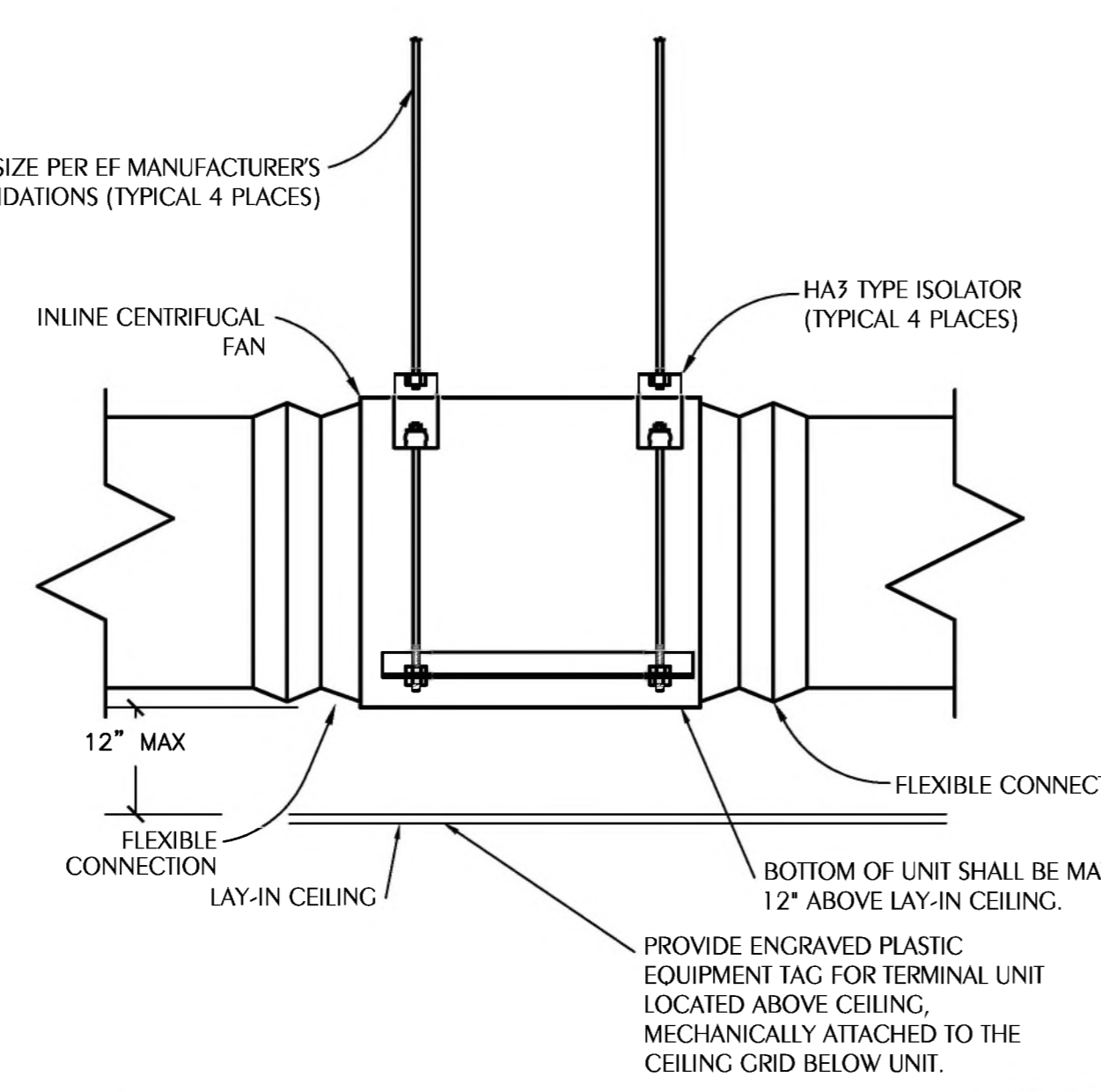
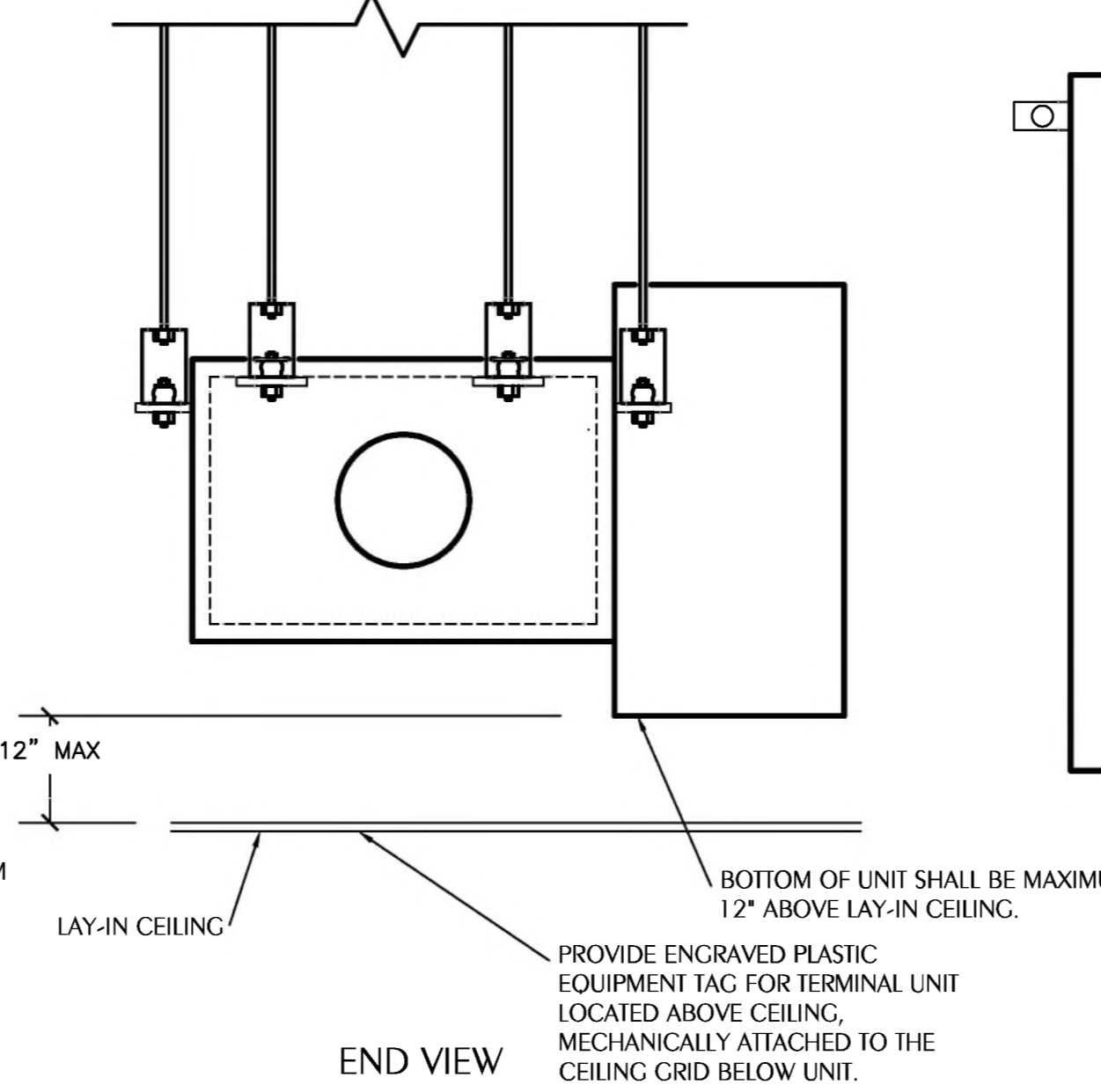


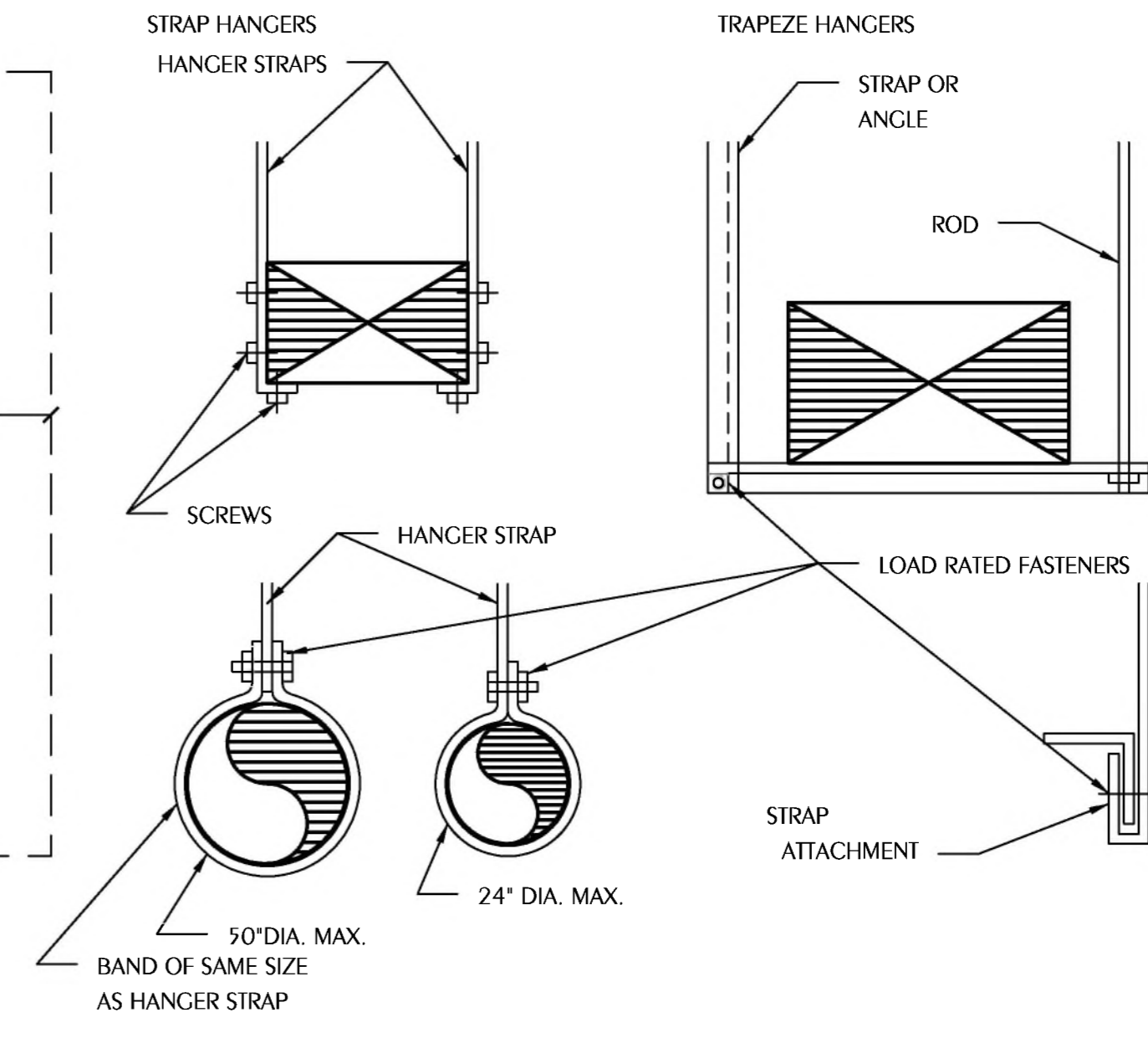
1 TYPICAL BRANCH DUCT TAKEOFF
 M3.1 SCALE: NONE



