 19

SECTION 23 09 23 BAS DIRECT DIGITAL CONTROL SYSTEM**PART 1 - GENERAL****1.1 RELATED SECTIONS**

- A. SECTION 23 09 00 BAS Instrumentation and Control
- B. SECTION 23 09 13, BAS Instrumentation and Control Devices
- C. SECTION 23 09 13.13, BAS Actuators and Operators
- D. SECTION 23 09 13.23, BAS Sensors and Transmitters
- E. SECTION 23 09 13.33, BAS Control Valves
- F. SECTION 23 09 13.43, BAS Control Dampers

1.2 REFERENCES

- A. Supplementing 23 09 00 1.2 References requirements.
 - 1. ANSI/ASHRAE 135-2004, BACnet^{®1} - A Data Communication Protocol for Building Automation and Control Networks including Addendums 135-2004a, 135-2004c, 135-2004d, 135-2004e, 135-2004f.

1.3 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- A. Supplementing 23 09 00 1.3 Acronyms, Abbreviations and Definitions requirements
 - 1. Acronyms used in BAS.
 - a. AI - Analog Input
 - b. AO - Analog Output
 - c. BACnet[®] - Building Automation and Control Network
 - d. BAS - Building Automation System
 - e. CAD - Computer Aided Design
 - f. CDL - Control Description Logic
 - g. COSV - Change of State or Value
 - h. CPU - Central Processing Unit
 - i. DI - Digital Input
 - j. DO - Digital Output
 - k. ECU - Equipment Control Unit
 - l. IDE - Interface Device Equipment
 - m. LAN - Local Area Network
 - n. LCU - Local Control Unit
 - o. NCU - Network Control Unit
 - p. Niagara4 – Software framework for building device-to-enterprise applications and Internet-enabled products.

- q. OS - Operating System
- r. OWS - Operator Work Station
- s. PC - Personal Computer
- t. PCI - Peripheral Control Interface
- u. PCMCIA - Personal Computer Micro Card Interface Adapter
- v. RAM - Random Access Memory
- w. ROM - Read Only Memory
- x. TCU - Terminal Control Unit
- y. USB - Universal Serial Bus
- z. UPS - Uninterruptible Power Supply

B. Definitions:

1. Point: a point may be logical or physical. Logical points are values calculated by system such as totals, counts, derived corrections i.e. as result of and/or statements in CDL's. Physical points are inputs or outputs, which have hardware, wired to controllers which are measuring or providing status conditions of contacts or relays providing interaction with related equipment (stop, start) or valve or damper actuators.

C. Symbols and Engineering unit abbreviations utilized in displays: to ANSI/ISAS 5.5.

1. Printouts: to ANSI/IEEE 260.

1.4 BAS CONTRACTOR QUALIFICATIONS

A. Supplementing 23 09 00 1.12 BAS Contractor Qualifications.

1. The contractor must be primarily and regularly engaged in the service and installation of BACnet and Niagara4 as specified herein.
2. The Contractor shall have a minimum of 10 years' experience in the sales, installation, engineering, programming, servicing and commissioning of Niagara systems.
3. The Contractor must be an authorized factory direct representative in good standing of the manufacturer of the proposed hardware and software components. Upon request, provide a letter dated within the last 12 months, from the manufacturer certifying that the Contractor is an authorized factory direct representative.
4. The Contractor shall provide proof that the lead onsite technician for this project has completed the factory authorized training of the proposed manufactures' hardware and software components and have successfully completed Niagara4 certification course(s).
 - a. Contractor must provide proof of required training.
 - b. The Contractor's capabilities shall include engineering and design of control systems, programming, electrical installation of control systems, troubleshooting and service.
5. The contractor shall submit a list of no less than three (3) similar (in function, application and design) projects, which have similar Building Automation Systems as specified herein installed by the Contractor.
 - a. These projects must be on-line and functional such that the Owner's/User's representative can observe the system in full operation.

1.5 GENERAL DESCRIPTION

A. Supplementing 23 09 00 1.5 General Description requirements.

1. System to be "Open Protocol".
 - a. BACnet® communications protocol will be used for communications.
2. Work covered by sections referred to above consists of fully operational BAS, including, but not limited to, following:
 - a. Building Controllers NCU, LCU, TCU.
 - b. OWSs.
 - c. Data communications equipment necessary to achieve a BAS data transmission system including LAN hardware and software for a BACnet® system.
 - d. Software complete with full documentation for software and equipment.

1.6 WORK INCLUDED

- A. Supplementing 23 09 00 1.10 Work Included requirements.
- B. The Installer furnishing the BAS network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network.
 1. The variable frequency drive (VFD) vendor shall furnish VFDs with an interface to the control and monitoring points specified utilizing:
 - a. Hardwired connections such as relay(s) and 0-10VDC.
 - b. BACnet/IP network connection.
 2. Energy and utility metering shall interface to the BAS system and provide the monitoring points specified herein utilizing:
 - a. Hardwired connections such as relay(s) and 0-10VDC.
 - b. BACnet/IP network connection.
 3. The Owner or his designated representative shall be present at this meeting.
 4. Each Installer shall provide the Owner and all other Installers with details of the proposed interface, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories.
 5. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS network.
 6. Submittals for these products shall not be approved prior to the completion of this meeting.
- C. Provide new controllers of the latest revisions with input and output points as specified herein.
- D. Furnish and install all controllers to achieve system operation, any control devices, conduit and wiring, in the facility as required to provide the operation specified.
- E. Furnish and load all software required to implement a complete and operational BAS.

1.7 SYSTEM DESIGN RESPONSIBILITY

- A. Supplementing 23 09 00 1.13 System Design Responsibility requirements.

1. Supply sufficient programmable controllers of all types to meet project requirements. Quantity and points contents to be approved by Owner prior to installation.
 - a. Local Control Units (LCU) shall be utilized for primary mechanical and electrical systems such as Air handling equipment, Make-up Air Unit, Boiler System Control, and Chiller System Control type of applications.
 - b. Terminal Control Units (TCU) shall be utilized for terminal equipment, such as Variable Air Volume, Fan Coil, Heat Pump, Roof Top, and Chilled Ceiling type of applications.
 - c. Each NCU and each LAN shall have the capability of accepting 20% additional LCU/TCU(s) without the necessity of adding additional LAN controllers or LAN wiring.
 - d. The LCU and TCU controller programming or configuration tools (see section 23 09 13 2.2 shall be fully accessible through the Operator Workstation and Web Browser Client.
 - e. All LCUs and TCUs shall be furnished with extended memory. No LCU/TCU shall be provided with less than 128 MB of RAM. The number of controllers attached to any NCU shall not exceed the following limits:

Combined Memory	Maximum Number of Controllers
128 MB SDRAM / 64 MB Serial Flash	25
256 MB DDR RAM / 128 MB Serial Flash	50
1 GB DDR2 RAM / 1 GB Serial Flash	125

2. Regardless of the maximum number of controllers indicated above, it is ultimately the exclusive responsibility of the systems integrator/building controls contractor to ensure that the NCU has adequate resources for the number of controllers attached to it.
3. Niagara4 Network Manager Server software shall be furnished and installed on a server grade PC for applications requiring two or more NCUs.

1.8 BUILDING AUTOMATION SYSTEM (BAS)

- A. The contractor shall be responsible for the hardware and software for the enterprise framework and system integration required for the complete Building Automation System.
- B. The BAS shall be comprised of Network Control Units (NCU) connected to the Building Automation System local area network (BAS LAN).
 1. Access to the BAS, either through a Workstation on the BAS LAN, within the building or through a Wireless Application Protocol device, or remotely through the Internet, shall be accomplished through a standard Web browser.
 2. Each NCU shall communicate to BTL Listed BACnet controllers provided under the Programmable Controllers section.
 3. Each NCU shall communicate to LonMark Certified LonWorks controllers provided under the Programmable Controllers section.
- C. The system includes software and programming of the NCU(s), Operator Workstation(s) (OWS) software and hardware, development of all graphical screens, setup of schedules, trends, logs and alarms, network management and connection of the NCU(s) to the local area network.

1.9 SYSTEM DESIGN

- A. The system shall consist of a network of Network Control Units (NCUs), interoperable Local Control Units (LCUs) and Terminal Control Units (TCUs) (VAV Box Controllers, Fan Coil Unit Controllers, etc.). All controllers for terminal units, air handling units (AHU) and controllers shall communicate and share data, utilizing BACnet communications protocols only
- B. The intent of this specification is to provide a distributed and networked open Building Automation System, the capability to integrate ANSI/ASHRAE Standard 135, BACnet and ISO/IEC 14908-1: Open Data Communication in Building Automation, Controls and Building Management – Control Network Protocol into a unified system in order to provide flexibility for expansion, maintenance, and service of the system.
- C. The proposed system must maintain strict adherence to industry standards including ANSI/ASHRAE Standard 135, Annex L, and Device Profile to assure interoperability between all system components. BACnet system must be tested and listed on BACnet Testing Laboratory (BTL) web site. Systems based on vendor specific proprietary hardware or software will not be considered for this project.
- D. Systems utilizing gateways to proprietary communication systems will not be considered for this project. A gateway is considered to be a device or controller where the sole function is mapping of data points from one protocol to another. A gateway device cannot perform higher-level energy management functions such as Outdoor Air Optimization, Electrical Demand Limiting and the like.
- E. The supplied system software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI/ASHRAE™ Standard 135, BACnet to assure interoperability between all system components is required.
- F. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a flat single tiered architecture shall not be acceptable. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 10 seconds for network connected user interfaces. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.
- G. User Access
 - 1. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs.
- H. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system databases, all controller program graphics and network databases which shall be provided in a Niagara4 Framework format.
 - 1. This data shall reside on a supplier-installed server for all database access.
 - 2. Systems requiring proprietary database and user interface programs shall not be acceptable.

I. Software Tools

1. Three copies of all software, software tools, and hardware tools, needed for full functional use, including programming of field controllers, network management and expansion, and graphical user interface use and development, of the BAS described within these specifications shall be provided, loaded and tested by the owners' direction or their designated agent.
 - a. Any licensing required by the manufacturer from the beginning of this project and to 10 years beyond the completion of the warranty period. This shall include changes to the licensee of the software tools and the addition of hardware corresponding to the licenses, to allow for a complete and operational system for both normal day to day operation and servicing shall be provided.
 - b. Any such changes to the designated license holders shall be made by the manufacturer upon written request by the owner or owner's agent.
 - c. Any cost associated with the license changes shall be identified within the BAS submittals. The absence of this will indicate that license changes will be provided at no cost to the owner or the owner's agent.
 - d. A full 'Admin' rights account will be provided, in every controller, to the owner's agent.
 - e. This is not intended to include computers, laptops, tablets, nor the Niagara4 software.
 - f. By submitting a bid for this project, you agree to these software tools requirements and shall be bound to them as a winning bidder.
2. All software and software tools needed for full functional use of the Niagara4 Framework network management and expansion, and graphical user interface use and development, of the BAS described within these specifications shall be provided to the owner or their designated agent.
 - a. The most current revision of Niagara4 will be provided and installed at the end of the warranty period. This will include the Server and all JACEs installed as part of this project.
 - b. Niagara4 software updates shall be provided free of charge, but not including labor, for two years after the end of the warranty period. This shall be accomplished by software subscription.
 - c. Any licensing required by the manufacturer now and to 10 years beyond the completion of the warranty period, including changes to the licensee of the software tools and the addition of hardware corresponding to the licenses, to allow for a complete and operational system for both normal day to day operation and servicing shall be provided.
 - d. Any such changes to the designated license holders shall be made by the manufacturer upon written request by the owner or owner's agent.
 - e. A full 'Admin' rights account will be provided, in every controller, to the owner's agent.
 - f. Any cost associated with the license changes shall be identified within the BAS submittals. The absence of this will indicate that license changes will be provided at no cost to the owner or the owner's agent.
 - g. By submitting a bid for this project, you agree to these software tools requirements and shall be bound to them as a winning bidder.

J. Software License Agreement

1. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract.

2. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
 - a. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).
 - b. In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project.
 - c. This shall include all custom, job specific software code, databases and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NCU, Server, OWS and any related LAN/WAN/Intranet and Internet connected routers and devices.
 - d. Any and all required User IDs and passwords for access to any component or software program shall be provided to the owner.

1.10 DYNAMIC DATA ACCESS

- A. All operator devices shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment.

1.11 NETWORKS

- A. The BAS network(s) must be based on Open Systems and BACnet IP exclusively.
- B. Niagara4 shall be used at the network levels as the manager(s).
- C. High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices.
- D. Support of any combination of controllers and operator workstations directly connected to the local area network. A minimum of 50 devices shall be supported on a single local area network.
- E. Detection and accommodation of single or multiple failures of workstations, controller panels and the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
- F. Message and alarm buffering to prevent information from being lost.
- G. Error detection, correction, and retransmission to guarantee data integrity.
- H. Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
- I. Commonly available, multiple sourced, networking components shall be used to allow the system to coexist with other networking applications such as office automation. Ethernet to IEEE 802.3 standard is the only acceptable technology.
- J. Synchronization of the real-time clocks in all NCU panels shall be provided.