2 INLINE FAN DETAIL
 M3.1 SCALE: NONE

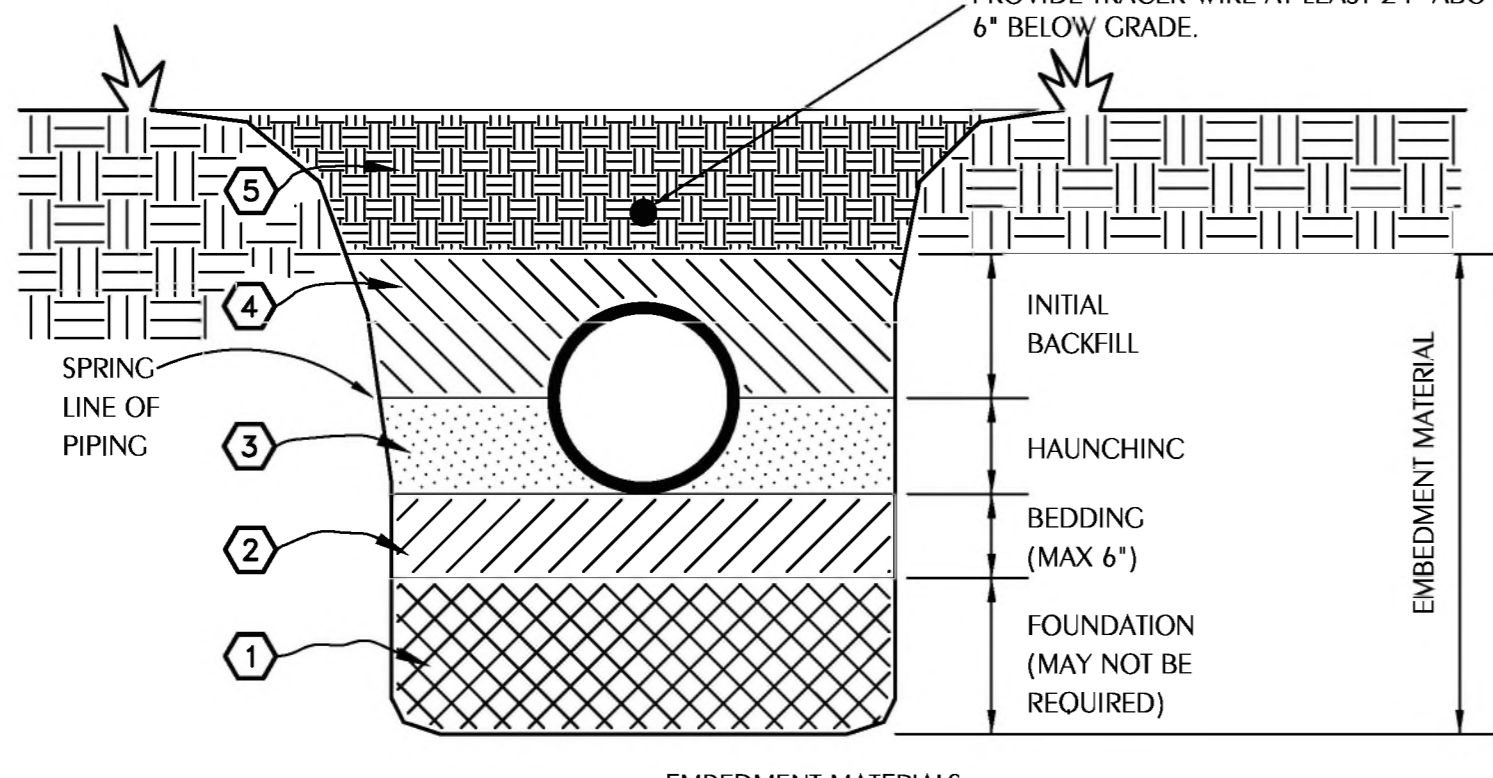


3 TERMINAL UNIT MOUNTING DETAIL
 M3.1 SCALE: NONE



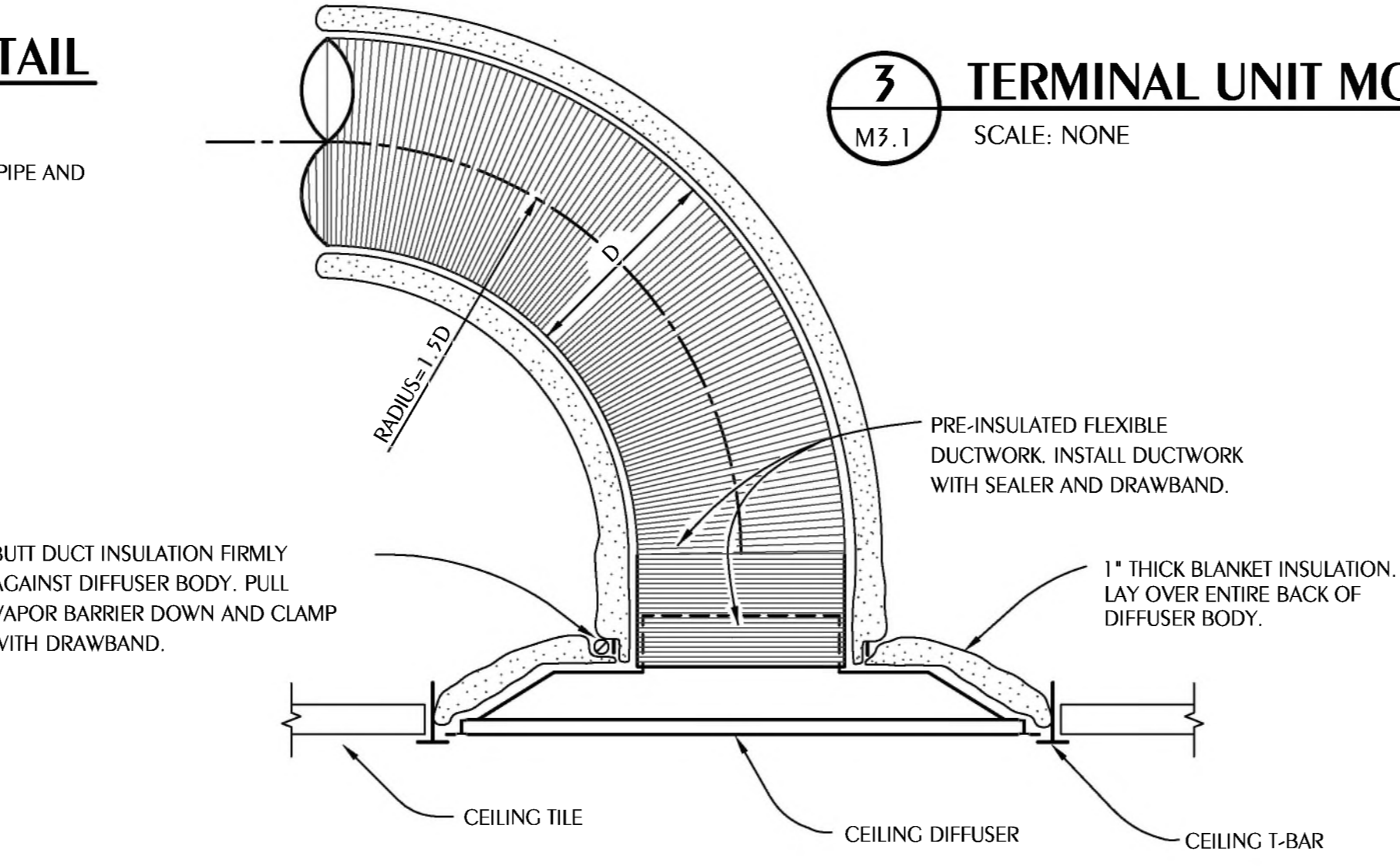
4 TYPICAL DUCT HANGER DETAILS
 M3.1 SCALE: NONE

- 1 A FOUNDATION MAY BE REQUIRED IN VERY POOR SOIL CONDITIONS.
- 2 BEDDING IS REQUIRED PRIMARILY TO BRING THE TRENCH BOTTOM UP TO GRADE. BEDDING MATERIALS SHALL PROVIDE A UNIFORM AND ADEQUATE LONGITUDINAL SUPPORT UNDER THE PIPE. IN DRY SOIL CONDITIONS, CLASS II OR III MATERIAL SHALL BE HAND PLACED IN 4-6\"/>
- 3 HAUNCHING MATERIAL SHALL BE HAND PLACED TO THE SPRINGLINE OF THE PIPE. CLASS II OR III MATERIAL SHALL BE CONSOLIDATED UNDER THE PIPE AND HAND TAMPED TO PROVIDE ADEQUATE SIDE SUPPORT.
- 4 INITIAL BACKFILL MATERIAL SHALL BE CLASS II OR III. IT SHALL BE PLACED WITHIN 30\"/>
- 5 FINAL BACKFILL UNDER ROADWAYS MAY REQUIRE SPECIAL COMPACTION AND DENSITY TESTS. A MINIMUM OF 30\"/>

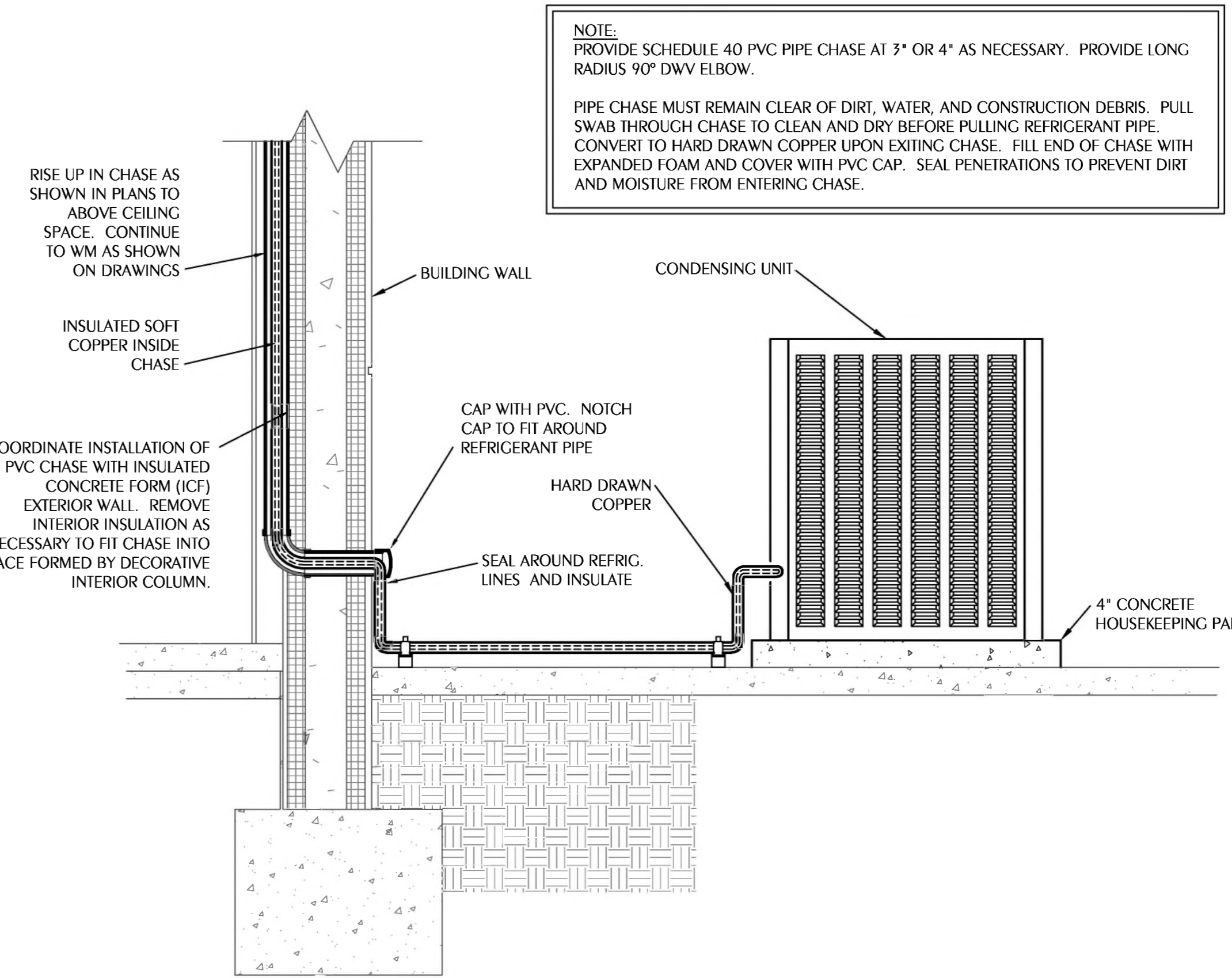


EMBEDMENT MATERIALS

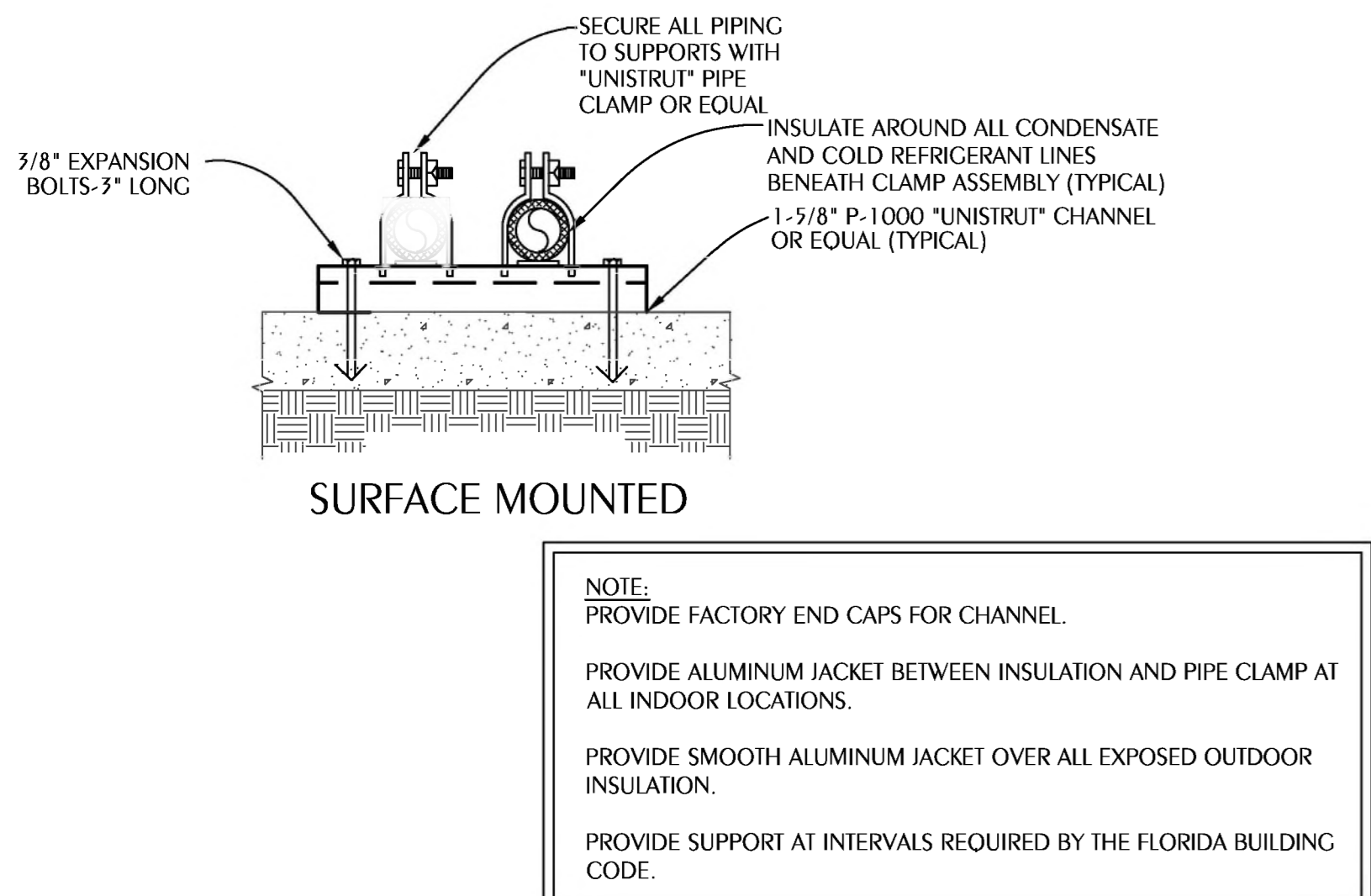
CLASS I:	ANGULAR, 1/4\"/>
CLASS II:	COARSE SANDS AND GRAVELS WITH MAXIMUM PARTICLE SIZE OF 1-1/2\"/>
CLASS III:	FINE SAND AND CLAY GRAVELS, INCLUDING FINE SANDS, SAND-CLAY MIXTURES AND GRAVEL-CLAY MIXTURES. SOIL TYPES CM, CC, SM, AND SC ARE INCLUDED IN THIS CLASS.
CLASS IV:	SILT, SILTY CLAYS, AND CLAYS, INCLUDING INORGANIC CLAYS AND SILT OF MEDIUM TO HIGH PLASTICITY AND LIQUID LIMITS. SOIL TYPES MH, ML, CH, AND CL ARE INCLUDED IN THIS CLASS. THESE MATERIALS ARE NOT TO BE USED FOR BEDDING, HAUNCHING, OR INITIAL BACKFILL.
CLASS V:	THIS CLASS INCLUDES THE ORGANIC SOILS, AS WELL AS SOILS CONTAINING FROZEN EARTH, DEBRIS, ROCKS LARGER THAN 1-1/2\"/>