- K. The BAS LAN shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, SOAP, OBIX, SNMP and SMTP Protocols for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Control Units (NCUs), user workstations and where specified, a local server. Local area network minimum physical and media access requirements:
1. Ethernet; IEEE standard 802.3
 2. Cable; 100 Base-T, UTP-8 wire, category 5e
 3. Minimum throughput; 100 Mbps
 4. Provide access to the BAS LAN via a Wireless Application Protocol (WAP) device. Through this connection the BAS LAN will provide authorized staff with the ability to monitor and control the BAS from any location within the through a web browser, or web enabled devices.
 5. Provide access to the BAS LAN from a remote location, via the Intranet or Internet. The owner shall provide (in future) a connection to the Internet to enable access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or access to an Internet Service Provider (ISP). If required, the owner will provide a switch/firewall between the building LAN and the BAS LAN. Through this connection the BAS LAN will provide authorized staff with the ability to monitor and control the BAS from a remote location through a web browser, or web enabled devices.
- L. Controller Local Area Network (BAS sub LAN)
1. Provide a network of stand-alone, distributed direct digital controllers that operate on the following protocol using the specified physical layers:
 - a. Controllers using proprietary protocols or protocols other than listed herein are unacceptable.
 2. The design of the BAS sub LAN shall network Local Control Unit (LCU) and Terminal Control Unit (TCU) to a Network Control Unit (NCU).
 3. This level of communication shall support a family of application specific controllers and shall communicate bi-directionally with the network through DDC Controllers for transmission of global data.
 4. Terminal Control Unit (TCU) shall be arranged on the BAS sub LAN's in a functional relationship manner with Local Control Unit (LCU). Ensure that a Variable Air Volume (VAV) Terminal Control Unit (TCU) is logically on the same LAN or segment as the Local Control Unit (LCU) that is controlling its corresponding Air Handling Unit (AHU).

PART 2 - PRODUCTS

2.1 QUALITY ASSURANCE

- A. Supplementing 23 09 00 2.1 Quality Assurance requirements.
1. The manufacturer of the Building Automation System digital controllers shall provide documentation supporting compliance with ISO 9001:2000 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing).
 2. Provide a copy of the registration certificate that contains the ISO 9001:2000 Certification bearing the name of the registered auditor.
 3. Control products such as direct digital controllers, control valves, actuators, sensors and transmitters shall be provided from a single manufacturer.

- a. Provide product literature that bears the name of the manufacturer on all direct digital controllers, control valves, actuators, sensors and transmitters.
4. Provide satisfactory operation without damage at 110% above and 85% below rated voltage and at 3 hertz variations in line frequency. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Bus connected devices shall be AC coupled, or equivalent so that any single device failure will not disrupt or halt bus communication.
5. All controllers provided as part of this system and used for indoor applications shall operate under ambient environmental conditions of 32 °F to 122 °F dry bulb and 5% to 90% relative humidity, non-condensing as a minimum.
6. All controllers provided as part of this system and used for outdoor applications shall operate under ambient environmental conditions of -40 °F to 158 °F dry bulb and 5% to 90% relative humidity, non-condensing as a minimum.

2.2 ACCEPTABLE SYSTEM MANUFACTURERS

- A. Provide a building automation system supplied by a company regularly engaged in the manufacturing and distribution of building automation systems. The BAS Manufacturer shall meet the following qualifications as a minimum:
 1. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of building automation systems as specified herein, and must have been so for a minimum of ten (10) years.
 2. The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the BACnet International.
 3. At least 75% of the manufactured product line shall be produced under their own direction, including R&D and assembly. Rebranding of another manufacture product shall not qualify.
- B. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll-free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- C. The contractor shall have Tridium's Niagara platform as their main software solution for supervisory controllers and site Supervisors.
- D. The contractor shall have Distech Controls brand controllers as at least 95% of their installations within the last 10 years.
- E. Acceptable Manufacturers
 1. Distech Controls as provided by Two Cubed Solutions, LLC.
- F. The existing front end workstation and graphics shall be replaced as required to match the building automation system that has been installed at the High School and shall meet the owners requirements. New equipment shown on these drawings are to have all new DDC controls and all existing HVAC equipment shall be integrated into the new system and graphics. Programming and commissioning of field controllers, supervisory controllers, graphics and integration to be by Two Cubed Solutions and included in the scope of work. TCC shall be responsible to provide and install all required components, valves, relays, sensors, wiring, accessories required for integration for a complete and functioning system.

- G. Control system shall consist of Niagara 4 framework, sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- H. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- I. Acceptable manufacturers wishing to seek equivalency to any of the above controls offerings, then the manufacturer or vendor will be subject to the original pre-qualification criteria that were used to qualify the 'Acceptable Manufacturers'. The contractor shall have Tridium's Niagara platform as their main software solution for supervisory controllers and site supervisors. Acceptable Manufacturers'. Failure to meet the qualifications will render the proposed solution by such a manufacturer or vendor as ineligible.

PART 3 - EXECUTION

3.1 PRELIMINARY DESIGN REVIEW

- A. Supplementing 23 09 00 3.8 Preliminary Design Review requirements.
 - 1. The BAS contractor shall submit a preliminary design document for review. This document shall contain the following information in addition to the requirements of 23 09 00:
 - a. Provide product brochures and a technical description of the Network Control Unit (NCU) software required to meet this specification. Provide a description of software programs included.
 - b. Open Protocols - For all direct digital controller hardware BACnet Protocol Implementation Conformance Statement PICS. Provide complete description and documentation of any proprietary services and/or objects were used in the system.
 - c. Submit the Niagara Compatibility Statement (NiCS) verifying that all aspects of the Niagara Framework as provided to maintain an Open System Design. The System as provided shall confirm with the following NiCS properties.

<u>Property</u>	<u>Value</u>
Station Compatibility IN	All
Station Compatibility OUT	All
Tool Compatibility IN	All
Tool Compatibility OUT	All
 - 2. Provide a description and samples of Operator Workstation graphics and reports.
 - 3. Provide a URL address for the engineer to view the proposed functionality via a web-based BAS through a standard web browser.

3.2 SUBMITTALS

A. Supplementing 23 09 00 3.9 Submittals requirements.

1. Control System Shop Drawings

- a. Detailed system architecture and points list showing all points associated with each controller, controller locations, and describing the spare point capacity at each controller and BAS LAN.

2. Direct Digital Control System Hardware

- a. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of BACnet controller.
- b. Bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- c. Manufacturer's description and technical data such including product specifications and installation and maintenance instructions for items listed herein:
 - 1) Direct digital controllers (BACnet IP)
 - 2) Sensors and Transmitters
 - 3) Transducers
 - 4) Actuators
 - 5) Automatic Control Valves
 - 6) Automatic Control Dampers
 - 7) Air Flow Stations
 - 8) Control panels
 - 9) Operator interface equipment
 - 10) Ancillary equipment such as relays, power supplies and wiring
- d. Riser diagrams showing control network layout, communication protocol, and wire types.

END OF SECTION 23 09 23

SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.
- B. Division 23 Section "Common Work Results for HVAC".
- C. Division 23 Section "Facility Management Systems".

1.2 DESCRIPTION OF WORK

- A. The sequence of operations included within this specification for all existing equipment is meant to be for reference only, It is the intent of this project that all existing sequence of operations for all equipment shall remain unchanged. The project consists of a "One for One" mechanical HVAC equipment replacement of an Air Handler and multiple VAV's.
- B. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.
- C. HVAC Systems shall be controlled with a Direct Digital Control (DDC) system, sometimes referred to as a Facility Management System (FMS), according to the point list contained at the end of this section. Additional hardware, input/output points or software programming not specifically identified in the point list but which are required to meet the following sequences of operation shall be provided.
- D. All electrical Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a NEMA 1 enclosure with a lockable door.
- E. All adjustable settings are to be Owner adjustable.

1.3 DEFINITIONS

- A. FMS: Facility management system
- B. DAT: Discharge air temperature.
- C. VSD: Variable speed drive.
- D. DX: Direct expansion.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ALARMS

- A. Generate an alarm at the computer graphics when any space temperature is <50 deg F for 15 minutes (adjustable) and an immediate alarm when any space temperature is <40 deg F (adjustable).
- B. Coordinate with the owner to identify alarms as "general" or "critical". General alarms will only be displayed at the computer graphics. Critical alarms will be displayed in the computer graphics program and dialed-out, emailed, or text messaged to pre-programmed telephone numbers and email address via the internet.

3.2 MONITORING SEQUENCES

- A. Monitor temperature of cooler and freezer.
- B. Monitor space temperature of Kitchen Storage and all IT/Server rooms and generate an alarm message at the computer graphics if space temperature falls below 50 deg F (adj.) or rises above 75 deg F (adj.).

3.3 TERMINAL UNITS' CONTROL SEQUENCES

- A. Unit Heater Control (Hot Water): FMS shall cycle fan motor and 2 position hot water valve to maintain space temperature between set point and 2 deg F (adjustable) below set point.
 - 1. De-energize unit when hot water supply water temperature falls below 95 deg F (adjustable) and outside air temperature is 80 deg F or above (adjustable).
- B. Cabinet Unit Heater Control: FMS shall cycle fan motor and 2-position hot water valve to maintain space temperature between set point and 2 deg F (adjustable) below set point.
 - 1. De-energize unit when hot water supply water temperature falls below 95 deg F (adjustable) and outside air temperature is 80 deg F or above (adjustable).
- C. Convactor Control: FMS shall cycle a 2-position hot water valve to maintain space temperature between set point and 2 deg F (adjustable) below set point.
 - 1. De-energize unit when hot water supply water temperature falls below 95 deg F (adjustable) and outside air temperature is 80 deg F or above (adjustable).
- D. Finned Tube Radiators: FMS shall cycle a 2-position hot water valve to maintain space temperature between set point and 2 deg F (adjustable) below set point.

3.4 AIR HANDLING UNITS CONTROL SEQUENCES

- A. Safety Controls for Air Handling Units:
 - 1. Provide a low-limit controller to prevent unit discharge air from falling below 45 deg F (adjustable). Sensor shall be located at the discharge of the unit.

2. Provide an electric low limit thermostat with a 20-foot element serpentine across the face of the leaving air side of the heating coil which will stop the supply fan, close the outside air damper (and relief dampers if applicable), and position heating control valve for full coil water flow.
3. Provide strap-on aquastat on the leaving water side of the hot water coil to stop the supply fan, close the outside air damper (and relief dampers if applicable), and position control valve for full coil water flow if leaving water temperature drops below 40 deg F (adjustable).
4. Provide a high-limit controller to prevent unit discharge air from rising above 125 deg F (adjustable). Sensor shall be located at the discharge of the unit.

B. AHU-1 and AHU-1A:

1. Occupied Mode: Open outside air damper to provide minimum outside air cfm on schedule. Supply fan shall operate continuously. Unit mounted ECM fan motors shall modulate supply fan speed to maintain the variable air volume (VAV) terminal unit with the greatest call for cooling at least 85% open. Increase duct static pressure at a rate of 0.25" every 10 minutes (adjustable) until any VAV terminal unit exceeding 95% open, closes down to 85% open. Duct static pressure shall be determined by the pressure sensors located 2/3 down the longest duct run or as shown on the drawings. A high limit discharge pressure sensor, located at the fan discharge, shall prevent the supply fan from generating a discharge pressure greater than 6.5" w.c. (adjustable). The outside air damper is to be set at minimum position to achieve design outside airflow with the fan at full speed. The outside air damper is to open on a reset schedule in proportion to the fan speed as it slows down. Activate stages of DX cooling as required to maintain discharge air temperature set point. Cooling minimum DAT shall be 55 deg F (adj.). If outside air temperature is 3 degrees less than the space return temperature, and outside air temperature is less than 72 degrees, and cooling is required, modulate outside air damper open to provide economizer cooling. A mixed air temperature sensor shall maintain a minimum DAT of 55 deg F. The discharge air temperature (DAT) shall be reset to satisfy the zone with the greatest call for cooling. Activate stages of DX cooling as required to maintain discharge air temperature set point. Cooling minimum DAT shall be 55 deg F (adj.).
2. If space humidity rises above set point (50 % RH, adjustable) at the supplied space humidity sensor and dehumidification is enabled, the unit will maintain the compressor operation and reduce the indoor fan airflow to increase latent capacity. If the space humidity value exceeds the dehumidification setpoint during no active call for cooling, the unit will energize the compressor and fans to an optimum capacity for dehumidification. If during active enhanced dehumidification the space humidity falls below the dehumidification setpoint - 2%, dehumidification will be terminated and the unit will transition back to normal cooling or heating control.
3. Unoccupied Mode: Outside air damper shall remain closed. Cycle supply fan and stages of cooling as required to maintain set back temperature. If space humidity exceeds set point, the unit shall be placed into dehumidification mode until the space humidity is 5% (adjustable) below set point. The outside air damper is to remain closed.
4. Optimal Start: The unit will use an optimal start algorithm for morning start-up. This algorithm will minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period. The mixed air

dampers will operate as described in the occupied mode except that the outside air damper will modulate to fully closed.

5. Monitor differential pressure across air filter bank(s) to indicate need for filter replacement when differential pressure reaches the loaded filter drop indicated in the air handler unit schedule. Actual pressure drop (in inches water column) shall be accessible through the computer graphics. A maintenance message reading "RTU-X FILTER CHANGE REQUIRED" shall automatically be displayed in computer graphics.
6. Freeze Protection: The unit will shut down and generate an alarm upon receiving a signal that the freezestat has tripped. The outdoor air damper will close and the heating and cooling coil valves will open.
7. Occupied Economizer Mode: If outside air temperature is below 55° F and cooling is required, the air handling unit shall operate in economizer mode. The FMS shall modulate the outside air and return air dampers to maintain a minimum discharge air temperature based on the following reset schedule.

Space Temperature
Set point + 4 deg F
Set point

Discharge Air Temperature
55 deg F (adjustable)
65 deg F (adjustable)

When outside air damper reaches 100% open for 30 minutes and space temperature is still 4 deg F above set point, close outside air economizer damper. Provide a signal to enable DX cooling.

3.5 SERIES FAN POWERED VAV TERMINAL UNIT WITH HOT WATER REHEAT

- A. Occupied Mode: Supply fan shall operate continuously. Modulate open primary air valve with a rise in space temperature. With a fall in space temperature, modulate primary air valve towards the minimum setting. With a continued fall in space temperature below the heating set point, modulate open the hot water coil control valve. When valve is 100% open, modulate air valve increasing air flow to maintain space heating set point. If hot water is not available, close primary air valve 100% with a fall in space temperature below heating set point. In dehumidification mode, modulate hot water coil control valve to maintain space temperature.
- B. Unoccupied Mode: Open primary air valve, close hot water coil control valve. In areas with wall radiation, modulate radiation control valve as source of heat to maintain reduced heating set point.
- C. Morning Warm-Up/Cool-Down: Refer to respective HVAC unit sequence of operation. Provide maximum primary air during morning cool down, modulating to prevent zone temperature from falling below heating set point. During morning warm-up, provide maximum primary air with full hot water coil flow until space occupied heating set point is reached at which time reset primary air valve to heating air flow and modulate control valve to maintain set point.

3.6 PUMP CONTROL SEQUENCE

- A. Building Hot Water Distribution Loop: Variable volume pumping. Energize lead variable volume pump on a call for hot water. Modulate lead pump with a 4-20 mA output to the variable speed drive (VSD) to maintain a 10 PSIG (adjustable) differential pressure across the supply and return mains. With a failure of the lead pump to establish flow within 15 seconds

after a call to operate, start the lag pump and generate an alarm message reading "BUILDING HOT WATER DISTRIBUTION LOOP LEAD PUMP FAILURE" to be automatically displayed in computer graphics and dial out, text messaged, and email to pre-programmed addresses and/or numbers. Alternate lead and lag pumps every seven days (adjustable). In unoccupied mode, if the outside air temperature is above 25 degrees (adjustable), the pumps are to be off. When outside air temperature is below 25 degrees (adjustable), the lead pump shall be energized on a call for hot water.

3.7 BOILER AND HEATING WATER CONTROL SEQUENCE

- A. On a call for hot water the FMS shall energize the hot water distribution pump(s), and packaged controls shall be enabled to maintain the hot water loop temperature. The packaged controls shall activate, and stage boilers and their associated pumps as required to maintain the loop supply temperature. The boiler controller shall sequence the boilers and modulate output such that total system efficiency is maximized. The packaged controller shall reset the supply water temperature based on outside air temperature. The packaged controller shall have a set of dry contacts to notify the FMS of any alarm state within the boiler plant or controller.
- B. Boiler isolation valves are to be open when the respective boiler is firing, closed otherwise.

END OF SECTION 23 09 93

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[illegible]

Customer: Horace Mann Elementary	INPUT/OUTPUT SUMMARY TABLE																																											
	HARDWARE															SOFTWARE																												
Location:	OUTPUT (O)		INPUT (T, D, V, C)										ALARMS		EMCS FUNCTIONS																													
	DG T	ANAL G	DIGITAL				ANALOG				DG T	ANAL G																																
Point Description	Control Relay	Solenoid	Pneumatic Transducer	Electrical Transducer	4-20 ma or 0-10 VDC	Pressure Switch	Flow Switch	Contact Closure	Auxiliary Contact	KW Meter Contact	Temperature	Relative Humidity	Set Point Adjustment	Psig, Psia, Psid, IN H2O	Flow	CO2	Position	Trending	Equipment Status	Maintenance	High Limit	Low Limit (Temperature)	Run Time	Scheduled On/Off	Optimum Start/Stop	Demand Limiting	Totalization	Day/Night Setback	Economizer	Ventilation/recirculation	DDC Temp Control	Enthalpy (Global)	Heating or Cooling Reset	Boiler Optimization	OA Reset	Chiller Optimization	Chilled Water Reset	VAV Control	Variable Speed Pumping	Ice Storage Control	Lead/Lag Control	Lighting Control	Color Graphics Item	
VAV (Fan Powered)																																												
Primary Air Damper															X					X																								X
Supply Fan	X																			X																								X
HW Valve					X												X															X												X
Discharge Air											X																						X											X
Space Served											X	X	X																															X
VAV (Shutoff)																																												
Primary Air Damper					X												X							X								X												X
HW Valve					X												X															X												X
Discharge Air											X											X	X																					X

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October 5, 2026

Mr. Terry Thornsburry
Viridian Architectural Design, Inc.
6435 West Jefferson Blvd. #144
Fort Wayne, IN 46804

Re: Horace Mann Elementary – HVAC Replacement Bidding RFI questions/responses
SCO Comm. No. 262850

Item 1:

Question - All of the VAV heating valves are rated for 180 deg inlet temp. This building has HE boilers that are most efficient at 140 deg and below. Should these valves be re-worked for 140 deg inlet?

Response – No, Hydronic Hot water system and all hot water coils in the building have been sized for 180° F entering water temp.

Item 2:

Question - FPVAV-B9 schedule shows 4.0 GPM the drawing shows 1/2" lines to B9. Shouldn't the line size be 1"?

Response – Yes, refer to Addendum 02.

Item 3:

Question - FPVAV-B10 schedule shows 10.0 GPM the drawing shows 1" lines to B10. Shouldn't the line size be 1-1/4"?

Response – Yes, refer to Addendum 02.

Item 4:

Question - FPVAV-B11 schedule shows 10.0 GPM the drawing shows 3/4" lines to B11. Shouldn't the line size be 1-1/4"?

Response – Yes, refer to Addendum 02.

Item 5:

Question - The Air Terminal section in the Spec is ambiguous concerning who is to provide the control transformer, the factory or TCC. Can this be clearly stated?

Response – Provided by Factory.

Item 6:

Question - Please provide the domestic hot water insulation specification.

Response –Refer to Addendum 02.

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Item 7:

Question - Please provide the refrigeration insulation specification.

Response –Refer to Addendum 02.

Item 8:

Question - Can the original building prints be made available?

Response – No, not available.

Item 9:

Question - Point lists are indicating Boiler and Pumps work.

Response – Existing boiler and pumps are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system.

Item 10:

Question - Point list indicates electric reheat for both style of VAVs.

Response – VAV's are to be provided with hot water coils, refer to forthcoming Addendum 02.

Item 11:

Question - Point list indicates CUH work. (these are currently controlled by the old JCI BAS)

Response – Existing CUH's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system

Item 12:

Question - Point list indicates UH work.

Response – Existing UH's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system

Item 13:

Question - Point list indicates Radiant Panel work.

Response – Existing Radiant Panel's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system

Item 14:

Question - Point list indicates Exh Fans work, beyond the Alternate Bid.

Response – Existing Exhaust Fan's are to be tied-into and connected to the new DDC system. TCC shall provide and install all required components and accessories for a complete and functioning system

Item 15:

Question - Drawings indicate TCC will do all ceiling grid and ceiling grid work. MG-1.0

Response –Refer to Addendum 01.

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Item 16:

Question - Drawings indicate four locations for TCC panels. Will Div. 26 provide a 120 VAC circuit in these location for TCC use?

Response – TCC is to provide 120 VAC power to the control panels per the Controls Contractor Responsibility Matrix on sheet.

Item 17:

Question - Point list indicate the AHU will have two airflow stations. If this is correct, TCC will provide it?

Response – TCC is to provide a single air flow station for the air handler. Refer to the Air Handler Schedule for additional information.

Item 18:

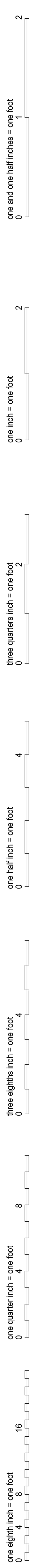
Question - Point list indicate the AHU will have a Space DP. If this correct, where should this located?

Response – Yes, Refer to Addendum 02.

Item 19:

Question - Can a detail be added for VAV control panel clearance? No control panel interference from horizontal of it to 90 degrees below horizontal, per NEC?

Response – Yes, Refer to Addendum 02.



FIRST FLOOR MECHANICAL DEMOLITION PLAN - UNIT A

SCALE: 1/8" = 1'-0"

NORTH

IT IS THE INTENT OF THIS PROJECT THAT IN ANY LOCATION WHERE THE REMOVAL OF ANY EXISTING DUCT OR PIPING INSULATION IS REQUIRED TO PERFORM ANY WORK BY THIS CONTRACTOR THAT IS SHOWN ON THE CONSTRUCTION DOCUMENTS, IT IS THE RESPONSIBILITY OF THIS CONTRACTOR TO PROVIDE AND INSTALL ALL NEW INSULATION ON ALL DUCTWORK, PIPING, AND ALL COMPONENTS FOR FULL COVERAGE.



one and one half inches = one foot

one inch = one foot

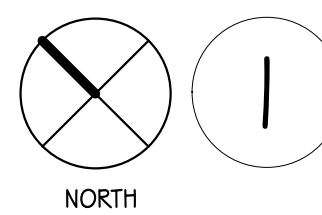
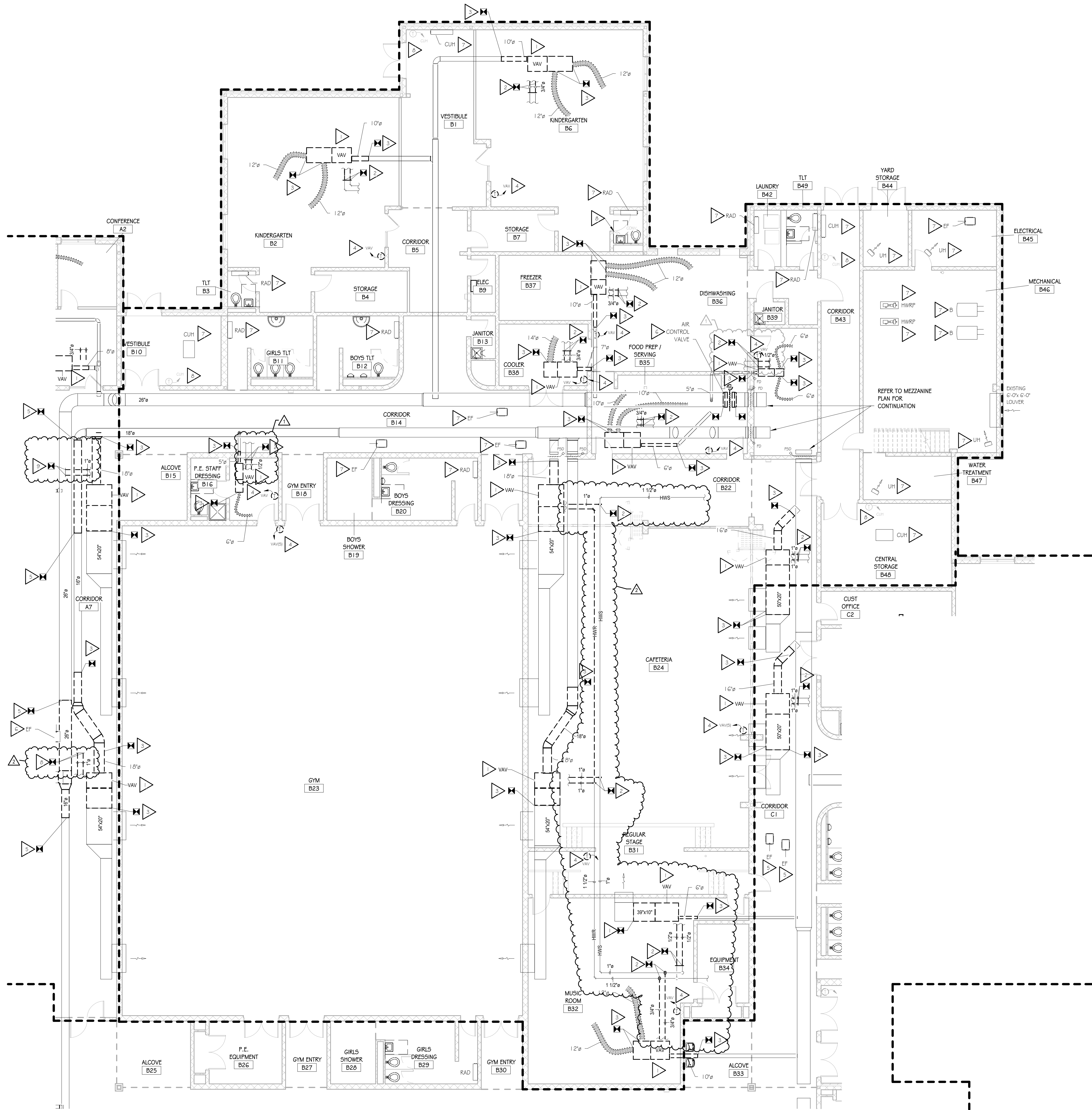
three quarters inch = one foot

one half inch = one foot

three eighths inch = one foot

one quarter inch = one foot

one eighth inch = one foot



FIRST FLOOR MECHANICAL DEMOLITION PLAN - UNIT B

SCALE: 1/8" = 1'-0"