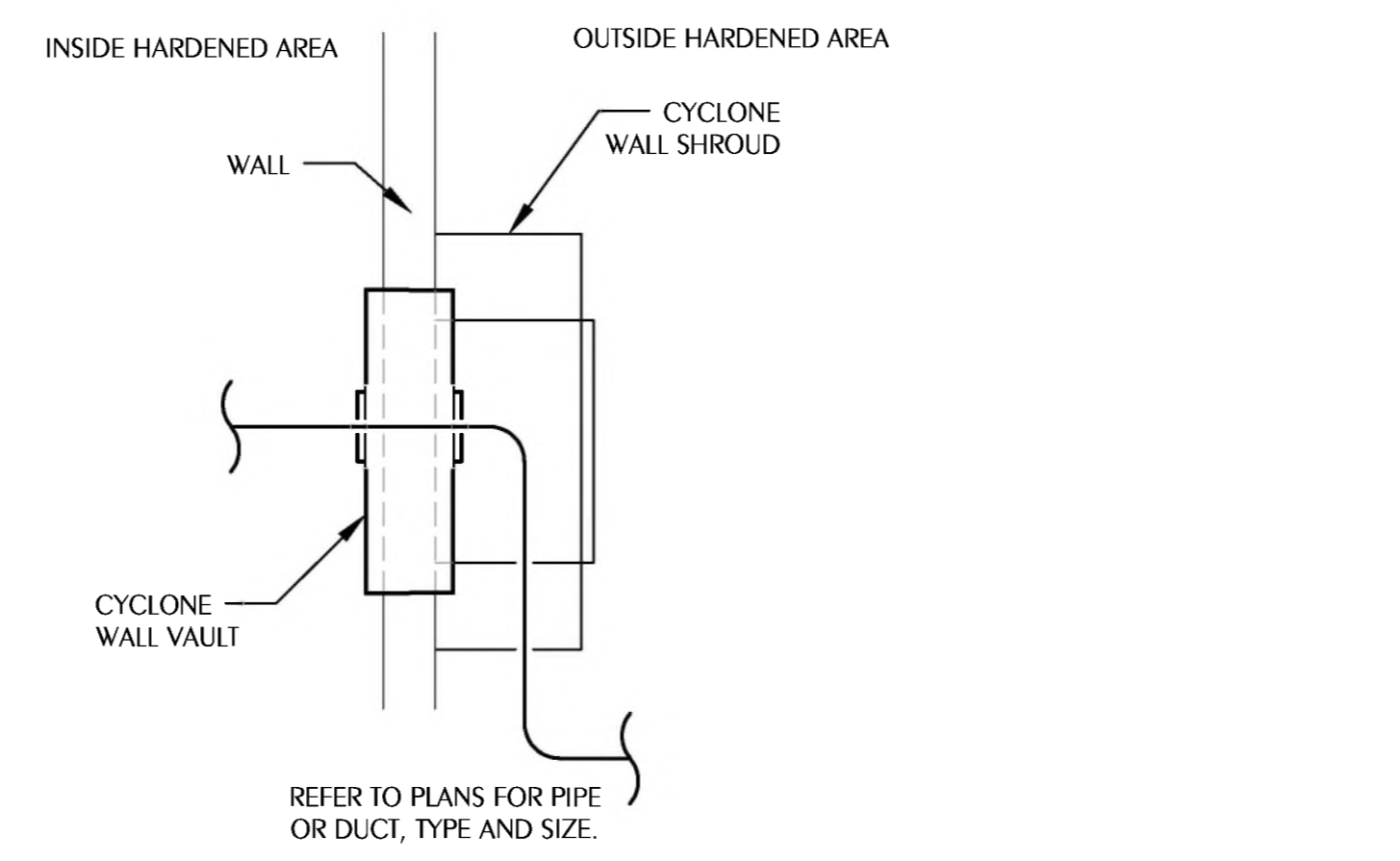
6 TYPICAL CEILING DIFFUSER DETAILS
 M3.1 SCALE: NONE



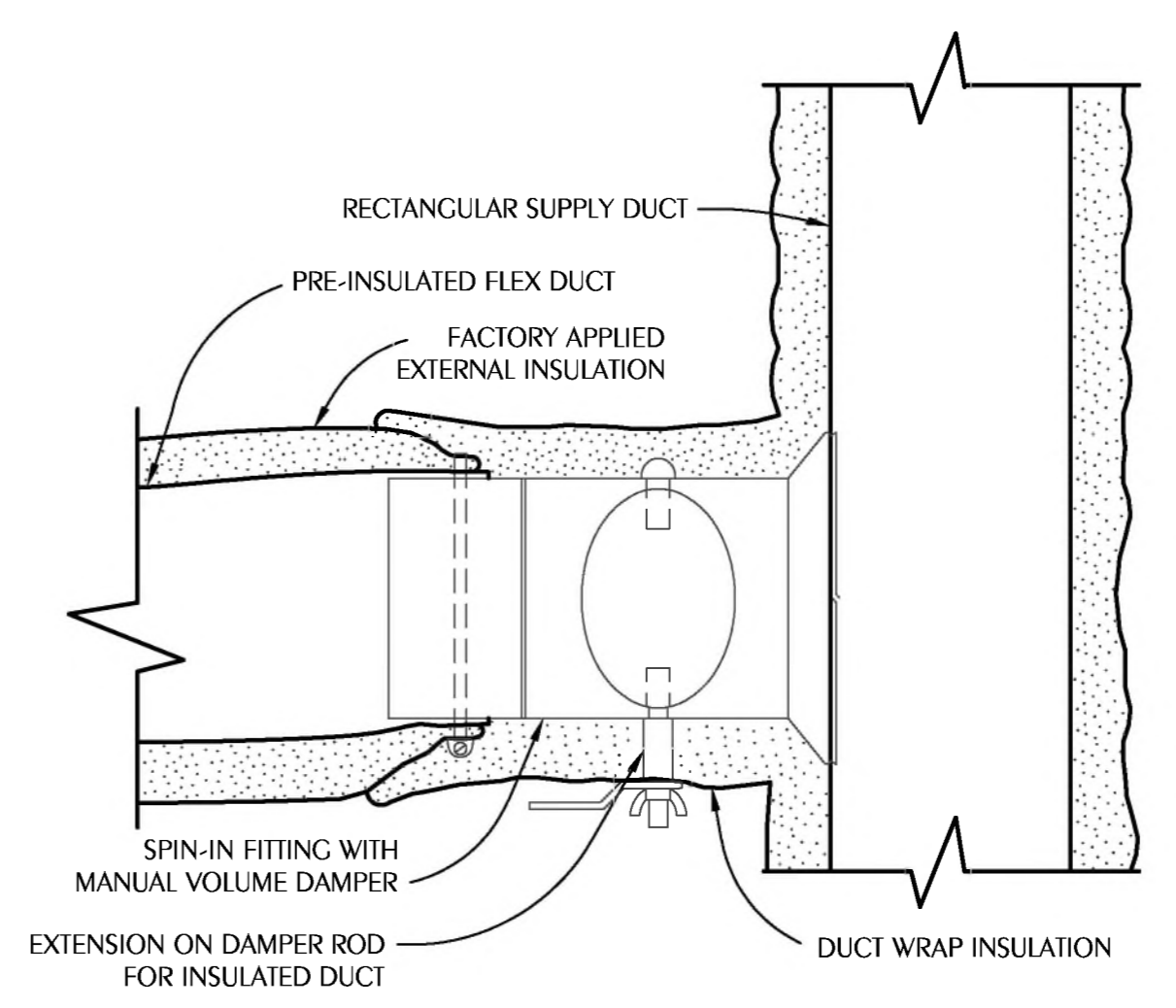
7 CONCEALED REFRIGERANT PIPE DETAIL
 M3.1 SCALE: NONE



8 TYPICAL PIPING SUPPORT DETAIL
 M3.1 SCALE: NONE



9 HARDENED WALL PENETRATION DETAIL
 M3.1 SCALE: NONE



10 TYPICAL FLEX DUCT TAKEOFF DETAIL
 M3.1 SCALE: NONE

REVISIONS

NO.	DATE	DESCRIPTION

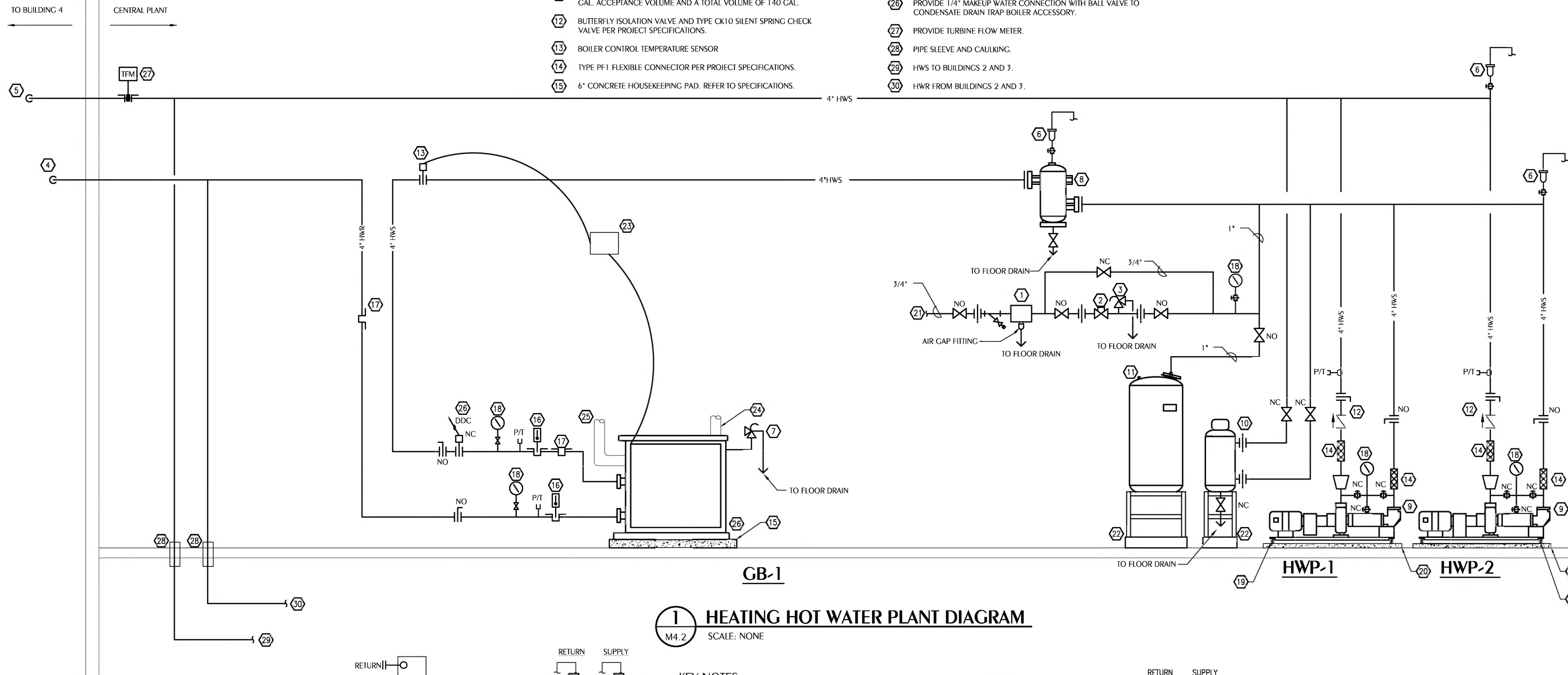
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DATE	DESCRIPTION

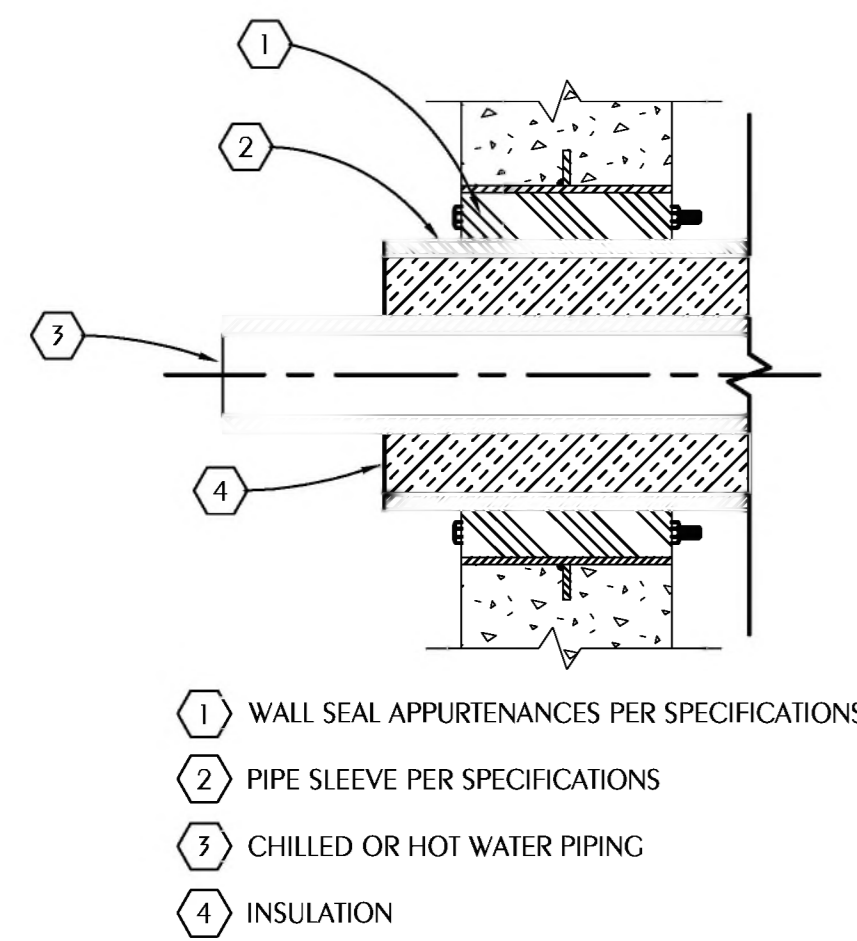
PROJECT NAME/LOCATION
MOWAT MIDDLE SCHOOL CAFETERIA AND ADMINISTRATION ADDITION
 PANAMA CITY, FLORIDA
 SHEET TITLE:
HVAC DETAILS

HEATING HOT WATER PLANT PIPING DIAGRAM NOTES

- | | |
|---|---|
| 1 REDUCED PRESSURE BACKFLOW PREVENTER AND METER | 16 THERMOMETER |
| 2 PRESSURE REDUCING VALVE SET AT 20 PSI | 17 STAINLESS STEEL WELL FOR EMCS SENSOR |
| 3 3/4" PRESSURE RELIEF VALVE SET AT 30 PSI | 18 PRESSURE GAUGE |
| 4 HWR FROM BLDG. | 19 TYPE BF2 VIBRATION ISOLATION PER SPECIFICATIONS |
| 5 HWS TO BLDG. | 20 CONCRETE HOUSEKEEPING PAD |
| 6 AUTOMATIC AIR VENT AT ALL HIGH POINTS IN SYSTEM, PIPE TO FLOOR DRAIN WITH 1/4" COPPER TUBING. | 21 CONNECT TO DOMESTIC COLD WATER SUPPLY |
| 7 ASME RELIEF VALVE SET AT 30 PSI, PIPE DISCHARGE TO FLOOR DRAIN. | 22 ANGLE IRON SUPPORT STAND - PAINT PER ARCHITECTURAL SPECIFICATIONS |
| 8 AIR SEPARATOR WITH STAINLESS STEEL STRAINER, PIPE DRAIN TO FLOOR DRAIN | 23 BOILER CONTROL PANEL |
| 9 SUCTION DIFFUSER | 24 6"Ø STAINLESS STEEL TYPE 'B' GAS FLUE VENT AND VENT CAP. REFER TO FLOOR PLANS FOR EXACT ROUTING. |
| 10 5 GAL. CHEMICAL SHOT FEEDER. FILL FOR SHOT FEEDER SHALL BE A MAX. OF 3/4" AFF. | 25 8"Ø PVC COMBUSTION AIR INTAKE ROUTED AS SHOWN ON FLOOR PLANS. |
| 11 REPLACEABLE BLADDER TYPE EXPANSION TANK WITH MINIMUM 140 GAL. ACCEPTANCE VOLUME AND A TOTAL VOLUME OF 140 GAL. | 26 PROVIDE 1/4" MAKEUP WATER CONNECTION WITH BALL VALVE TO CONDENSATE DRAIN TRAP BOILER ACCESSORY. |
| 12 BUTTERFLY ISOLATION VALVE AND TYPE CK10 SILENT SPRING CHECK VALVE PER PROJECT SPECIFICATIONS. | 27 PROVIDE TURBINE FLOW METER. |
| 13 BOILER CONTROL TEMPERATURE SENSOR | 28 PIPE SLEEVE AND CAULKING. |
| 14 TYPE PF1 FLEXIBLE CONNECTOR PER PROJECT SPECIFICATIONS. | 29 HWS TO BUILDINGS 2 AND 3. |
| 15 6" CONCRETE HOUSEKEEPING PAD. REFER TO SPECIFICATIONS. | 30 HWR FROM BUILDINGS 2 AND 3. |