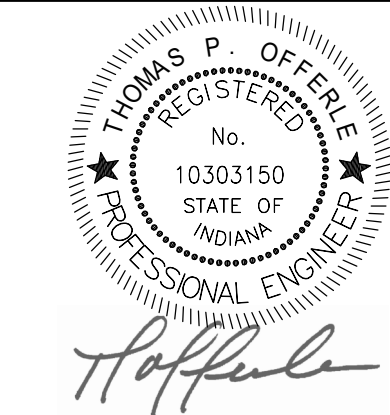
- ### MECHANICAL DEMOLITION PLAN NOTES
- ALL SCOPE OF WORK WITHIN 'M' SERIES OF DRAWINGS, ARE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR.
 - MECHANICAL CONTRACTOR SHALL COORDINATE ALL WORK WITHIN THIS SCOPE OF WORK WITH ALL OTHER TRADES AND GENERAL CONTRACTOR/CONSTRUCTION MANAGER.
 - CONTRACTOR SHALL CAREFULLY DISCONNECT AND REMOVE THE EXISTING VAV BOX COMPLETE, INCLUDING ALL HOT WATER HYDRONIC PIPING, SUPPLY AIR DUCTWORK AND FLEXIBLE DUCTWORK, WIRING, CONTROLS, AND ACCESSORIES AND MAKE READY FOR THE INSTALLATION OF A NEW UNIT TO BE INSTALLED IN THE SAME LOCATION. IT IS THE INTENT OF THESE DRAWINGS THAT THE CONTRACTOR SHALL REMOVE THE MINIMUM AMOUNT OF EXISTING DUCTWORK AS REQUIRED FOR REMOVAL AND REINSTALLATION OF THE NEW UNIT AS REQUIRED.
 - CONTRACTOR SHALL CAREFULLY DISCONNECT AND REMOVE THE EXISTING HYDRONIC WATER PIPING AND HYDRONIC ACCESSORIES FROM THE EXISTING TERMINAL BOX INCLUDING THE CONTROL VALVE, BALANCING VALVES, AIR VENTS, AND STRAINER AND MAKE READY FOR THE INSTALLATION OF NEW COMPONENTS TO BE INSTALLED FOR CONNECTION TO THE NEW UNITS. IT IS THE INTENT OF THESE DRAWINGS THAT THE CONTRACTOR SHALL REMOVE THE MINIMUM AMOUNT OF EXISTING PIPING AS REQUIRED FOR REMOVAL AND REINSTALLATION OF THE NEW UNIT AS REQUIRED.
 - IT IS THE INTENT OF THIS PROJECT THAT THE EXISTING SUPPLY AIR DUCTWORK IS TO BE REMOVED FROM THE VAV TO THE POINT INDICATE TO ALLOW FOR THE INSTALLATION OF A NEW VAV BOX. CONTRACTOR SHALL CAREFULLY DISCONNECT THE EXISTING SHEET METAL DUCTWORK AND FLEXIBLE SUPPLY AIR DUCTWORK SHOWN TO REMAIN AND MAKE READY FOR RECONNECTION TO NEW DUCTWORK.
 - DISCONNECT AND REMOVE EXISTING THERMOSTAT / TEMPERATURE SENSOR COMPLETE, INCLUDING ALL ASSOCIATED WIRING, BASE, AND DEVICES AND MAKE READY FOR THE INSTALLATION OF A NEW DDC THERMOSTAT / TEMPERATURE SENSOR TO BE INSTALLED IN THE SAME LOCATION.
 - IT IS THE INTENT OF THIS PROJECT THAT THE MECHANICAL CONTRACTOR SHALL CAREFULLY DISCONNECT AND REMOVE THE EXISTING DUCTWORK, INCLUDING ALL ASSOCIATED HANGERS, AND ACCESSORIES BACK TO THE POINT INDICATED, OR AS REQUIRED, TO ALLOW FOR THE INSTALLATION OF THE NEW VAV TERMINAL BOX THAT IS TO BE INSTALLED UP ABOVE THE DUCTWORK IN THE CORRIDOR AT APPROXIMATELY 16'-0" ABOVE FINISHED FLOOR. CONTRACTOR SHALL MAKE EXISTING DUCTWORK THAT IS TO REMAIN READY FOR NEW WORK.
 - CONTRACTOR SHALL CAREFULLY DISCONNECT AND REMOVE THE EXISTING MOTORIZED AIR CONTROL DAMPER THAT IS INSTALLED WITHIN THE DUCTWORK, COMPLETE, INCLUDING ALL WIRING, CONTROLS, DAMPER ACTUATOR, AND ALL ACCESSORIES AND MAKE READY FOR THE INSTALLATION OF A NEW MOTORIZED CONTROL DAMPER TO BE INSTALLED IN THE SAME LOCATION. CONTRACTOR SHALL BE RESPONSIBLE TO REMOVE THE EXISTING SHEETMETAL DUCTWORK AND INSULATION AS REQUIRED FOR THE REMOVAL AND RE-INSTALLATION OF NEW WORK.
 - TEMPERATURE CONTROLS CONTRACTOR SHALL DISCONNECT AND REMOVE EXISTING CONTROLS COMPLETE, INCLUDING ALL TUBING, RELAY, ACTUATORS, CONTROL VALVES, AND ALL ACCESSORIES FROM THE EXISTING HVAC EQUIPMENT THAT IS TO REMAIN. CONTRACTOR SHALL MAKE ALL EXISTING EQUIPMENT THAT IS TO REMAIN, READY FOR THE INSTALLATION OF NEW DDC CONTROLS, VALVES, WIRING, AND ALL ACCESSORIES REQUIRED FOR A FULLY FUNCTIONAL SYSTEM.
 - TEMPERATURE CONTROLS CONTRACTOR SHALL DISCONNECT AND REMOVE EXISTING THERMOSTAT COMPLETE, INCLUDING ALL ASSOCIATED CONTROLS, WIRING, TUBING, BASE, AND DEVICES AND MAKE READY FOR THE INSTALLATION OF A NEW DDC CONTROLS.

IT IS THE INTENT OF THIS PROJECT THAT IN ANY LOCATION WHERE THE REMOVAL OF ANY EXISTING DUCT OR PIPING INSULATION IS REQUIRED TO PERFORM ANY WORK, BY THIS CONTRACTOR THAT IS SHOWN ON THE CONSTRUCTION DOCUMENTS, IT IS THE RESPONSIBILITY OF THIS CONTRACTOR TO PROVIDE AND INSTALL ALL NEW INSULATION ON ALL DUCTWORK, PIPING, AND ALL COMPONENTS FOR FULL COVERAGE.



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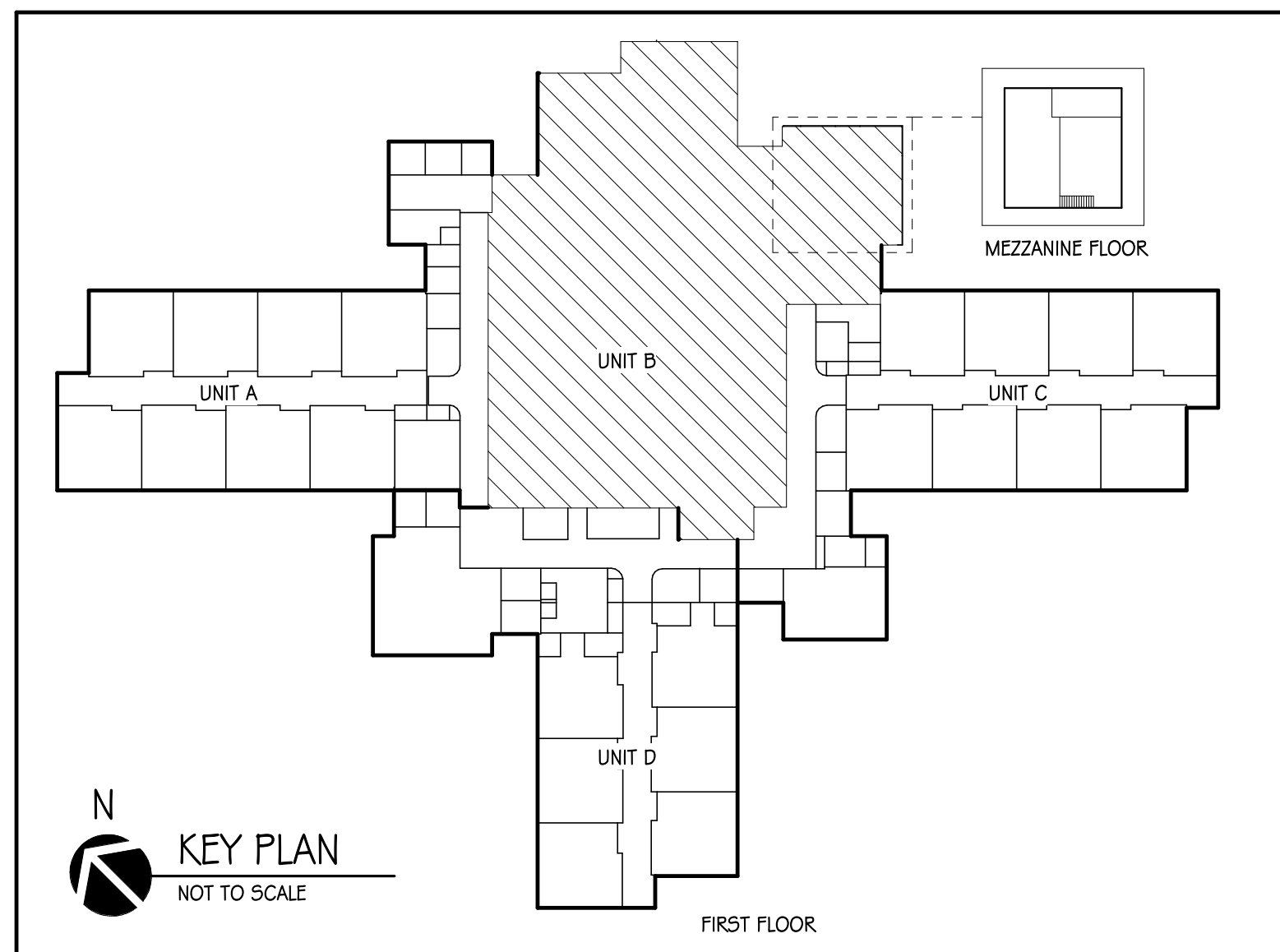
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HVAC Replacement
2485 Waterworks Road
Huntington, Indiana 46750

REVISION	DATE	DESCRIPTION
1	9-28-2026	Addendum 01
2	10-5-2026	Addendum 02

DATE	PROJECT
09/21/2026	2025.0014
TITLE	
FIRST FLOOR MECHANICAL DEMOLITION PLAN - UNIT B	

SHEET

MDI.1B



one and one half inches = one foot

one inch = one foot

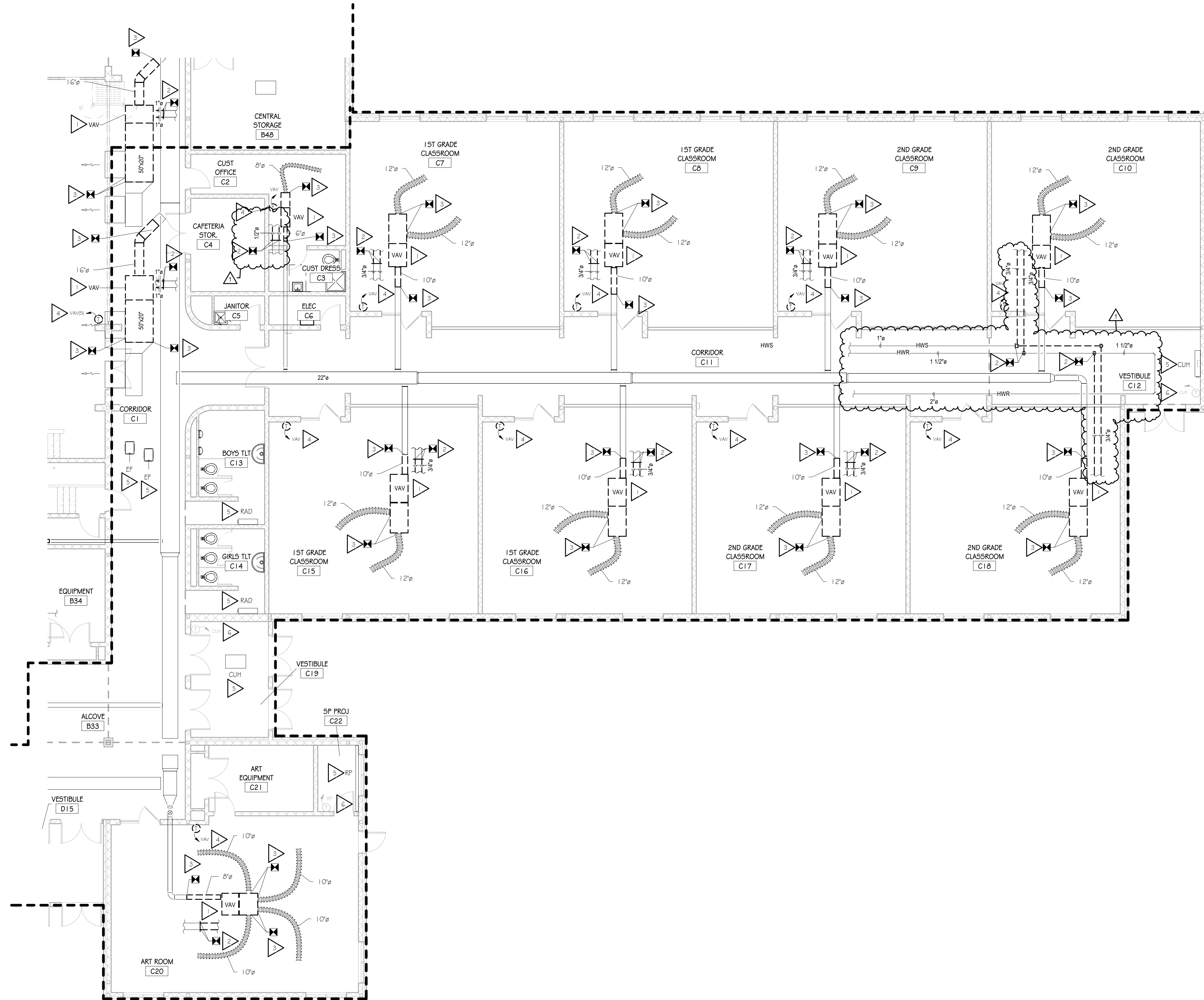
three quarters inch = one foot

one half inch = one foot

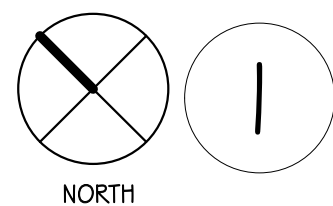
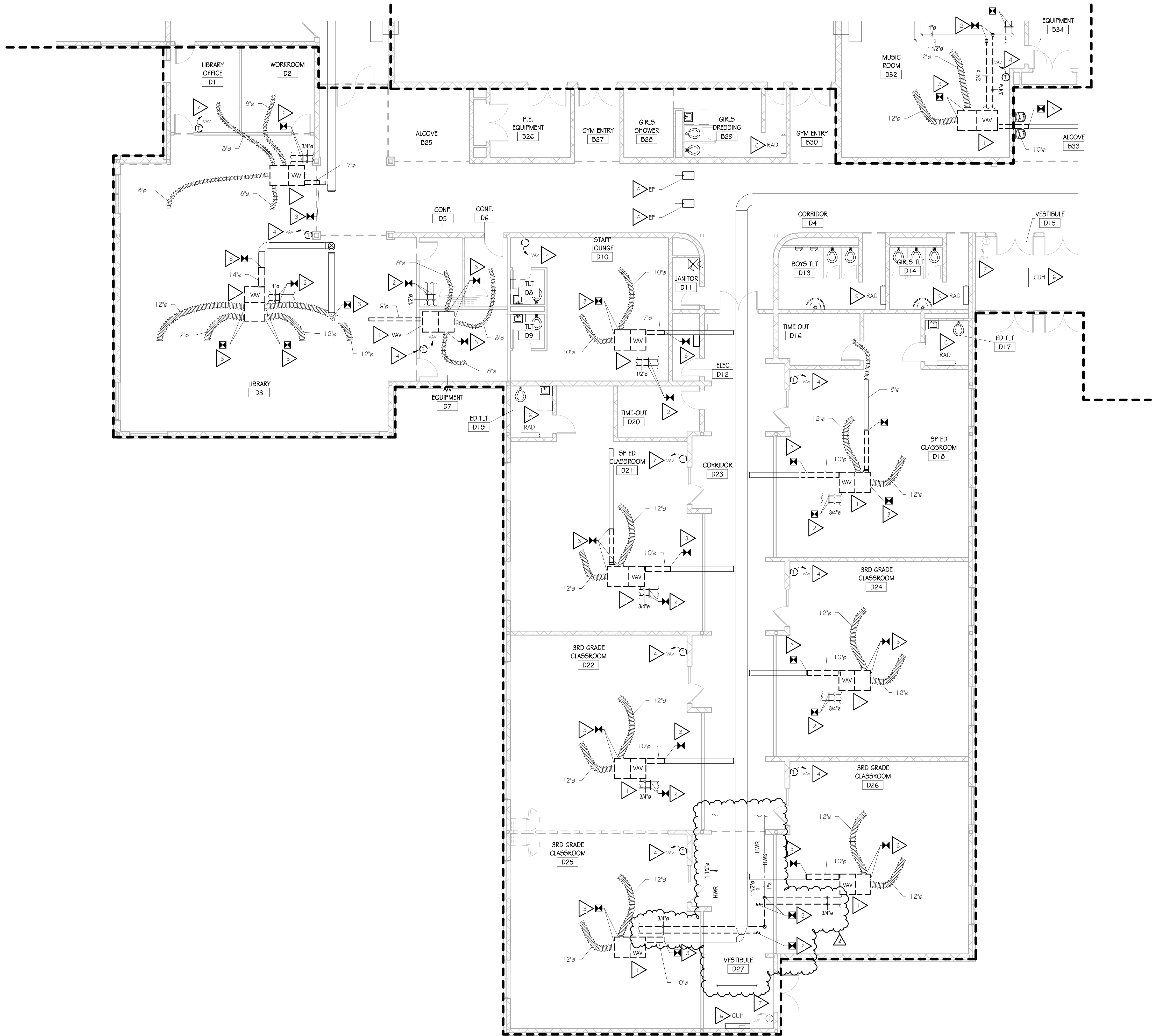
three eighths inch = one foot

one quarter inch = one foot

one eighth inch = one foot



one and one half inches = one foot
one inch = one foot
three quarters inch = one foot
one half inch = one foot
three eighths inch = one foot
one quarter inch = one foot
one eighth inch = one foot



FIRST FLOOR MECHANICAL DEMOLITION PLAN - UNIT D

MECHANICAL DEMOLITION PLAN NOTES

ALL SCOPES OF WORK WITHIN 'M' SERIES OF DRAWINGS, ARE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR.

MECHANICAL CONTRACTOR SHALL COORDINATE ALL WORK WITHIN THIS SCOPE OF WORK WITH ALL OTHER TRADES AND GENERAL CONTRACTOR/CONSTRUCTION MANAGER.

CONTRACTOR SHALL CAREFULLY DISCONNECT AND REMOVE THE EXISTING VAV BOX COMPLETE, INCLUDING ALL HOT WATER HYDRONIC PIPING, SUPPLY AIR DUCTWORK AND FLEXIBLE DUCTWORK, WIRING, CONTROLS, AND ACCESSORIES AND MAKE READY FOR THE INSTALLATION OF A NEW UNIT TO BE INSTALLED IN THE SAME LOCATION. IT IS THE INTENT OF THESE DRAWINGS THAT THE CONTRACTOR SHALL REMOVE THE MINIMUM AMOUNT OF EXISTING DUCTWORK AS REQUIRED FOR REMOVAL AND REINSTALLATION OF THE NEW UNIT AS REQUIRED.

CONTRACTOR SHALL CAREFULLY DISCONNECT AND REMOVE THE EXISTING HYDRONIC WATER PIPING AND HYDRONIC ACCESSORIES FROM THE EXISTING TERMINAL BOX INCLUDING THE CONTROL VALVE, BALANCING VALVES, AIR VENTS, AND STRAINER AND MAKE READY FOR THE INSTALLATION OF NEW COMPONENTS TO BE INSTALLED FOR CONNECTION TO THE NEW UNITS. IT IS THE INTENT OF THESE DRAWINGS THAT THE CONTRACTOR SHALL REMOVE THE MINIMUM AMOUNT OF EXISTING PIPING AS REQUIRED FOR REMOVAL AND REINSTALLATION OF THE NEW UNIT AS REQUIRED.

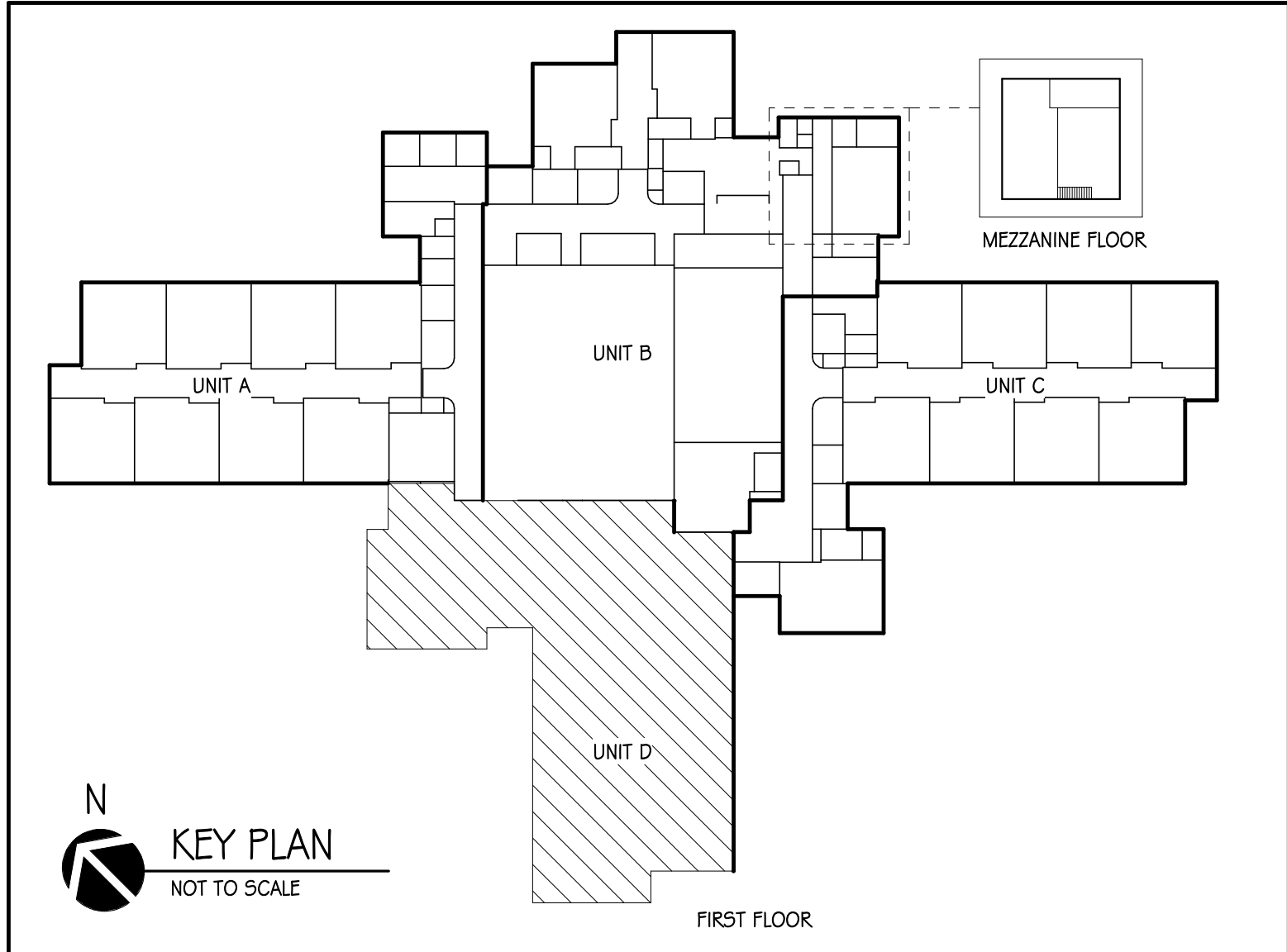
IT IS THE INTENT OF THIS PROJECT THAT THE EXISTING SUPPLY AIR DUCTWORK IS TO BE REMOVED FROM THE VAV TO THE POINT INDICATE TO ALLOW FOR THE INSTALLATION OF A NEW VAV BOX. CONTRACTOR SHALL CAREFULLY DISCONNECT THE EXISTING SHEET METAL DUCTWORK AND FLEXIBLE SUPPLY AIR DUCTWORK SHOWN TO REMAIN AND MAKE READY FOR RECONNECTION TO NEW DUCTWORK.

DISCONNECT AND REMOVE EXISTING THERMOSTAT / TEMPERATURE SENSOR COMPLETE, INCLUDING ALL ASSOCIATED WIRING, BASE, AND DEVICES AND MAKE READY FOR THE INSTALLATION OF A NEW DDC THERMOSTAT / TEMPERATURE SENSOR TO BE INSTALLED IN THE SAME LOCATION.

TEMPERATURE CONTROLS CONTRACTOR SHALL DISCONNECT AND REMOVE EXISTING CONTROLS COMPLETE, INCLUDING ALL TUBING, RELAY, ACTUATORS, CONTROL VALVES, AND ALL ACCESSORIES FROM THE EXISTING HVAC EQUIPMENT THAT IS TO REMAIN. CONTRACTOR SHALL MAKE ALL EXISTING EQUIPMENT THAT IS TO REMAIN, READY FOR THE INSTALLATION OF NEW DDC CONTROLS, VALVES, WIRING, AND ALL ACCESSORIES REQUIRED FOR A FULLY FUNCTIONAL SYSTEM.

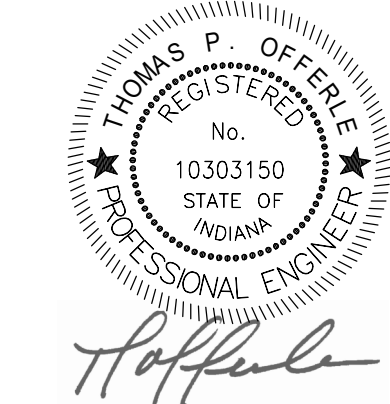
TEMPERATURE CONTROLS CONTRACTOR SHALL DISCONNECT AND REMOVE EXISTING THERMOSTAT COMPLETE, INCLUDING ALL ASSOCIATED CONTROLS, WIRING, TUBING, BASE, AND DEVICES AND MAKE READY FOR THE INSTALLATION OF A NEW DDC CONTROLS.

IT IS THE INTENT OF THIS PROJECT THAT IN ANY LOCATION WHERE THE REMOVAL OF ANY EXISTING DUCT OR PIPING INSULATION IS REQUIRED TO PERFORM ANY WORK BY THIS CONTRACTOR THAT IS SHOWN ON THE CONSTRUCTION DOCUMENTS, IT IS THE RESPONSIBILITY OF THIS CONTRACTOR TO PROVIDE AND INSTALL ALL NEW INSULATION ON ALL DUCTWORK, PIPING, AND ALL COMPONENTS FOR FULL COVERAGE.