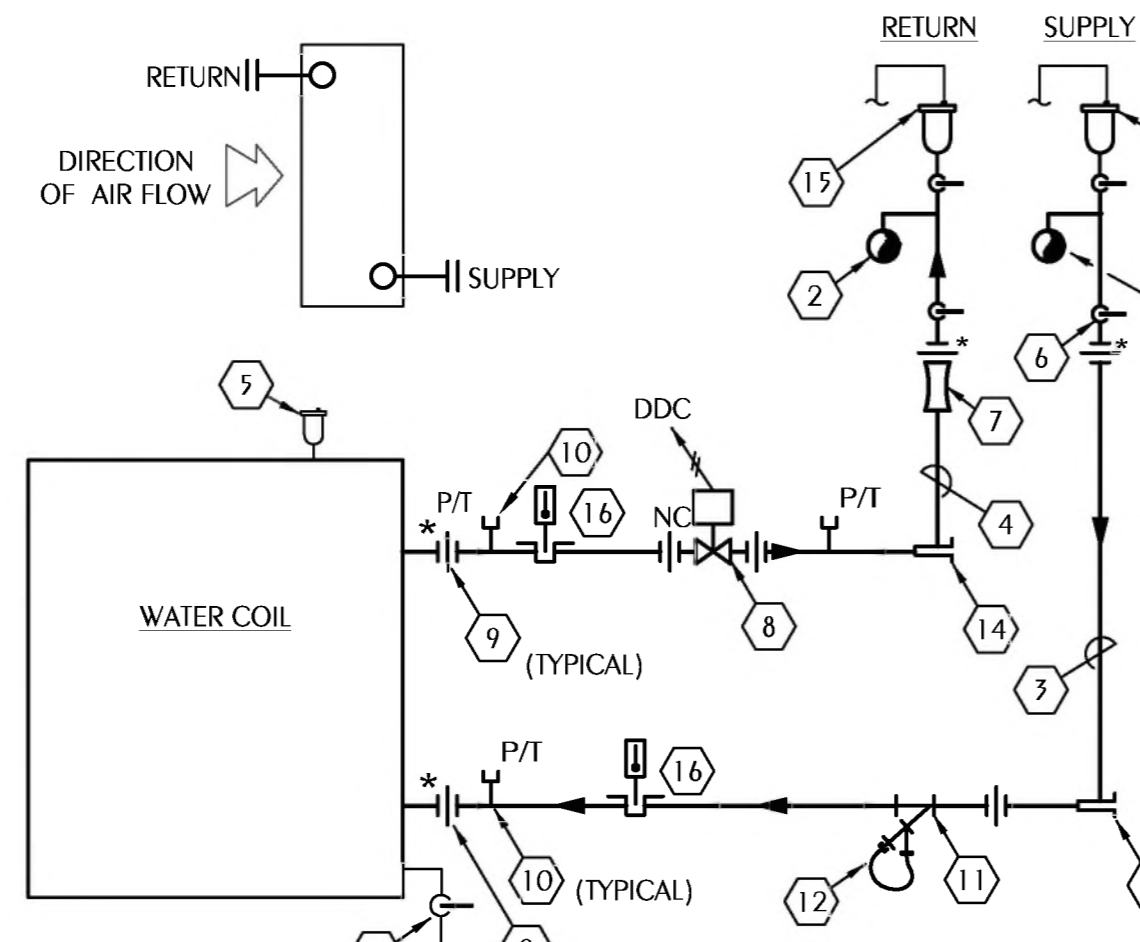


1 HEATING HOT WATER PLANT DIAGRAM
M4.2 SCALE: NONE



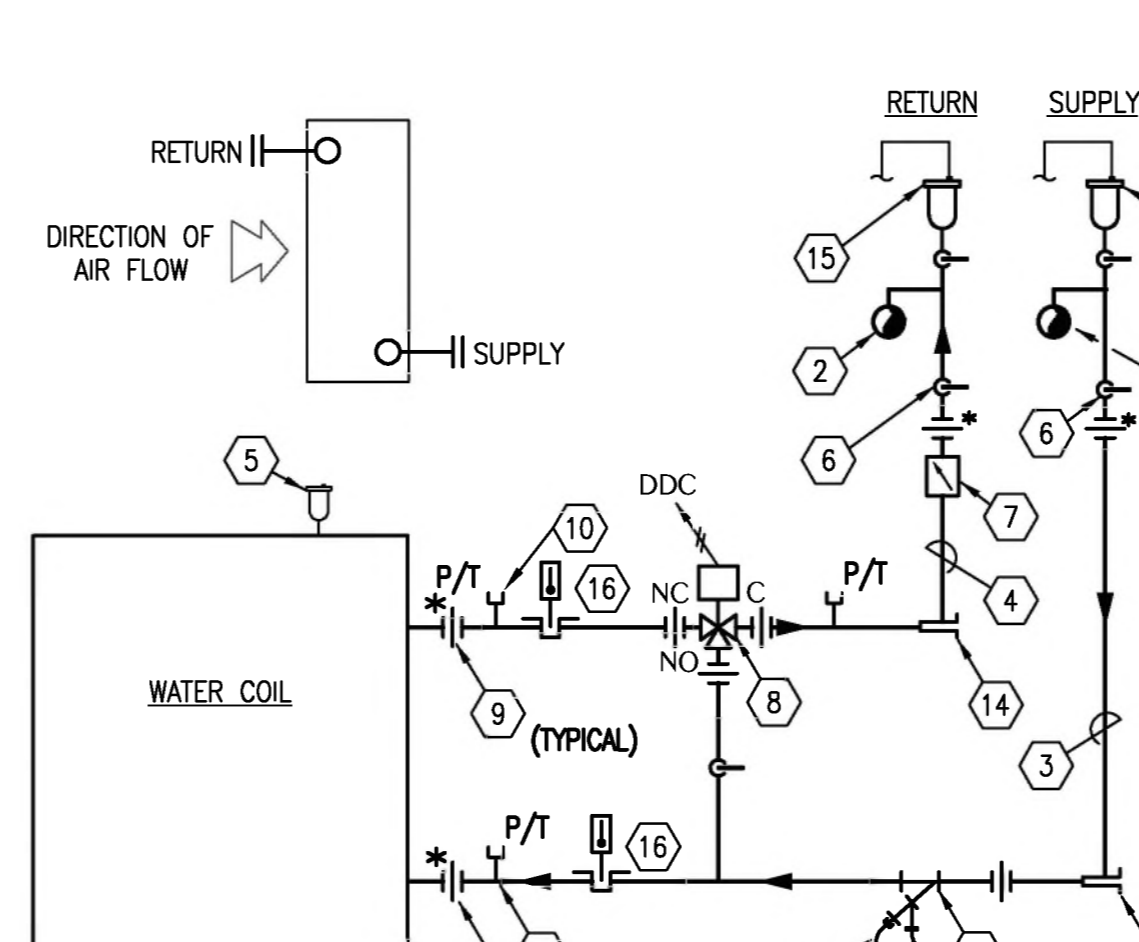
- 1 WALL SEAL APPURTENANCES PER SPECIFICATIONS
- 2 PIPE SLEEVE PER SPECIFICATIONS
- 3 CHILLED OR HOT WATER PIPING
- 4 INSULATION

2 TYPICAL WALL PIPE PENETRATION
M4.2 SCALE: NONE



- GENERAL NOTES:**
- 1) SUPPLY AND RETURN RUNOUT PIPING FROM TEE AT AUTO AIR VENT TO COIL SHALL BE SCHEDULE 40 STEEL. TYPE L HARD DRAWN COPPER IS ACCEPTABLE AT THE CONTRACTOR'S OPTION
 - 2) PROVIDE PRESSURE INDEPENDENT ELECTRIC CONTROL VALVES WITH CONSTANT DIFFERENTIAL PRESSURE FOR 100% VALVE AUTHORITY, OPERATING RANGE 4-60 PSI.
 - 3) INSTALL COIL COMPONENTS IN THE PHYSICAL RELATIONSHIP INDICATED WITH RESPECT TO THE COIL, AND TO EACH OTHER.
 - 4) INSTALL 2-WAY CONTROL VALVE WITH ACTUATOR IN VERTICAL POSITION.
 - 5) INSTALL P/T PORTS IN REDUCING TEE. HALF COUPLINGS ARE NOT ALLOWABLE.
 - 6) ARRANGE PIPING SUCH THAT THE ENTIRE COIL CONNECTION ASSEMBLY CAN BE REMOVED BY DISCONNECTING AT POINTS MARKED WITH AN ASTERISK (*) FOR COIL SERVICING. PIPING SHALL NOT INTERFERE WITH ACCESS TO ANY COMPONENT OF THE AIR HANDLING UNIT THAT REQUIRES SERVICE.

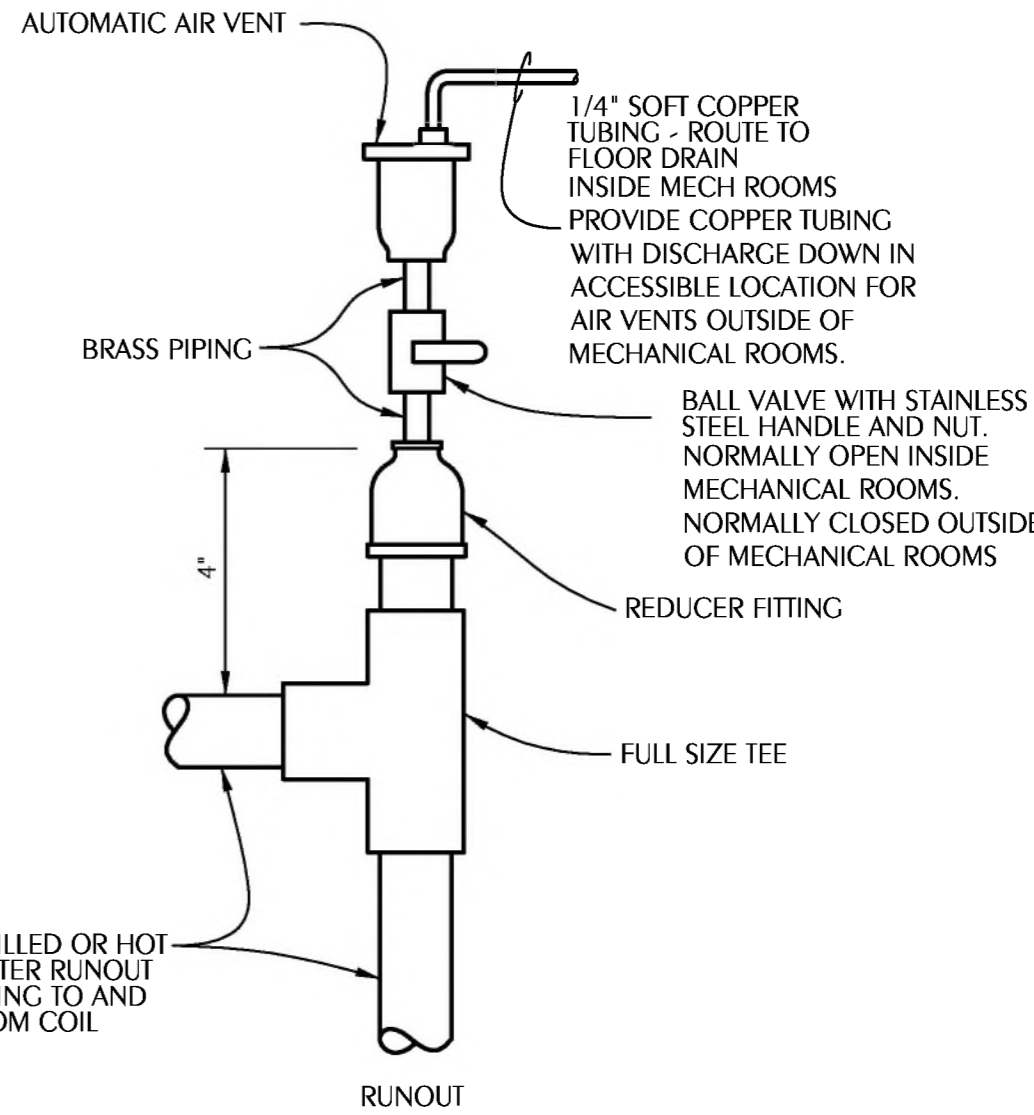
3 TYPICAL COIL CONNECTION SCHEMATIC
M4.2 SCALE: NONE PIPE SIZE 2" AND SMALLER



- GENERAL NOTES:**
- 1) SUPPLY AND RETURN RUNOUT PIPING FROM TEE AT AUTO AIR VENT TO COIL SHALL BE HARD DRAWN TYPE L COPPER.
 - 2) AUTOMATIC FLOW CONTROL VALVES SHALL BE FLOW DESIGN AUTO FLOW SERIES YR, SCREWED ENDS, Y-PATTERN, LINE SIZE, WITH TWO FACTORY P/T PORTS, RANGE 2-32 PSID.
 - 3) INSTALL COIL COMPONENTS IN THE PHYSICAL RELATIONSHIP INDICATED WITH RESPECT TO THE COIL, AND TO EACH OTHER.
 - 4) INSTALL 3-WAY CONTROL VALVE WITH ACTUATOR IN VERTICAL POSITION.
 - 5) INSTALL P/T PORTS IN REDUCING TEE. HALF COUPLINGS ARE NOT ALLOWABLE.
 - 6) ARRANGE PIPING SUCH THAT THE ENTIRE COIL CONNECTION ASSEMBLY CAN BE REMOVED BY DISCONNECTING AT POINTS MARKED WITH AN ASTERISK (*) FOR COIL SERVICING. PIPING SHALL NOT INTERFERE WITH ACCESS TO ANY COMPONENT OF THE AIR HANDLING UNIT THAT REQUIRES SERVICE.