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REVISION	DATE	DESCRIPTION
2	10-5-2026	Addendum 02

DATE	PROJECT
09/21/2026	2025.0014

TITLE
FIRST FLOOR MECHANICAL DEMOLITION PLAN - UNIT D

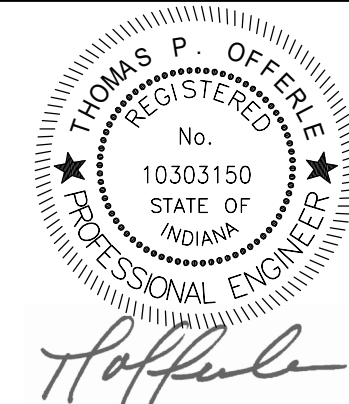
SHEET
MDI.1D



SCALE: $1/8'' = 1'-0''$

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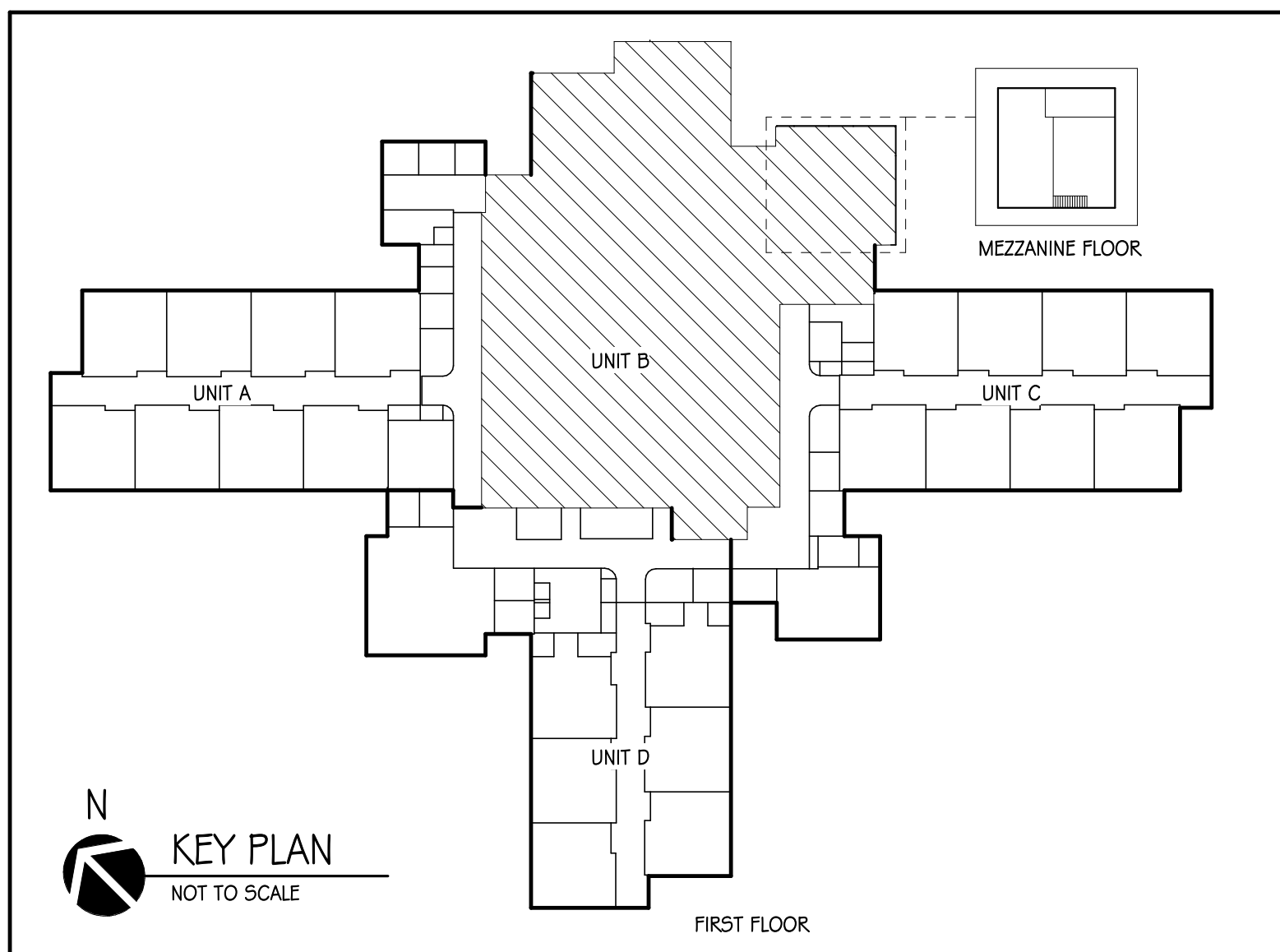
DATE	PROJECT
09/21/2026	2025.0014
TITLE	
FIRST FLOOR MECHANICAL PLAN - UNIT B	
SHEET	

MI.1B

MECHANICAL PLAN NOTES

- ALL SCOPES OF WORK WITHIN "M" SERIES OF DRAWINGS, ARE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR. MECHANICAL CONTRACTOR SHALL COORDINATE ALL WORK WITHIN THIS SCOPE OF WORK WITH ALL OTHER TRADES AND GENERAL CONTRACTOR/CONSTRUCTION MANAGER.
- CONTRACTOR SHALL PROVIDE AND INSTALL NEW FAN POWERED VAV BOX IN THE SAME LOCATION AS THE PREVIOUSLY REMOVED BOX. PROVIDE AND INSTALL A PERMANENTLY AFFIXED EQUIPMENT LABEL TO THE CEILING GRID TO IDENTIFY THE LOCATION OF THE UNIT. COORDINATE INSTALLATION LOCATION OF THE LABEL WITH THE OWNER PRIOR TO INSTALLATION. CONTRACTOR SHALL PROVIDE AND INSTALL ALL REQUIRED COMPONENTS, WIRING, DUCTWORK, DUCT INSULATION, CONTROLS, AND ACCESSORIES REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. MECHANICAL CONTRACTOR SHALL MODIFY AND EXTEND THE EXISTING SHEET METAL DUCTWORK AS REQUIRED TO INSTALL THE NEW VAV BOX. PROVIDE AN ADDITIONAL 5'-0" LINEAR FOOT OF DUCTWORK AND RE-CONNECT TO THE EXISTING DUCTWORK, AND EXTEND THE DUCTWORK AS REQUIRED FOR THE INSTALLATION OF THE VAV IN THE LOCATION AS SHOWN. CONTRACTOR SHALL INSULATE ALL NEW DUCTWORK AND ANY EXISTING DUCTWORK THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN DUCTWORK AS REQUIRED.
- TI-IN AND CONNECT NEW HYDRONIC HOT WATER SUPPLY, AND HOT WATER RETURN PIPING TO THE EXISTING PIPING AND ROUTE FOR CONNECTION TO THE NEW HOT WATER COIL ON THE VAV BOX. PROVIDE AND INSTALL ALL NEW FLOW CONTROL, CONTROL VALVES, PIPING INSULATION, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR TO PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN THE PIPING AS REQUIRED FOR ROUTING AND INSTALLATION. FIELD VERIFY THE EXACT ROUTE AND LOCATION OF PIPING WITH EXISTING STRUCTURE AND EQUIPMENT. CONTRACTOR SHALL INSULATE ALL NEW HYDRONIC SUPPLY/RETURN PIPING AND ANY EXISTING PIPING THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. REFER TO FAN POWERED VAVS 2-WAY OR 3-WAY PIPING DETAIL ON SHEET MS-1 FOR ADDITIONAL PIPING REQUIREMENTS AND INFORMATION.
- PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL NEW ELECTRONIC DAMPER ACTUATORS, ELECTRONIC HOT WATER CONTROL VALVES, NEW FREEZE STAT, SENSORS, CONTROL WIRING, RELAYS, AND ACCESSORIES TO THE NEW UNIT THAT AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- TI-IN AND CONNECT NEW SUPPLY AIR DUCTWORK TO THE EXISTING BRANCH LINE AND ROUTE FOR CONNECTION TO THE NEW VAV UNIT. CONTRACTOR SHALL INSULATE ALL NEW DUCTWORK AND ANY EXISTING DUCTWORK THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN DUCTWORK AS REQUIRED.
- PROVIDE AND INSTALL NEW DDC TEMPERATURE SENSOR/THERMOSTAT TO BE INSTALLED WITHIN THE SAME LOCATION AS THE PREVIOUSLY REMOVED THERMOSTAT. THE NEW SENSOR SHALL BE INSTALLED WITHIN THE EXISTING WALL BOX AND THE NEW CONTROL WIRING SHALL BE ROUTED DOWN THE WALL WITHIN THE EXISTING CONDUIT FOR CONNECTION TO THE NEW SENSOR. TEMPERATURE CONTROLS CONTRACTOR SHALL PROVIDE AND INSTALL ALL CONTROL WIRING, RELAYS, AND ACCESSORIES AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- TI-IN AND CONNECT EXISTING DUCTWORK TO THE NEW SUPPLY AIR DUCTWORK ROUTED OFF THE DISCHARGE OF THE VAV AS SHOWN. CONTRACTOR SHALL MODIFY/EXTEND THE EXISTING FLEXIBLE DUCTWORK AS REQUIRED FOR THE INSTALLATION OF NEW WORK. PROVIDE AND INSTALL ALL NECESSARY OFFSETS, TRANSITIONS, AND FITTINGS AS REQUIRED.
- PROVIDE AND INSTALL A NEW MODULATING DAMPER AND ELECTRONIC DAMPER ACTUATOR TO THE EXISTING SUPPLY AIR DUCTWORK THAT IS TO REMAIN. PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL CONTROL WIRING, RELAYS, AND ACCESSORIES AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- PROPOSED TEMPERATURE CONTROL PANEL LOCATION TO BE INSTALLED IN THE SAME LOCATION AS THE PREVIOUSLY REMOVED CONTROL PANEL AS SHOWN ON THE ELECTRICAL DEMOLITION PLANS. CONTRACTOR IS TO VERIFY QUANTITY AND LOCATION OF PANELS REQUIRED AND PROVIDE ELECTRICAL POWER TO ANY CHANGE IN LOCATION OR ADDITIONAL PANELS REQUIRED.
- TEMPERATURE CONTROLS CONTRACTOR SHALL PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL NEW ELECTRONIC DAMPER ACTUATORS, ELECTRONIC HOT WATER/CHILLED WATER CONTROL VALVES, NEW FREEZE STAT, SENSORS, CONTROL WIRING, RELAYS, AND ACCESSORIES TO THE EXISTING HVAC UNIT THAT IS TO REMAIN AS REQUIRED TO TI-IN AND CONNECT TO THE NEW BUILDING MANAGEMENT SYSTEM FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
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- TI-IN AND CONNECT EXISTING BOILER TO NEW DDC CONTROL SYSTEM. PROVIDE AND INSTALL NEW BOILER CONTROL PANEL (IF REQUIRED FOR INTEGRATION), ALL NEW SENSING ELEMENTS, CABLING/WIRING BETWEEN BOILER CONTROL VALVE AND PACKAGED BOILER CONTROLS, RELAYS, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE. CONTRACTOR SHALL FIELD VERIFY FINAL CONTROL PANEL INSTALLATION LOCATION BASED UPON ALL EXISTING BUILDING CONDITIONS.
- TI-IN AND CONNECT EXISTING CONDENSING UNIT TO THE NEW DDC CONTROL SYSTEM. PROVIDE AND INSTALL A NEW CONTROL PANEL (IF REQUIRED FOR INTEGRATION), ALL NEW SENSING ELEMENTS, CABLING/WIRING BETWEEN ACCU AND PACKAGED CONTROLS, RELAYS, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE. CONTRACTOR SHALL FIELD VERIFY FINAL CONTROL PANEL INSTALLATION LOCATION BASED UPON ALL EXISTING BUILDING CONDITIONS.

IT IS THE INTENT OF THIS PROJECT THAT IN ANY LOCATION WHERE THE REMOVAL OF ANY EXISTING DUCT OR PIPING INSULATION IS REQUIRED TO PERFORM ANY WORK BY THIS CONTRACTOR THAT IS SHOWN ON THE CONSTRUCTION DOCUMENTS, IT IS THE RESPONSIBILITY OF THIS CONTRACTOR TO PROVIDE AND INSTALL ALL NEW INSULATION ON ALL DUCTWORK, PIPING, AND ALL COMPONENTS FOR FULL COVERAGE.



FIRST FLOOR MECHANICAL PLAN - UNIT B
SCALE: 1/8" = 1'-0"
NORTH

one and one half inches = one foot

one inch = one foot

three quarters inch = one foot

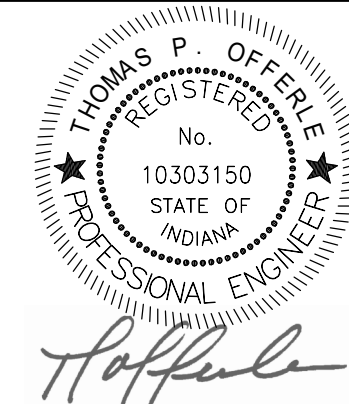
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2	10-5-2026	Addendum 02

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09/21/2026	2025.0014
TITLE	
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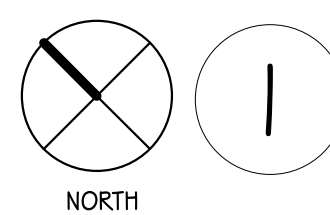
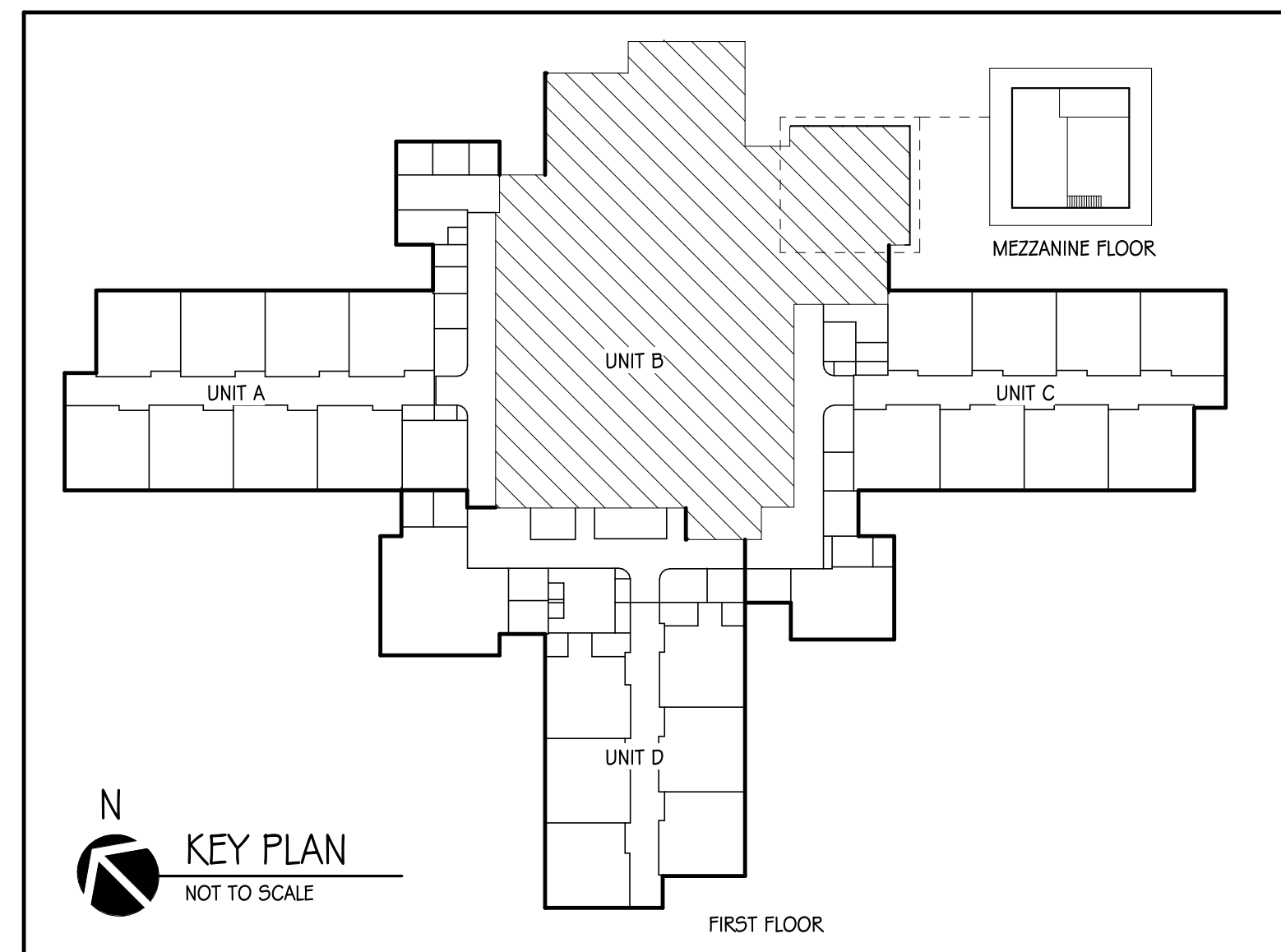
SHEET

MI.1B

MECHANICAL PLAN NOTES

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- CONTRACTOR SHALL PROVIDE AND INSTALL NEW FAN POWERED VAV BOX IN THE SAME LOCATION AS THE PREVIOUSLY REMOVED BOX. PROVIDE AND INSTALL A PERMANENTLY AFFIXED EQUIPMENT LABEL TO THE CEILING GRID TO IDENTIFY THE LOCATION OF THE UNIT. COORDINATE INSTALLATION LOCATION OF THE LABEL WITH THE OWNER PRIOR TO INSTALLATION. CONTRACTOR SHALL PROVIDE AND INSTALL ALL REQUIRED COMPONENTS, WIRING, DUCTWORK, DUCT INSULATION, CONTROLS, AND ACCESSORIES REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. MECHANICAL CONTRACTOR SHALL MODIFY AND EXTEND THE EXISTING SHEET METAL DUCTWORK AS REQUIRED TO INSTALL THE NEW VAV BOX. PROVIDE AN ADDITIONAL 5'-0" LINEAR FOOT OF DUCTWORK AND RE-CONNECT TO THE EXISTING DUCTWORK, AND EXTEND THE DUCTWORK AS REQUIRED FOR THE INSTALLATION OF THE VAV IN THE LOCATION AS SHOWN. CONTRACTOR SHALL INSULATE ALL NEW DUCTWORK AND ANY EXISTING DUCTWORK THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN DUCTWORK AS REQUIRED.
- TI-IN AND CONNECT NEW HYDRONIC HOT WATER SUPPLY, AND HOT WATER RETURN PIPING TO THE EXISTING PIPING AND ROUTE FOR CONNECTION TO THE NEW HOT WATER COIL ON THE VAV BOX. PROVIDE AND INSTALL ALL NEW FLOW CONTROL, CONTROL VALVES, PIPING INSULATION, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR TO PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN THE PIPING AS REQUIRED FOR ROUTING AND INSTALLATION. FIELD VERIFY THE EXACT ROUTE AND LOCATION OF PIPING WITH EXISTING STRUCTURE AND EQUIPMENT. CONTRACTOR SHALL INSULATE ALL NEW HYDRONIC SUPPLY/RETURN PIPING AND ANY EXISTING PIPING THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. REFER TO FAN POWERED VAVS 2-WAY OR 3-WAY PIPING DETAIL ON SHEET MS-1 FOR ADDITIONAL PIPING REQUIREMENTS AND INFORMATION.
- PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL NEW ELECTRONIC DAMPER ACTUATORS, ELECTRONIC HOT WATER CONTROL VALVES, NEW FREEZE STAT, SENSORS, CONTROL WIRING, RELAYS, AND ACCESSORIES TO THE NEW UNIT THAT AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- TI-IN AND CONNECT NEW SUPPLY AIR DUCTWORK TO THE EXISTING BRANCH LINE AND ROUTE FOR CONNECTION TO THE NEW VAV UNIT. CONTRACTOR SHALL INSULATE ALL NEW DUCTWORK AND ANY EXISTING DUCTWORK THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN DUCTWORK AS REQUIRED.
- PROVIDE AND INSTALL NEW DDC TEMPERATURE SENSOR/THERMOSTAT TO BE INSTALLED WITHIN THE SAME LOCATION AS THE PREVIOUSLY REMOVED THERMOSTAT. THE NEW SENSOR SHALL BE INSTALLED WITHIN THE EXISTING WALL BOX AND THE NEW CONTROL WIRING SHALL BE ROUTED DOWN THE WALL WITHIN THE EXISTING CONDUIT FOR CONNECTION TO THE NEW SENSOR. TEMPERATURE CONTROLS CONTRACTOR SHALL PROVIDE AND INSTALL ALL CONTROL WIRING, RELAYS, AND ACCESSORIES AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- TI-IN AND CONNECT EXISTING DUCTWORK TO THE NEW SUPPLY AIR DUCTWORK ROUTED OFF THE DISCHARGE OF THE VAV AS SHOWN. CONTRACTOR SHALL MODIFY/EXTEND THE EXISTING FLEXIBLE DUCTWORK AS REQUIRED FOR THE INSTALLATION OF NEW WORK. PROVIDE AND INSTALL ALL NECESSARY OFFSETS, TRANSITIONS, AND FITTINGS AS REQUIRED.
- PROVIDE AND INSTALL A NEW MODULATING DAMPER AND ELECTRONIC DAMPER ACTUATOR TO THE EXISTING SUPPLY AIR DUCTWORK THAT IS TO REMAIN. PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL CONTROL WIRING, RELAYS, AND ACCESSORIES AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- PROPOSED TEMPERATURE CONTROL PANEL LOCATION TO BE INSTALLED IN THE SAME LOCATION AS THE PREVIOUSLY REMOVED CONTROL PANEL AS SHOWN ON THE ELECTRICAL DEMOLITION PLANS. CONTRACTOR IS TO VERIFY QUANTITY AND LOCATION OF PANELS REQUIRED AND PROVIDE ELECTRICAL POWER TO ANY CHANGE IN LOCATION OR ADDITIONAL PANELS REQUIRED.
- TEMPERATURE CONTROLS CONTRACTOR SHALL PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL NEW ELECTRONIC DAMPER ACTUATORS, ELECTRONIC HOT WATER/CHILLED WATER CONTROL VALVES, NEW FREEZE STAT, SENSORS, CONTROL WIRING, RELAYS, AND ACCESSORIES TO THE EXISTING HVAC UNIT THAT IS TO REMAIN AS REQUIRED TO TI-IN AND CONNECT TO THE NEW BUILDING MANAGEMENT SYSTEM FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
- PROVIDE AND INSTALL NEW DDC TEMPERATURE SENSOR/THERMOSTAT TO BE INSTALLED WITHIN THE SAME LOCATION AS THE EXISTING THERMOSTAT. THE NEW SENSOR SHALL BE INSTALLED WITHIN THE EXISTING WALL BOX AND THE NEW CONTROL WIRING SHALL BE ROUTED DOWN THE WALL WITHIN THE EXISTING CONDUIT FOR CONNECTION TO THE NEW SENSOR. TEMPERATURE CONTROLS CONTRACTOR SHALL REMOVE THE EXISTING THERMOSTAT AND WIRING COMPLETE AND PROVIDE AND INSTALL ALL NEW CONTROL WIRING, RELAYS, AND ACCESSORIES AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE. CONTRACTOR SHALL FIELD VERIFY FINAL CONTROL PANEL INSTALLATION LOCATION BASED UPON ALL EXISTING BUILDING CONDITIONS.
- TI-IN AND CONNECT EXISTING BOILER TO NEW DDC CONTROL SYSTEM. PROVIDE AND INSTALL NEW BOILER CONTROL PANEL (IF REQUIRED FOR INTEGRATION), ALL NEW SENSING ELEMENTS, CABLE/WIRING BETWEEN BOILER CONTROL VALVE AND PACKAGED BOILER CONTROLS, RELAYS, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE. CONTRACTOR SHALL FIELD VERIFY FINAL CONTROL PANEL INSTALLATION LOCATION BASED UPON ALL EXISTING BUILDING CONDITIONS.
- TI-IN AND CONNECT EXISTING CONDENSING UNIT TO THE NEW DDC CONTROL SYSTEM. PROVIDE AND INSTALL A NEW CONTROL PANEL (IF REQUIRED FOR INTEGRATION), ALL NEW SENSING ELEMENTS, CABLE/WIRING BETWEEN ACCU AND PACKAGED CONTROLS, RELAYS, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE. CONTRACTOR SHALL FIELD VERIFY FINAL CONTROL PANEL INSTALLATION LOCATION BASED UPON ALL EXISTING BUILDING CONDITIONS.
- PROVIDE AND INSTALL DUCT STATIC PRESSURE SENSOR IN LOCATION AS SHOWN.

IT IS THE INTENT OF THIS PROJECT THAT IN ANY LOCATION WHERE THE REMOVAL OF ANY EXISTING DUCT OR PIPING INSULATION IS REQUIRED TO PERFORM ANY WORK BY THIS CONTRACTOR, THAT IS SHOWN ON THE CONSTRUCTION DOCUMENTS, IT IS THE RESPONSIBILITY OF THIS CONTRACTOR TO PROVIDE AND INSTALL ALL NEW INSULATION ON ALL DUCTWORK, PIPING, AND ALL COMPONENTS FOR FULL COVERAGE.