4 TYPICAL COIL CONNECTION SCHEMATIC
M4.2 SCALE: NONE PIPE SIZE 2" AND SMALLER - THREE WAY CONTROL VALVE

- KEY NOTES:**
- 1 SUPPLY MAIN
 - 2 RETURN MAIN
 - 3 SUPPLY RUNOUT
 - 4 RETURN RUNOUT
 - 5 1/4" AUTOMATIC AIR VENT IN COIL HEADER, FLOW DESIGN MODEL AA025.
 - 6 BALL SERVICE VALVE, SCREWED
 - 7 MANUAL SHUTOFF VENTURI VALVE
 - 8 2-WAY PRESSURE INDEPENDENT CONTROL VALVE, BRASS CONSTRUCTION
 - 9 SERVICE UNION
 - 10 PRESSURE/TEMPERATURE PORT WITH EXTENDED NECK
 - 11 BRONZE STRAINER, SCREWED.
 - 12 STRAINER BLOWDOWN/HOSE END DRAIN VALVE WITH BRASS CAP AND CHAIN FLOW DESIGN MODEL HE.
 - 13 3/8" COPPER DRAIN W/BALL VALVE
 - 14 STAINLESS STEEL WELL FOR DDC TEMPERATURE TRANSMITTER IN TEE, COORDINATE WITH DDC CONTRACTOR.
 - 15 1/2" AUTOMATIC AIR VENT, SEE MOUNTING DETAIL THIS SHEET.
 - 16 THERMOMETER



5 TYPICAL AUTOMATIC AIR VENT DETAILS
M4.2 SCALE: NONE

NO.	DATE	DESCRIPTION

DATE	DESCRIPTION
01/08/2025	

PROJECT NAME/LOCATION
MOWAT MIDDLE SCHOOL CAFETERIA AND ADMINISTRATION ADDITION
PANAMA CITY, FLORIDA
SHEET TITLE
HEATING WATER PIPING DIAGRAM AND DETAILS

VERTICAL INSTALLATION

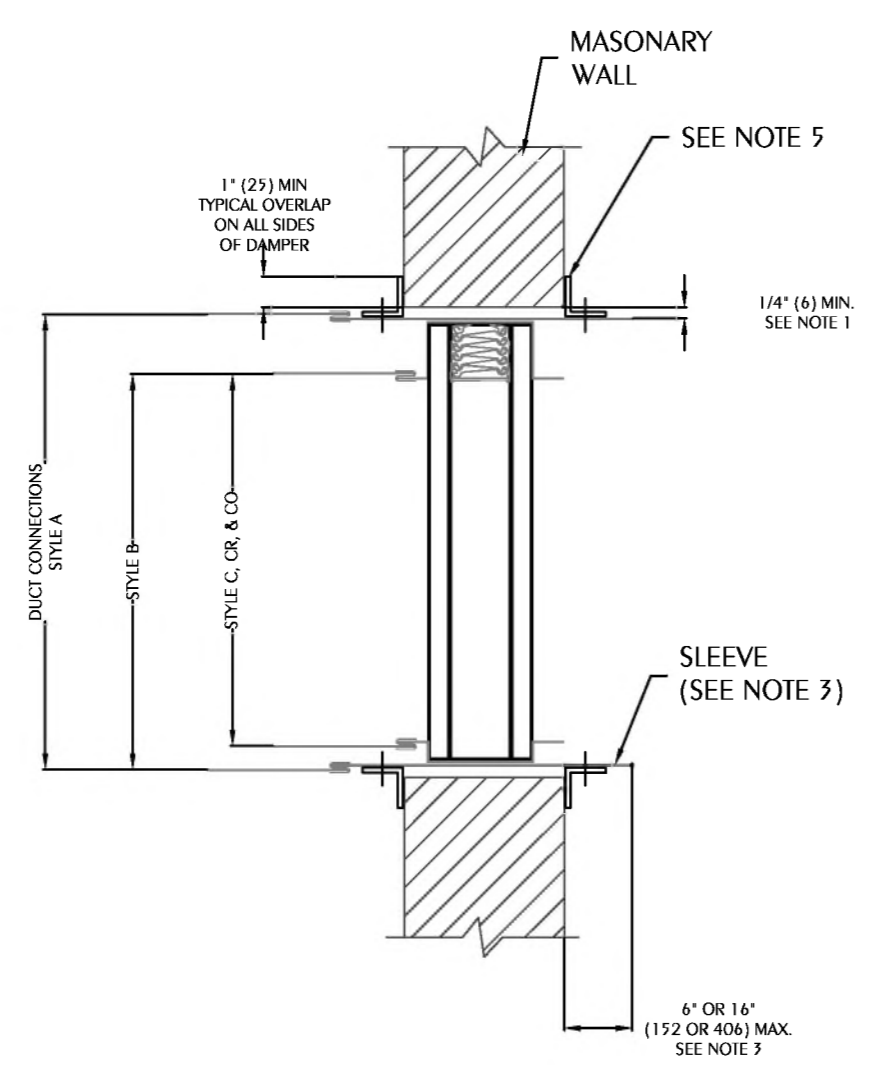


FIGURE 1

STAINLESS STEEL DAMPERS

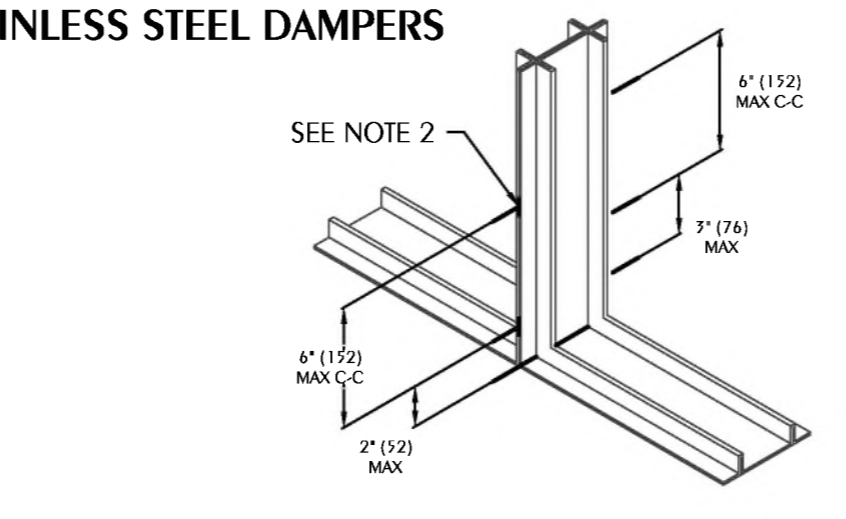
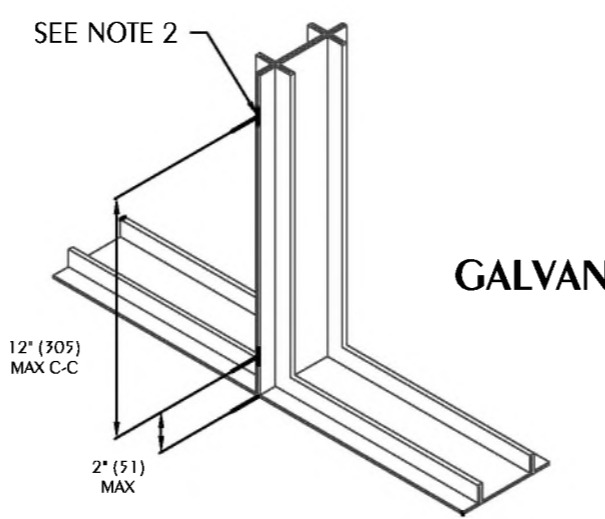