FIRST FLOOR MECHANICAL PLAN - UNIT B
SCALE: 1/8" = 1'-0"

one and one half inches = one foot

one inch = one foot

three quarters inch = one foot

one half inch = one foot

three eighths inch = one foot

one quarter inch = one foot

one eighth inch = one foot

one and one half inches = one foot

one inch = one foot

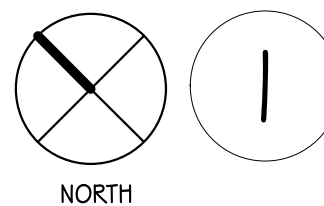
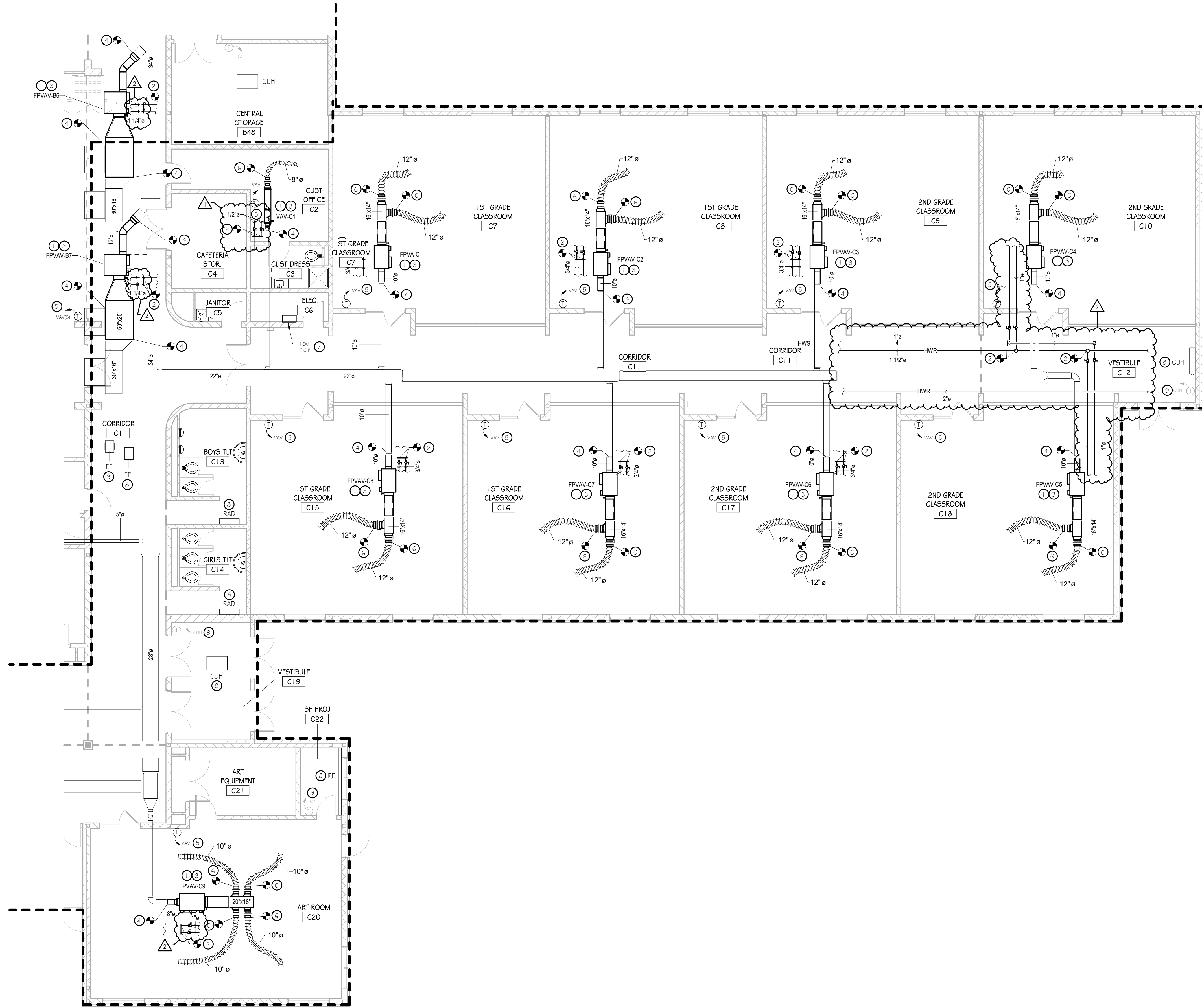
three quarters inch = one foot

one half inch = one foot

three eighths inch = one foot

one quarter inch = one foot

one eighth inch = one foot

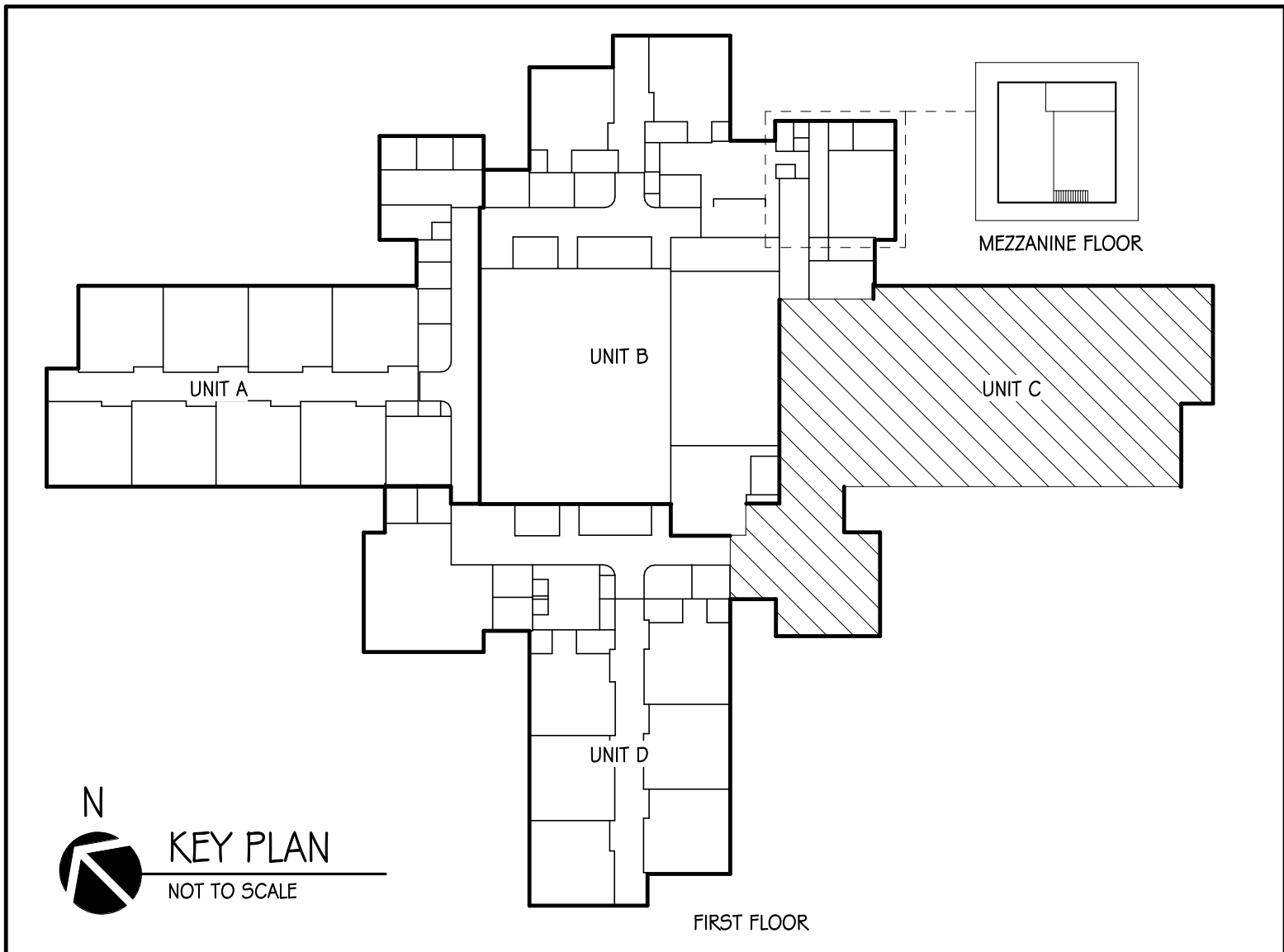


FIRST FLOOR MECHANICAL PLAN - UNIT C
SCALE: 1/8" = 1'-0"

MECHANICAL PLAN NOTES

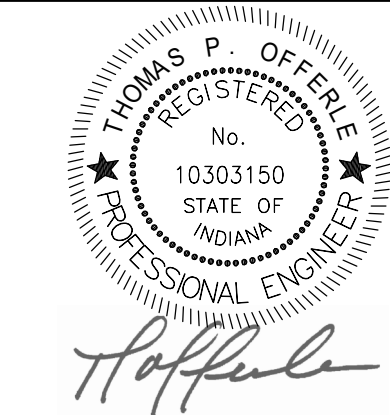
- ALL SCOPES OF WORK WITHIN V SERIES OF DRAWINGS, ARE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR.
- MECHANICAL CONTRACTOR SHALL COORDINATE ALL WORK WITHIN THIS SCOPE OF WORK WITH ALL OTHER TRADES AND GENERAL CONTRACTOR/CONSTRUCTION MANAGER.
- CONTRACTOR SHALL PROVIDE AND INSTALL NEW FAN POWERED VAV BOX IN THE SAME LOCATION AS THE PREVIOUSLY REMOVED BOX. PROVIDE AND INSTALL A PERMANENTLY AFFIXED EQUIPMENT LABEL TO THE CEILING GRID TO IDENTIFY THE LOCATION OF THE UNIT, COORDINATE INSTALLATION LOCATION OF THE LABEL WITH THE OWNER PRIOR TO INSTALLATION. CONTRACTOR SHALL PROVIDE AND INSTALL ALL REQUIRED COMPONENTS, WIRING, DUCTWORK, DUCT INSULATION, CONTROLS, AND ACCESSORIES REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. MECHANICAL CONTRACTOR SHALL MODIFY AND EXTEND THE EXISTING SHEET METAL DUCTWORK AS REQUIRED TO INSTALL THE NEW VAV BOX. PROVIDE AN ADDITIONAL 9'-0" BREAK FOOT OF DUCTWORK AND RE-CONNECT TO THE EXISTING DUCTWORK AND EXTEND THE DUCTWORK AS REQUIRED FOR THE INSTALLATION OF THE VAV IN THE LOCATION AS SHOWN. CONTRACTOR SHALL INSULATE ALL NEW DUCTWORK AND ANY EXISTING DUCTWORK THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN DUCTWORK AS REQUIRED.
- TI-IN AND CONNECT NEW HYDRONIC HOT WATER SUPPLY, AND HOT WATER RETURN PIPING TO THE EXISTING PIPING AND ROUTE FOR CONNECTION TO THE NEW HOT WATER COIL ON THE VAV BOX. PROVIDE AND INSTALL ALL NEW FLOW CONTROL, CONTROL VALVES, PIPING INSULATION, AND ALL REQUIRED ACCESSORIES FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR TO PROVIDE AND INSTALL ALL NECESSARY OFFSETS AND TRANSITIONS IN THE PIPING AS REQUIRED FOR ROUTING AND INSTALLATION. FIELD VERIFY THE EXACT ROUTE AND LOCATION OF PIPING WITH EXISTING STRUCTURE AND EQUIPMENT. CONTRACTOR SHALL INSULATE ALL NEW HYDRONIC SUPPLY/RETURN PIPING AND ANY EXISTING PIPING THAT HAD THE EXISTING INSULATION REMOVED TO ALLOW FOR VAV INSTALLATION. REFER TO FAN POWERED VAVS 2-WAY OR 3-WAY PIPING DETAIL ON SHEET M5.1 FOR ADDITIONAL PIPING REQUIREMENTS AND INFORMATION.
- PROVIDE AND INSTALL NEW DDC CONTROLS, INCLUDING ALL NEW ELECTRONIC DAMPER ACTUATORS, ELECTRONIC HOT WATER CONTROL VALVES, NEW FREEZE STAT, SENSORS, CONTROL WIRING, RELAYS, AND ACCESSORIES TO THE NEW UNIT THAT AS REQUIRED FOR A COMPLETE AND FUNCTIONING SYSTEM. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL ELECTRICAL POWER, COMPONENTS/WIRING AND PROGRAMMING AS REQUIRED TO CONNECT THE SYSTEM FOR A FULLY FUNCTIONING SYSTEM. WIRING SHALL BE INSTALLED PER THE CURRENT INDIANA NEC CODE.
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Horace Mann Elementary
HVAC Replacement
2485 Waterworks Road
Huntington, Indiana 46750

REVISION	DATE	DESCRIPTION
1	9-28-2026	Addendum 01
2	10-5-2026	Addendum 02

DATE
09/21/2026

PROJECT
2025.0014

TITLE
**FIRST FLOOR MECHANICAL
PLAN - UNIT C**

SHEET

MI.IC

MI.ID

one and one half inches = one foot

one inch = one foot

three quarters inch = one foot

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three eighths inch = one foot

one quarter inch = one foot

one eighth inch = one foot

8 LOUVER PLENUM SECTION

NOT TO SCALE

A LOUVER PLENUM SECTION ENLARGED PLAN

NOT TO SCALE

10 PIPE SUPPORT DETAIL

NOT TO SCALE

9 OPEN SITE DRAIN

NOT TO SCALE

7 REFRIGERANT PIPING DETAIL

NOT TO SCALE

6 AIR HANDLER CONDENSATE DRAIN PIPING DETAIL

NOT TO SCALE

5 DEEP A/C CONDENSATE TRAP DETAIL

NOT TO SCALE

4 SERIES FAN POWERED VAV BOX DETAIL

NOT TO SCALE

3 3-WAY 2 POSITION CABINET HEATER HEATING COIL

NOT TO SCALE

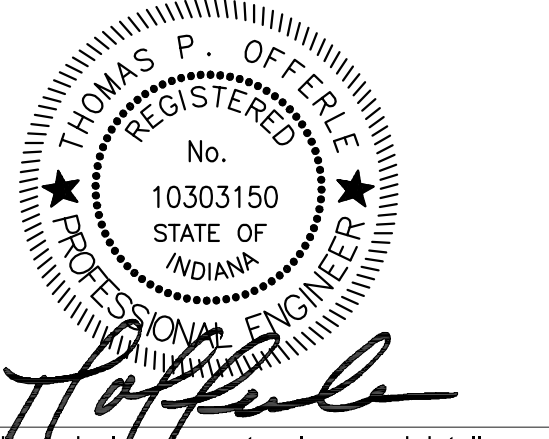
2 FAN POWERED VAV'S, FIN TUBE RADIATORS, AND CABINET HEATERS 3-WAY HEATING COILS

NOT TO SCALE

1 FAN POWERED VAV'S, FIN TUBE RADIATORS, AND CABINET HEATERS 2-WAY HEATING COILS

NOT TO SCALE

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REVISION	DATE	DESCRIPTION
1	10-05-2026	Addendum 02

DATE	PROJECT
09/21/2026	2025.0014
TITLE	
MECHANICAL DETAILS	

SHEET

M5.1