FIGURE 2
1 1/2 HOUR

GALVANIZED DAMPERS



HORIZONTAL INSTALLATION

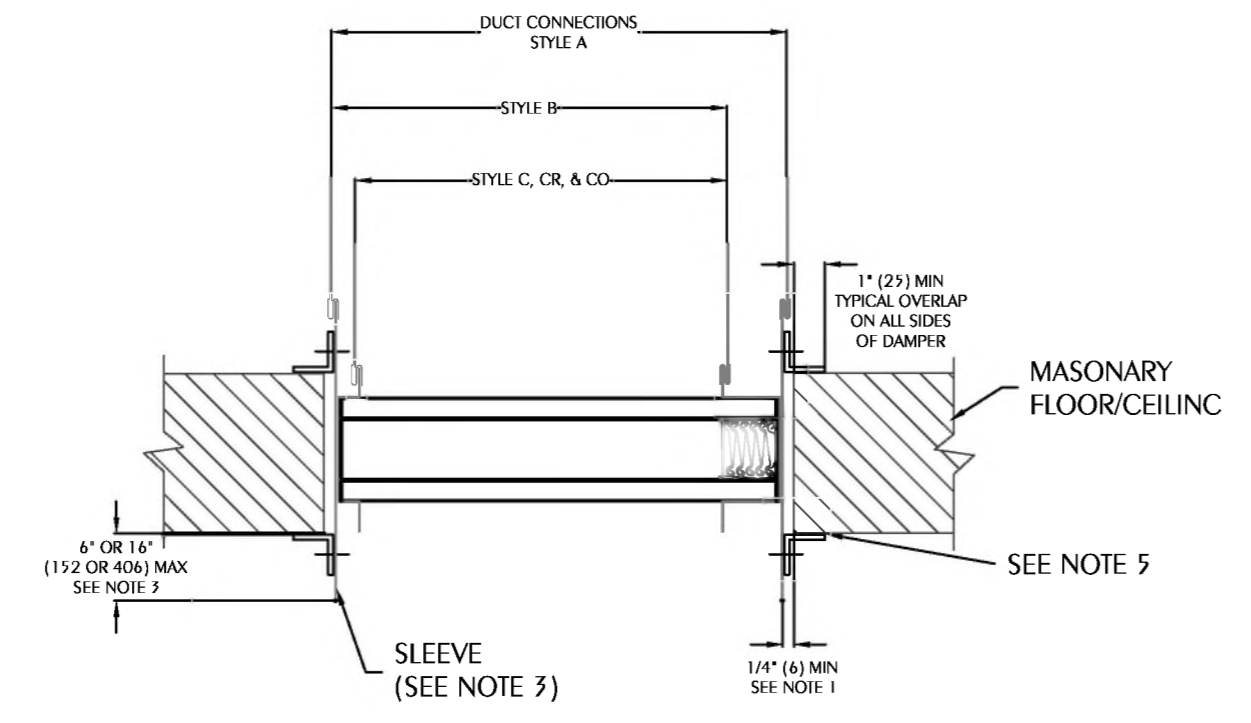


FIGURE 3

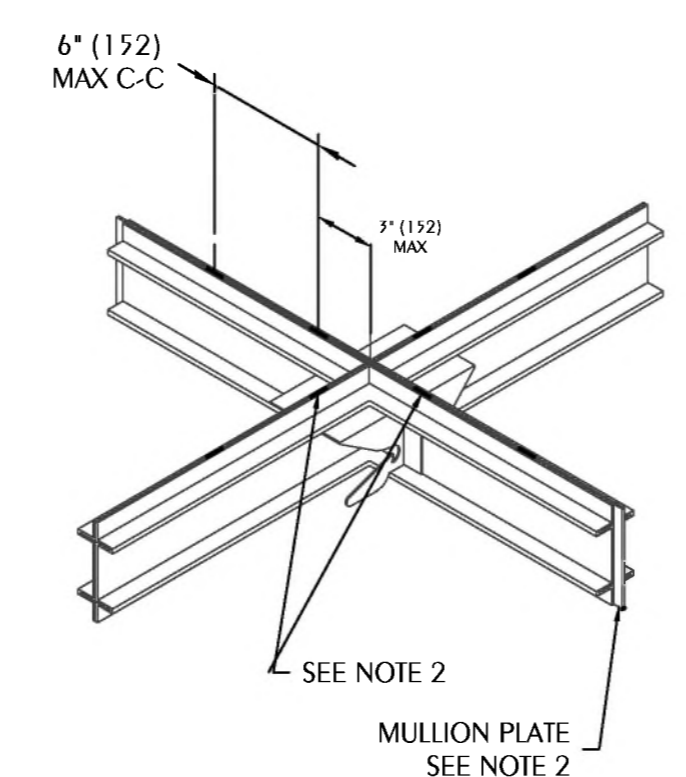


FIGURE 4
1 1/2 HOUR

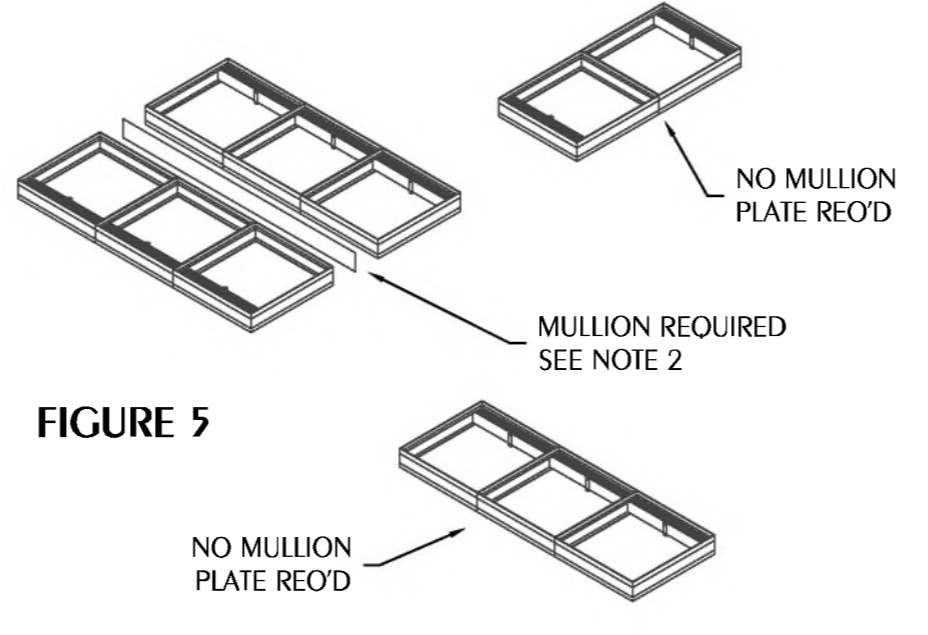


FIGURE 5

- 1. OPENING CLEARANCE**
 The opening in the wall or floor shall be larger than the damper/sleeve assembly to permit installation or expansion. For two angle installations the opening shall be a minimum of 1/8" per foot (3 per 305) larger than the overall size of the damper/sleeve assembly. The maximum opening size shall not exceed 1/8" per foot (3 per 305) plus 2" (51), nor shall the opening be less than 1/4" (6) larger than the damper/sleeve assembly. For one angle installations, the opening shall be a minimum of 1/4" (6) to a maximum of 1" (25) larger than the overall size of the damper/sleeve assembly. The opening may be as much as 2" (51) larger than the damper/sleeve assembly if a 1.6ga (1.6) mounting angles is utilized.
- 2. FASTENERS AND Multiple Section Assembly**
 Use No. 10 (M5) bolts or screws, 3/16" (5) rivets, tack welds or spot welds as depicted in figures 3 and 4 and spaced as follows when joining individual dampers to make multiple section damper assemblies or when fastening damper to the sleeve.
 Vertical Mount (In wall)
 Galvanized steel dampers 12" (305) spacing
 Stainless steel dampers 6" (152) spacing
 Horizontal Mount (In floor)
 All dampers 6" (152) spacing
 Multiple section horizontal mount dampers require a 1/4" gage thick x 41/2" (2 x 114) wide steel reinforcing plate sandwiched between the damper frames with 1/2" (13) long welds staggered intermittently and spaced on maximum 6" (152) centers. The reinforcing plate must be the same material as the dampers. The length must be equal to the damper width of two or more adjoining damper sections. Reinforcing plates are not required for assemblies consisting of two dampers attached end-to-end or three dampers attached side-to-side as depicted in figure 5.
- 3. Damper Sleeve**
 Sleeve thickness must be equal to or thicker than the duct connected to it. Sleeve gage requirements are listed in the SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and in NFPA90A. If a breakaway style duct/sleeve connection is not used, the sleeve shall be a minimum of 1.6 gage (1.6) for dampers up to 36" (914) wide by 24" (610) high and 1.4 gage (1.9) for dampers exceeding 36" (914) wide by 24" (610) high. Damper sleeve shall not extend more than 6" (152) beyond the fire wall or partition unless damper is equipped with a factory installed access door. Sleeve may extend up to 16" (406) beyond the fire wall or partition on sides equipped with a factory installed access door. Sleeve shall terminate at both sides of wall within dimensions shown.
- 4. Damper Orientation**
 Use "Air Flow" and "Mount with Arrow Up" labels on Dynamic DBD and DBDX models for proper damper orientation. For Static IBD models use only "Mount with Arrow Up" label on damper for proper damper orientation.
- 5. Mounting Angles**
 Mounting angles shall be a minimum of 1 1/2" x 1 1/2" x 20 gage steel (38 x 38 x 1.0). For openings in metal stud, wood stud walls or concrete/masonry walls and floors of sizes 90" x 49" or 49" x 90" (2286 x 1245 or 1245 x 2286) and less mounting angles are only required on one side of the wall or top side of the floor and must be attached to both the sleeve and the wall or floor. Mounting angles may be installed directly to the metal stud under the wall based on metal stud wall insulations only. Larger openings require mounting angles on both sides of the partition and must be attached only to the sleeve. Mounting angles must overlap the partition a minimum of 1" (25). Do not weld or fasten angles together at corners of dampers. Rusklin fire dampers may be installed using Rusklin FAST angle for one angle installation or Rusklin PFMA for two angle installations.
- 6. Duct/Sleeve Connections**
 - a. Break-away Duct/Sleeve Connections**
 Rectangular ducts must use one or more of the connections: plain "S" slip, hemmed "S" slip, double "S" slip, inside slip joint, standing S, standing S (angle reinforced), standing S (bar reinforced), standing S (angle reinforced), or drive slip joint.
 A maximum of two #10 sheet metal screws on each side and the bottom, located in the center of the slip pocket and penetrating both sides of the slip pocket may be used. Connections using these slip joints on the top and bottom with flat drive slips up to 20" (508) long on the sides may also be used.
 - b. Round and Oval Break-away Connections**
 Round and flat oval break-away connections must use either a 4" (102) wide dowelbar or #10 sheet metal screws spaced equally around the circumference of the duct as follows:
 • Duct diameters 22" (559) and smaller – Maximum 3 screws.
 • Duct diameters over 22" (559) and including 36" (914) – Maximum 5 screws.
 • Duct diameters over 36" (914) and up to and including 191" (4851) round perimeter – Maximum 8 screws. For flat oval ducts, the diameter is considered the largest (major) dimension of the duct.
 Note: When optional sealing of these joints is desired, the following sealants may be applied in accordance with the sealant manufacturer's instructions:
 Handcast, Inc. – Iron Grip 601 Precision – PA2084T
 Eco Duct Seal 414-52 Design Polymers – DP 1010
 - c. Flanged Break-away Style Duct/Sleeve Connections**
 Flanged connection systems manufactured by Ductmate, Nexus or Ward are approved break-away connections when installed as shown on the Flanged System Breakaway Connections Supplement.
 Connections Supplement, TDC and TDF roll-formed flanged connections using 5/8" (10) steel bolts and nuts, and metal cleats, as tested by SMACNA, are approved break-away connections when installed as shown on the Flanged System Breakaway Connections Supplement.
 - d. Non-Break-away Duct/Sleeve Connections**
 If other duct/sleeve connections are used, the sleeve shall be a minimum of 1.6 gage (1.6) for dampers up to 36" (914) wide x 24" (610) high and 1.4 gage (2.0) for dampers exceeding 36" (914) wide x 24" (610) high.
- 7. Installation and Maintenance**
 To ensure optimum operation and performance, the damper must be installed so it is square and free from binding. Each fire damper should be maintained and tested on a regular basis and in accordance with the latest editions of NFPA 90A and local codes. Care should be exercised to ensure that such tests are performed safely and do not cause system damage.

1 TYPICAL HORIZONTAL AND VERTICAL FIRE DAMPER DETAIL
 M5.1 SCALE: NONE

NOTE: ALL SYSTEMS DETAILED ON MECHANICAL PENETRATIONS SHEETS ARE BASED ON THE MANUFACTURERS SPECIFIED AS BASIS OF DESIGN AND APPLY TO MECHANICAL, FIRE PROTECTION, AND PLUMBING. THE CONTRACTOR SHALL SUBMIT A PENETRATIONS PACKAGE DETAILING EACH PENETRATION AND PRODUCTS TO BE USED TO THE PERMITTING AUTHORITY FOR THE ACTUAL SYSTEMS TO BE USED.

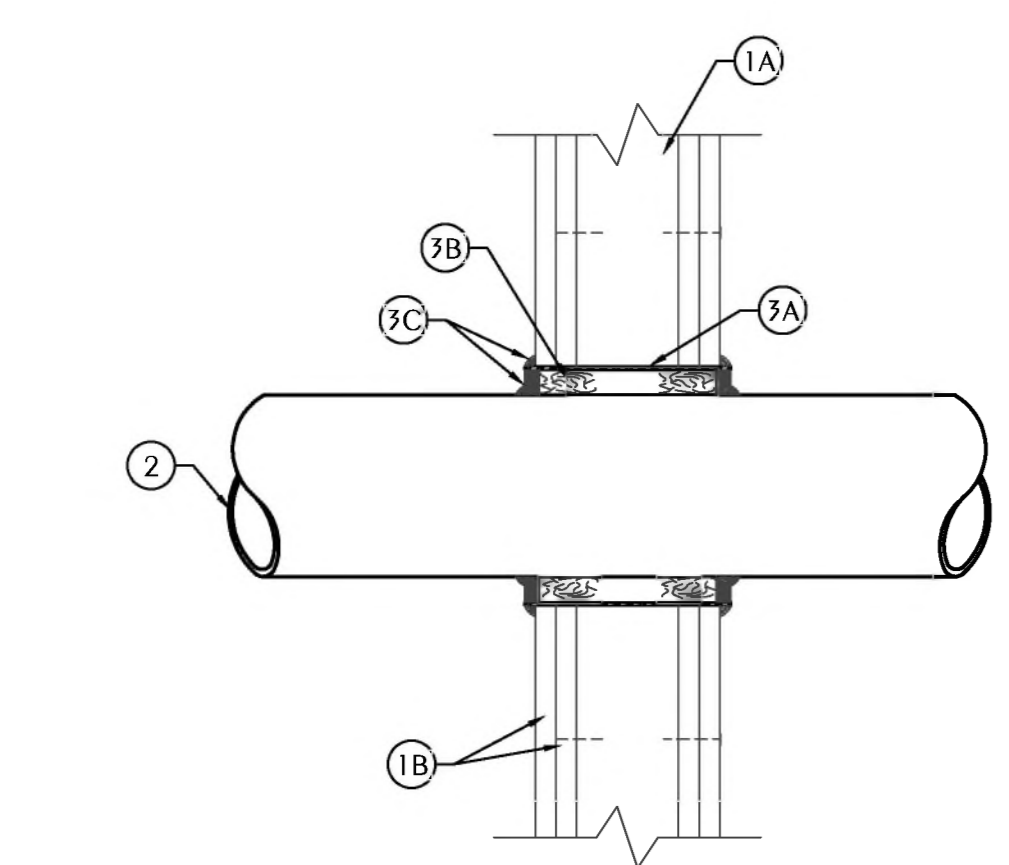
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NO.	DATE	

SUBMITTAL	DATE	DESCRIPTION

REVISIONS		DATE	DESCRIPTION
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SUBMITTAL SHEET DOCUMENTS		DATE	DESCRIPTION
NO.	DATE		

PROJECT NAME/LOCATION
MOWAT MIDDLE SCHOOL CATERERIA AND ADMINISTRATION ADDITION
 PANAMA CITY, FLORIDA
 SHEET TITLE:
FIRE RATED WALL PENETRATION DETAILS



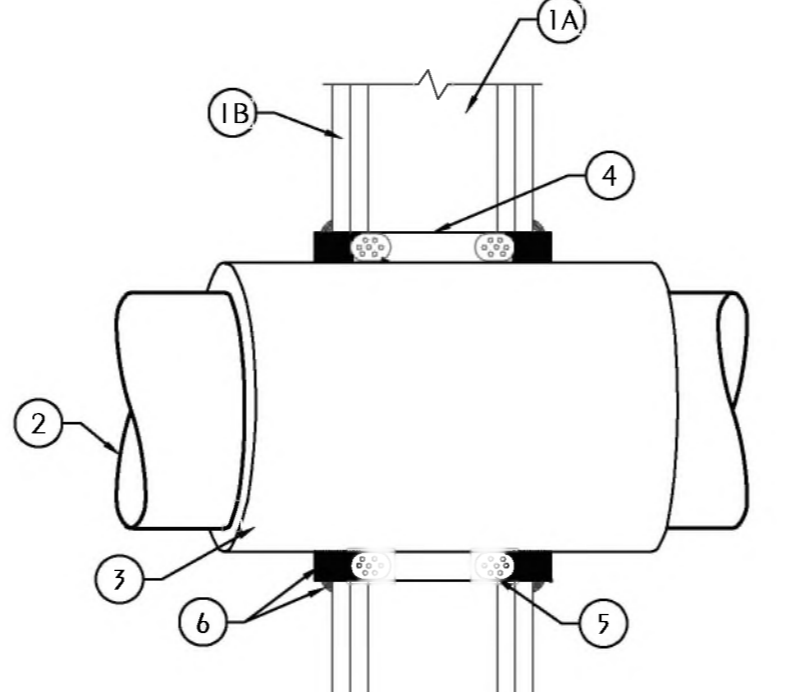
CONSULT CURRENT UNDERWRITERS LABORATORIES, INC. "FIRE RESISTANCE DIRECTORY" FOR DETAILS.
 UL SYSTEM WL1003

- WALL ASSEMBLY**—THE 1 OR 2 HR FIRE-RATED GYPSUM WALLBOARD/STUD WALL ASSEMBLY SHALL BE CONSTRUCTED OF THE MATERIALS AND IN THE MANNER DESCRIBED IN THE INDIVIDUAL U300 OR U400 SERIES WALL OR PARTITION DESIGN IN THE UL FIRE RESISTANCE DIRECTORY AND SHALL INCLUDE THE FOLLOWING CONSTRUCTION FEATURES:
 - STUDS**—WALL FRAMING MAY CONSIST OF EITHER WOOD STUDS OR STEEL CHANNEL STUDS. WOOD STUDS TO CONSIST OF NOM 2 BY 4 IN. LUMBER SPACED 16 IN. OC WITH NOM 2 BY 4 IN. LUMBER END PLATES AND CROSS BRACES. STEEL STUDS TO BE MIN 3 1/2 IN. WIDE BY 1 3/8 IN. DEEP CHANNELS SPACED MAX 24 IN. OC.
 - WALLBOARD, GYPSUM**—NOM 5/8 IN. THICK, 4 FT. WIDE WITH SQUARE OR TAPERED EDGES. THE GYPSUM WALLBOARD TYPE, THICKNESS, NUMBER OF LAYERS, FASTENER TYPE AND SHEET ORIENTATION SHALL BE AS SPECIFIED IN THE INDIVIDUAL U300 OR U400 SERIES DESIGN IN THE UL FIRE RESISTANCE DIRECTORY. MAX DIAM OF OPENING IS 1 1/2 IN.
- THROUGH-PENETRANT**—ONE METALLIC PIPE, CONDUIT OR TUBING TO BE INSTALLED EITHER CONCENTRICALLY OR ECCENTRICALLY WITHIN THE FIRESTOP SYSTEM. THE SPACE BETWEEN PIPES, CONDUITS OR TUBING AND THE STEEL SLEEVE (ITEM 3A) SHALL BE MIN OF 0 IN. (POINT CONTACT) TO MAX 2 3/8 IN. PIPE, CONDUIT OR TUBING TO BE RIGIDLY SUPPORTED ON BOTH SIDERS OF WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES, CONDUITS OR TUBING MAY BE USED:
 - STEEL PIPE**—NOM 1 1/2 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
 - IRON PIPE**—NOM 1 1/2 IN. DIAM (OR SMALLER) SERVICE WEIGHT (OR HEAVIER) CAST IRON SOIL PIPE, NOM 1 1/2 IN. DIAM (OR SMALLER) OR CLASS 50 (OR HEAVIER) DUCTILE IRON PRESSURE PIPE.
 - CONDUIT**—NOM 6 IN. DIAM (OR SMALLER) STEEL CONDUIT OR NOM 4 IN. DIAM (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING.
 - COPPER PIPE**—NOM 6 IN. DIAM (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING.
- FIRESTOP SYSTEM**—INSTALLED SYMMETRICALLY ON BOTH SIDERS OF WALL ASSEMBLY. THE DETAILS OF THE FIRESTOP SYSTEM SHALL BE AS FOLLOWS:
 - STEEL SLEEVE**—CYLINDRICAL SLEEVE FABRICATED FROM MIN 0.019 IN. THICK (NO. 28 GAUGE) GALV SHEET STEEL AND HAVING A MIN 2 IN. LAP ALONG THE LONGITUDINAL SEAM. LENGTH OF STEEL SLEEVE TO BE EQUAL TO THICKNESS OF WALL PLUS 1 TO 4 IN. SUCH THAT, WHEN INSTALLED, THE ENDS OF THE SLEEVE WILL PROJECT APPROXIMATELY 1/2 TO 2 IN. BEYOND THE SURFACE OF THE WALL ON BOTH SIDERS OF THE WALL ASSEMBLY.
 - WALLBOARD, GYPSUM**—NOM 5/8 IN. THICK, 4 FT WIDE WITH SQUARE OR TAPERED EDGES. THE GYPSUM WALLBOARD TYPE, THICKNESS, NUMBER OF LAYERS, FASTENER TYPE AND SHEET ORIENTATION SHALL BE AS SPECIFIED IN THE INDIVIDUAL U300 OR U400 SERIES DESIGN IN THE UL FIRE RESISTANCE DIRECTORY. MAX DIAM OF OPENING IS 1 1/2 IN. FOR WOOD STUD WALLS AND 1 1/2 IN. FOR STEEL STUD WALLS.
 - THROUGH PENETRANTS**—ONE METALLIC PIPE, CONDUIT OR TUBING TO BE CENTERED WITHIN THE FIRESTOP SYSTEM. PIPE, CONDUIT OR TUBING TO BE RIGIDLY SUPPORTED ON BOTH SIDERS OF WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES, CONDUITS OR TUBING MAY BE USED:
 - STEEL PIPE**—NOM 1 1/2 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE. WHEN STEEL PIPE IS USED, 1 RATING IS 1 HR.
 - CONDUIT**—NOM 3 IN. DIAM (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING OR STEEL CONDUIT. WHEN STEEL CONDUIT IS USED, 1 RATING IS 1/4 HR.
 - COPPER TUBING**—NOM 6 IN. DIAM (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING. WHEN COPPER TUBING IS USED, 1 RATING IS 1/2 AND 1 HR WHEN INSTALLED IN 1 AND 2 HR RATED WALLS, RESPECTIVELY.
 - COPPER PIPE**—NOM 6 IN. DIAM (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE. WHEN COPPER PIPE IS USED, 1 RATING IS 1/2 AND 1 HR WHEN INSTALLED IN 1 AND 2 HR RATED WALLS, RESPECTIVELY.
- PIPE COVERING**—NOM 1 OR 1-1/2 IN. THICK HOLLOW CYLINDRICAL HEAVY DENSITY (MIN 3.5 PCF) CLASS FIBER UNITS JACKETED ON THE OUTSIDE WITH AN ALL SERVICE JACKET. LONGITUDINAL JOINTS SEALED WITH METAL FASTENERS OR FACTORY-APPLIED SELF-SEALING LAP TAPE.
 - PACKING MATERIAL**—MIN 1 IN. THICKNESS OF FIRMLY PACKED MINERAL WOOL BATT INSULATION USED AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR WALL OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF CALK/FILL MATERIAL (ITEM B).
 - FILL VOID OR CAVITY MATERIALS**—CALK—INSTALLED TO FILL THE ANNULAR SPACE FLUSH WITH THE TOP SURFACE OF THE FLOOR OR SLEEVE OR FLUSH WITH BOTH SURFACES OF WALL. WHEN NOM PIPE COVERING THICKNESS IS 2 IN., MIN THICKNESS OF CALK/FILL MATERIAL IS 2 IN. WHEN NOM PIPE COVERING THICKNESS IS 1-1/2 IN. OR LESS, MIN THICKNESS OF CALK/FILL MATERIAL IS 1 IN. THE HOURLY F AND T RATINGS OF THE FIRESTOP SYSTEM ARE DEPENDENT UPON THE THICKNESS OF THE FLOOR OR WALL, THE SIZE OF PIPE, THE THICKNESS OF PIPE COVERING MATERIAL AND THE SIZE OF THE ANNULAR SPACE. (BETWEEN THE PIPE COVERING MATERIAL AND THE EDGE OF THE CIRCULAR THROUGH OPENING), AS SHOWN IN THE FOLLOWING TABLE:

MIN FLOOR OR WALL THKNS	MAX PIPE DIAM	NOM PIPE COVERING THKNS	ANNULAR SPACE	F RATING	T RATING
2-1/2	4	1 OR 1-1/2	1/2 TO 2-3/8	2	1
4-1/2	4	2	1/4 TO 3-5/8	2	1-1/2
2-1/2	12	1	1/2 TO 1-1/2	2	1/2
4-1/2	12	1	1/2 TO 2-3/8	2	1
2-1/2	12	1/2	1/2 TO 2-3/8	2	0

 MINNESOTA MINING & MFG. CO.—CP 25WB+.
 *BEARING THE UL CLASSIFICATION MARKING.

1 TYPICAL FIRE RATED WALL PENETRATION
 M5.2 SCALE: NONE BARE METALLIC PIPE



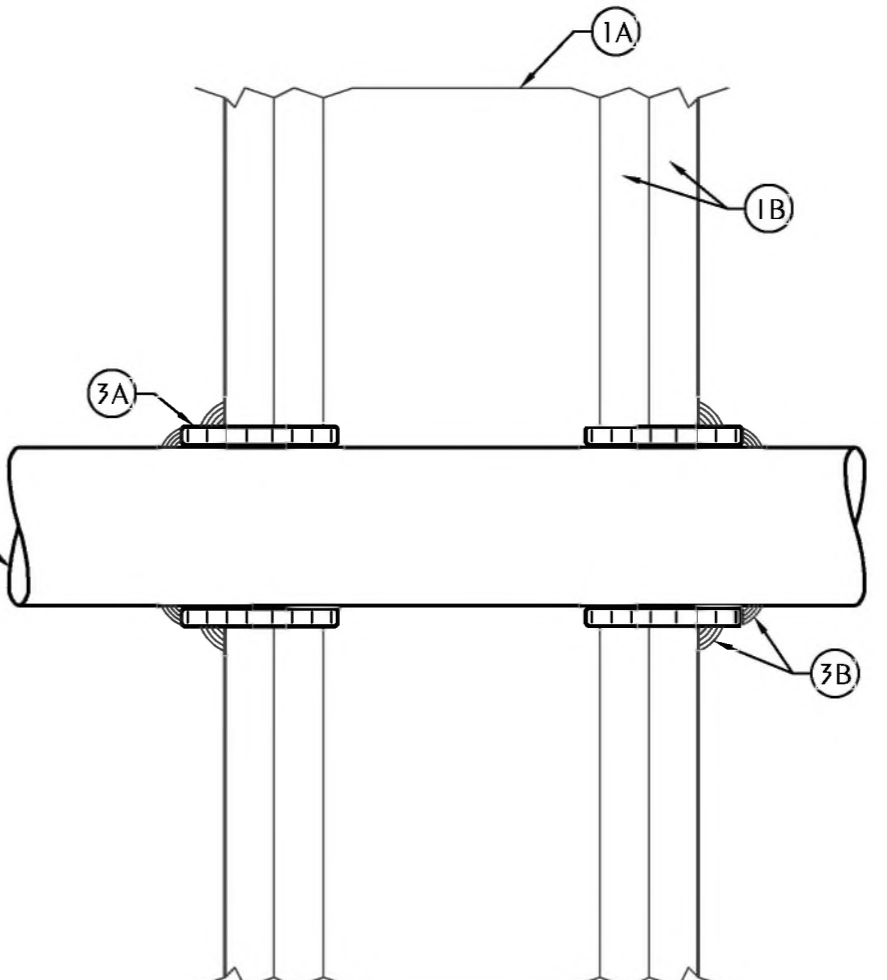
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- WALL ASSEMBLY**—THE 1 OR 2 HR FIRE-RATED GYPSUM WALLBOARD/STUD WALL ASSEMBLY SHALL BE CONSTRUCTED OF THE MATERIALS AND IN THE MANNER DESCRIBED IN THE INDIVIDUAL U300 OR U400 SERIES WALL AND PARTITION DESIGN IN THE UL FIRE RESISTANCE DIRECTORY AND SHALL INCLUDE THE FOLLOWING CONSTRUCTION FEATURES:
 - STUDS**—WALL FRAMING MAY CONSIST OF EITHER WOOD STUDS OR STEEL CHANNEL STUDS. WOOD STUDS TO CONSIST OF NOM 2 BY 4 IN. LUMBER SPACED 16 IN. OC WITH NOM 2 BY 4 IN. LUMBER END PLATES AND CROSS BRACES. STEEL STUDS TO BE MIN 3-5/8 IN. WIDE BY 1-3/8 IN. DEEP CHANNELS SPACED MAX 24 IN. OC.
 - WALLBOARD, GYPSUM**—NOM 5/8 IN. THICK, 4 FT WIDE WITH SQUARE OR TAPERED EDGES. THE GYPSUM WALLBOARD TYPE, THICKNESS, NUMBER OF LAYERS, FASTENER TYPE AND SHEET ORIENTATION SHALL BE AS SPECIFIED IN THE INDIVIDUAL U300 OR U400 SERIES DESIGN IN THE UL FIRE RESISTANCE DIRECTORY. MAX DIAM OF OPENING IS 1 1/2 IN. FOR WOOD STUD WALLS AND 1 1/2 IN. FOR STEEL STUD WALLS.
 - THROUGH PENETRANTS**—ONE METALLIC PIPE, CONDUIT OR TUBING TO BE CENTERED WITHIN THE FIRESTOP SYSTEM. PIPE, CONDUIT OR TUBING TO BE RIGIDLY SUPPORTED ON BOTH SIDERS OF WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES, CONDUITS OR TUBING MAY BE USED:
 - STEEL PIPE**—NOM 1 1/2 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE. WHEN STEEL PIPE IS USED, 1 RATING IS 1 HR.
 - CONDUIT**—NOM 3 IN. DIAM (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING OR STEEL CONDUIT. WHEN STEEL CONDUIT IS USED, 1 RATING IS 1/4 HR.
 - COPPER TUBING**—NOM 6 IN. DIAM (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING. WHEN COPPER TUBING IS USED, 1 RATING IS 1/2 AND 1 HR WHEN INSTALLED IN 1 AND 2 HR RATED WALLS, RESPECTIVELY.
 - COPPER PIPE**—NOM 6 IN. DIAM (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE. WHEN COPPER PIPE IS USED, 1 RATING IS 1/2 AND 1 HR WHEN INSTALLED IN 1 AND 2 HR RATED WALLS, RESPECTIVELY.
- PIPE COVERING**—NOM 1 OR 1-1/2 IN. THICK HOLLOW CYLINDRICAL HEAVY DENSITY (MIN 3.5 PCF) CLASS FIBER UNITS JACKETED ON THE OUTSIDE WITH AN ALL SERVICE JACKET. LONGITUDINAL JOINTS SEALED WITH METAL FASTENERS OR FACTORY-APPLIED SELF-SEALING LAP TAPE.
 - PACKING MATERIAL**—MIN 1 IN. THICKNESS OF FIRMLY PACKED MINERAL WOOL BATT INSULATION USED AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR WALL OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF CALK/FILL MATERIAL (ITEM B).
 - FILL VOID OR CAVITY MATERIALS**—CALK—INSTALLED TO FILL THE ANNULAR SPACE FLUSH WITH THE TOP SURFACE OF THE FLOOR OR SLEEVE OR FLUSH WITH BOTH SURFACES OF WALL. WHEN NOM PIPE COVERING THICKNESS IS 2 IN., MIN THICKNESS OF CALK/FILL MATERIAL IS 2 IN. WHEN NOM PIPE COVERING THICKNESS IS 1-1/2 IN. OR LESS, MIN THICKNESS OF CALK/FILL MATERIAL IS 1 IN. THE HOURLY F AND T RATINGS OF THE FIRESTOP SYSTEM ARE DEPENDENT UPON THE THICKNESS OF THE FLOOR OR WALL, THE SIZE OF PIPE, THE THICKNESS OF PIPE COVERING MATERIAL AND THE SIZE OF THE ANNULAR SPACE. (BETWEEN THE PIPE COVERING MATERIAL AND THE EDGE OF THE CIRCULAR THROUGH OPENING), AS SHOWN IN THE FOLLOWING TABLE:

MIN FLOOR OR WALL THKNS	MAX PIPE DIAM	NOM PIPE COVERING THKNS	ANNULAR SPACE	F RATING	T RATING
2-1/2	4	1 OR 1-1/2	1/2 TO 2-3/8	2	1
4-1/2	4	2	1/4 TO 3-5/8	2	1-1/2
2-1/2	12	1	1/2 TO 1-1/2	2	1/2
4-1/2	12	1	1/2 TO 2-3/8	2	1
2-1/2	12	1/2	1/2 TO 2-3/8	2	0

 MINNESOTA MINING & MFG. CO.—CP 25WB+.
 *BEARING THE UL CLASSIFICATION MARKING.

2 TYPICAL FIRE RATED WALL PENETRATION
 M5.2 SCALE: NONE INSULATED METALLIC PIPE



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 UL SYSTEM WL2003

- FLOOR OR WALL ASSEMBLY**—MIN 2-1/2 IN. THICK LIGHTWEIGHT OR NORMAL WEIGHT (100-150 PCF) CONCRETE. WALL MAY ALSO BE CONSTRUCTED OF ANY UL CLASSIFIED CONCRETE BLOCKS*. F RATINGS AND T RATINGS ARE DEPENDENT ON THE MIN THICKNESS OF FLOOR OR WALL, AS WELL AS THE MAX SIZE OF THE PIPE AND THE NOM THICKNESS OF THE CELLULAR CLASS INSULATION, AS NOTED IN ITEM 3. MAX DIAM OF THROUGH OPENING IS 28-1/2 IN.

SEE CONCRETE BLOCKS (CAZ1) CATEGORY IN THE FIRE RESISTANCE DIRECTORY FOR NAMES OF MANUFACTURERS.
- STEEL SLEEVE**—MIN 15 IN. ID (OR SMALLER), MIN 0.25 IN. WALL THICKNESS (OR HEAVIER) STEEL SLEEVE CAST OR GROUDED INTO FLOOR OR WALL ASSEMBLY. SLEEVE MAY EXTEND A MAX OF 2 IN. ABOVE TOP OF FLOOR OR BEYOND EITHER SURFACE OF WALL. 1 RATING IS 0 HR WHEN SLEEVE IS USED.
- THROUGH PENETRANTS**—ONE METALLIC PIPE OR TUBING TO BE POSITIONED WITHIN THE FIRESTOP SYSTEM. PIPE OR TUBING TO BE RIGIDLY SUPPORTED ON BOTH SIDERS OF FLOOR OR WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES OR TUBING MAY BE USED:
 - STEEL PIPE**—NOM 20 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
 - COPPER TUBING**—NOM 6 IN. DIAM (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING.
 - COPPER PIPE**—NOM 6 IN. DIAM (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE.
- PIPE COVERING MATERIALS**—CELLULAR CLASS INSULATION—NOM 1-1/2 TO 3 IN. THICK CELLULAR CLASS UNITS SIZED TO THE OUTSIDE DIAM OF THE STEEL PIPE AND SUPPLIED IN NOM 24 IN. LONG HALF SECTIONS OR NOM 18 IN. LONG SEGMENTS. PIPE INSULATION INSTALLED ON PIPE IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS. F RATINGS AND T RATINGS ARE DEPENDENT ON THE ITEMS NOTED IN THE FOLLOWING TABLE:

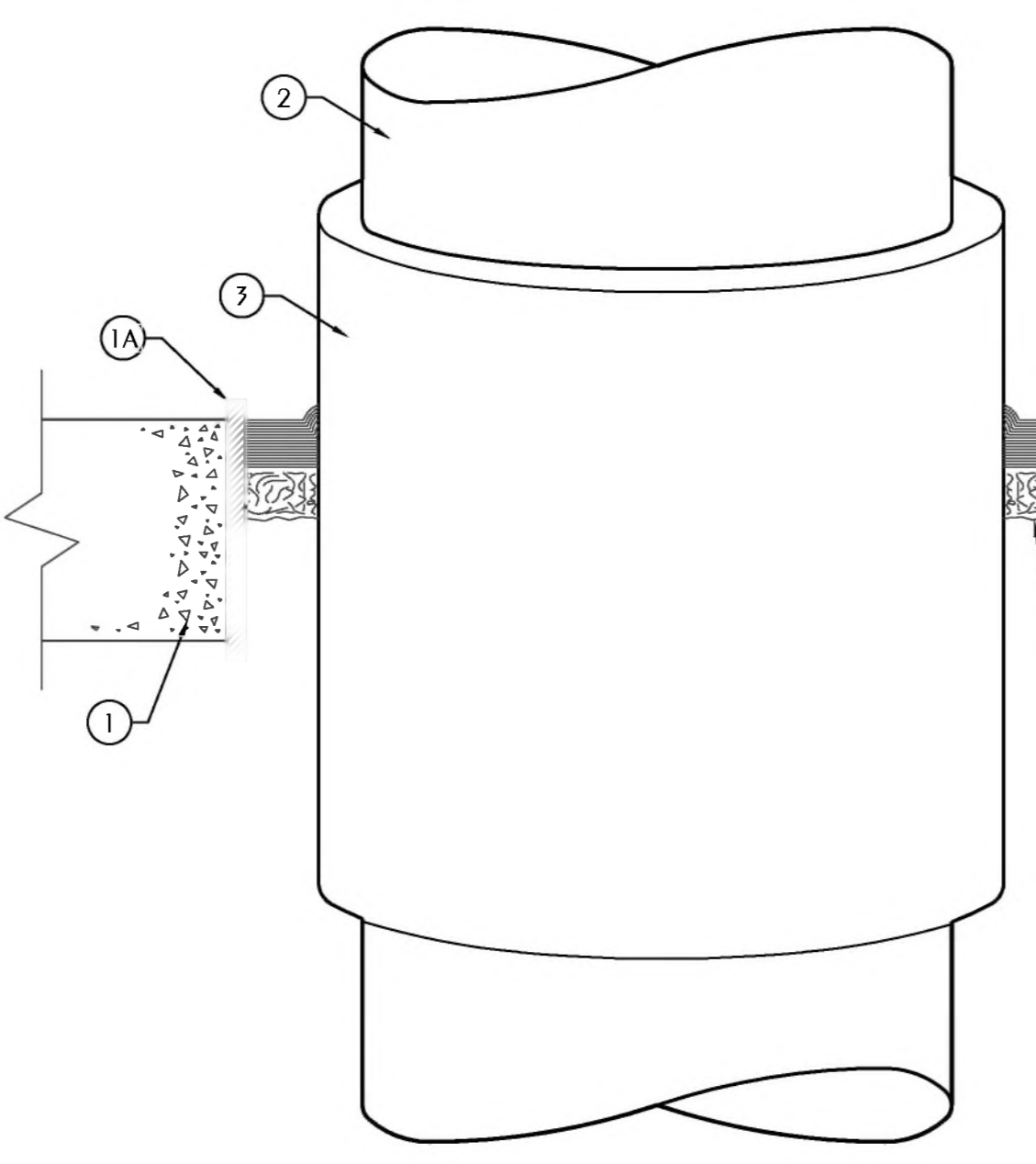
MIN FLOOR OR WALL THKNS IN.	MAX PIPE DIAM IN.	NOM CLASS INSULATION THKNS IN.	F RATING	T RATING
2-1/2	6	1-1/2 AND 3	2	3/4
4-1/2	6	1-1/2	3	1
4-1/2	6	3	3	1-1/2
4-1/2	20	1-1/2	2	1/2
4-1/2	20	3	2	1
- PACKING MATERIAL**—MIN 1 IN. THICKNESS OF TIGHTLY-PACKED MINERAL WOOL BATT INSULATION MATERIAL USED AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED MIN 1 IN. FROM TOP SURFACE OF FLOOR OR FROM BOTH SURFACES OF WALL TO ACCOMMODATE THE CALK/FILL MATERIAL (ITEM 5).
- FILL VOID OR CAVITY MATERIALS**—CALK—INSTALLED TO FILL ANNULAR SPACE TO A MIN DEPTH OF 1 IN., FLUSH WITH TOP SURFACE OF FLOOR OR BOTH SURFACES OF WALL. A MIN 1/2 IN. DIAM BEAD OF CALK SHALL BE APPLIED TO THE PIPE INSULATION/CONCRETE INTERFACE AT THE POINT CONTACT LOCATION ON THE TOP SURFACE OF THE FLOOR AND ON BOTH SIDERS OF WALLS.
 - MINNESOTA MINING & MFG. CO.—CP 25WB+.**
 - METAL JACKET**—MIN 1 1/2 IN. LONG JACKET FORMED OF MIN 0.010 IN. THICK STEEL OR ALUMINUM SHEET CUT TO WRAP TIGHTLY AROUND THE PIPE INSULATION WITH A MIN 2 IN. LAP AND SECURED USING BANDS AND SEALS OF SIMILAR MATERIAL. BANDS TO BE LOCATED WITHIN 2 IN. OF EACH END OF THE JACKET AND SPACED MAX 10 IN. OC. JACKET TO BE INSTALLED WITH EDGE ABUTTING SURFACE OF CALK/FILL MATERIAL (ITEM 5) ON TOP SURFACE OF FLOOR OR BOTH SURFACES OF WALL. METAL JACKET TO BE USED IN ADDITION TO ANY OTHER JACKETING MATERIAL WHICH MAY BE REQUIRED OR DESIRED ON THE PIPE INSULATION.
 *BEARING THE UL CLASSIFICATION MARKING.

3 TYPICAL FIRE RATED WALL PENETRATION
 M5.2 SCALE: NONE BARE PLASTIC PIPE 2" DIAMETER OR SMALLER

- FLOOR OR WALL ASSEMBLY**—MIN 2-1/2 IN. THICK REINFORCED LIGHTWEIGHT OR NORMAL WEIGHT (100-150) PCF CONCRETE. WALL MAY ALSO BE CONSTRUCTED OF ANY UL CLASSIFIED CONCRETE BLOCKS*. MAX DIAM OF OPENING IS 18 IN. SEE CONCRETE BLOCKS (CAZ1) CATEGORY IN THE FIRE RESISTANCE DIRECTORY FOR NAMES OF MANUFACTURERS.
- STEEL SLEEVE**—NOM 10 IN. (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL SLEEVE CAST OR GROUDED INTO FLOOR OR WALL ASSEMBLY. SLEEVE MAY EXTEND A MAX OF 2 IN. ABOVE TOP OF FLOOR OR BEYOND EITHER SURFACE OF WALL. 1 RATING IS 0 HR WHEN SLEEVE IS USED.
- THROUGH PENETRANT**—NOM 4 IN. DIAM (OR SMALLER) TYPE L (OR HEAVIER) COPPER PIPE, NOM 1 1/2 IN. DIAM (OR SMALLER) SERVICE WEIGHT (OR HEAVIER) CAST IRON SOIL PIPE, NOM 1 1/2 IN. DIAM (OR SMALLER) CLASS 50 (OR HEAVIER) DUCTILE IRON PRESSURE PIPE OR NOM 1 1/2 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE CENTERED IN THE OPENING AND RIGIDLY SUPPORTED ON BOTH SIDERS OF THE FLOOR OR WALL ASSEMBLY.
- PIPE COVERING**—NOM 1 1/2 TO 2 IN. THICK HOLLOW CYLINDRICAL HEAVY DENSITY (MIN 3.5 PCF) CLASS FIBER UNITS JACKETED ON THE OUTSIDE WITH AN ALL SERVICE JACKET. LONGITUDINAL JOINTS SEALED WITH METAL FASTENERS OR FACTORY-APPLIED SELF-SEALING LAP TAPE. TRANSVERSE JOINTS SEALED WITH METAL FASTENERS OR WITH BUTT STRIP TAPE SUPPLIED WITH THE PRODUCT. SEE PIPE AND EQUIPMENT COVERING—MATERIALS (BRGU) CATEGORY IN BUILDING MATERIALS DIRECTORY FOR NAMES OF MANUFACTURERS. ANY PIPE COVERING MATERIAL MEETING THE ABOVE SPECIFICATIONS AND BEARING THE UL CLASSIFICATION MARKING WITH A FLAME SPREAD INDEX OF 25 OR LESS AND A SMOKE DEVELOPED INDEX OF 50 OR LESS MAY BE USED.
- FIRESTOP SYSTEM**—THE DETAILS OF THE FIRESTOP SYSTEM SHALL BE AS FOLLOWS:
 - PACKING MATERIAL**—MIN 1 IN. THICKNESS OF FIRMLY PACKED MINERAL WOOL BATT INSULATION USED AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR WALL OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF CALK/FILL MATERIAL (ITEM B).
 - FILL VOID OR CAVITY MATERIALS**—CALK—INSTALLED TO FILL THE ANNULAR SPACE FLUSH WITH THE TOP SURFACE OF THE FLOOR OR SLEEVE OR FLUSH WITH BOTH SURFACES OF WALL. WHEN NOM PIPE COVERING THICKNESS IS 2 IN., MIN THICKNESS OF CALK/FILL MATERIAL IS 2 IN. WHEN NOM PIPE COVERING THICKNESS IS 1-1/2 IN. OR LESS, MIN THICKNESS OF CALK/FILL MATERIAL IS 1 IN. THE HOURLY F AND T RATINGS OF THE FIRESTOP SYSTEM ARE DEPENDENT UPON THE THICKNESS OF THE FLOOR OR WALL, THE SIZE OF PIPE, THE THICKNESS OF PIPE COVERING MATERIAL AND THE SIZE OF THE ANNULAR SPACE. (BETWEEN THE PIPE COVERING MATERIAL AND THE EDGE OF THE CIRCULAR THROUGH OPENING), AS SHOWN IN THE FOLLOWING TABLE:

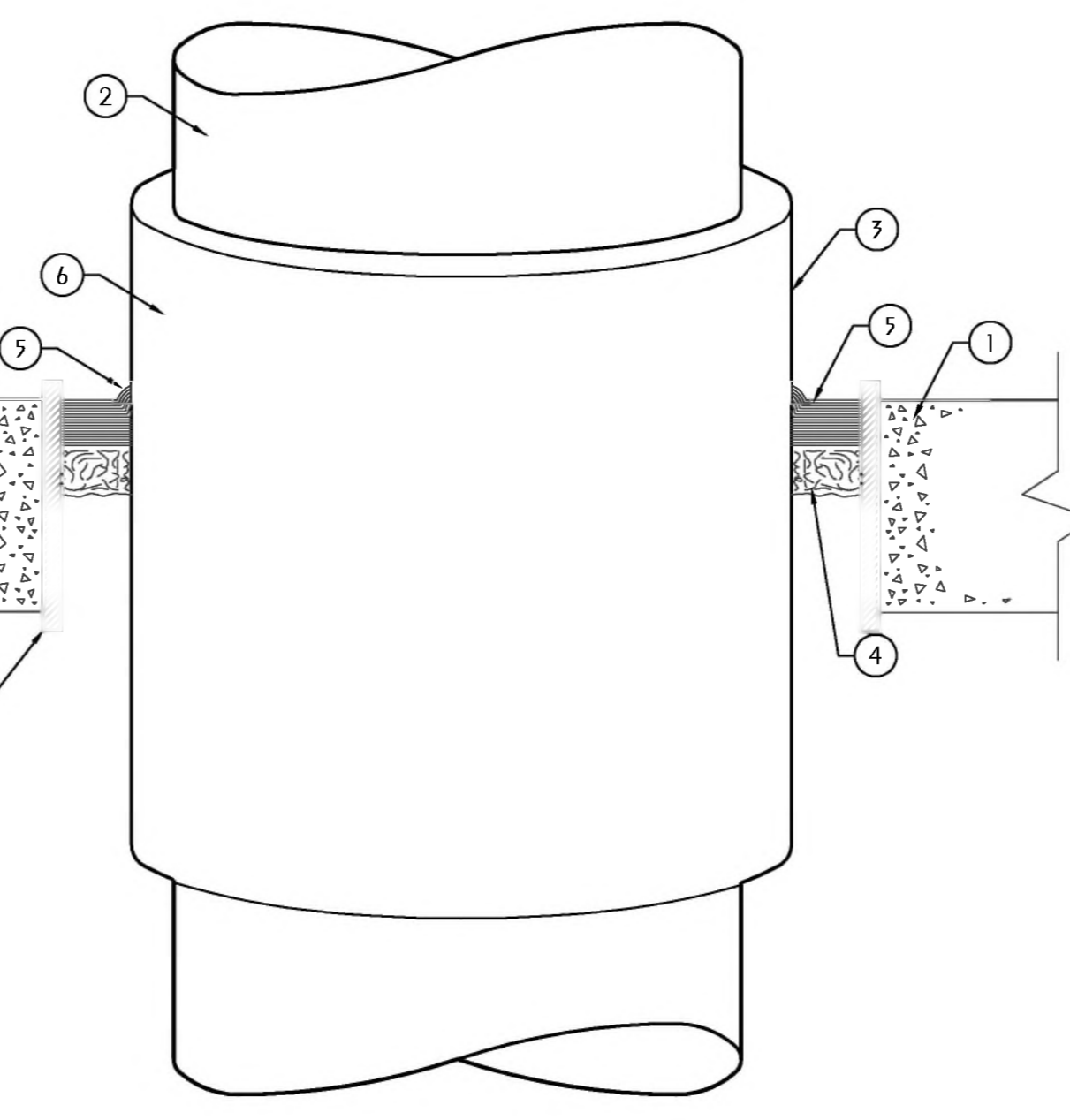
MIN FLOOR OR WALL THKNS	MAX PIPE DIAM	NOM PIPE COVERING THKNS	ANNULAR SPACE	F RATING	T RATING
2-1/2	4	1 OR 1-1/2	1/2 TO 2-3/8	2	1
4-1/2	4	2	1/4 TO 3-5/8	2	1-1/2
2-1/2	12	1	1/2 TO 1-1/2	2	1/2
4-1/2	12	1	1/2 TO 2-3/8	2	1
2-1/2	12	1/2	1/2 TO 2-3/8	2	0

 MINNESOTA MINING & MFG. CO.—CP 25WB+.
 *BEARING THE UL CLASSIFICATION MARKING.



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 UL SYSTEM CA15001

4 TYPICAL FIRE RATED WALL/FLOOR PENETRATION
 M5.2 SCALE: NONE FIBERGLASS INSULATED METALLIC PIPE



CONSULT CURRENT UNDERWRITERS LABORATORIES "FIRE RESISTANCE DIRECTORY" FOR DETAILS
 UL SYSTEM CA15060

5 TYPICAL FIRE RATED WALL/FLOOR PENETRATION
 M5.2 SCALE: NONE CELLULAR CLASS INSULATED METALLIC PIPE

NOTE: ALL SYSTEMS DETAILED ON MECHANICAL PENETRATIONS SHEETS ARE BASED ON THE MANUFACTURERS SPECIFIED AS BASIS OF DESIGN AND APPLY TO MECHANICAL, FIRE PROTECTION, AND PLUMBING. THE CONTRACTOR SHALL SUBMIT A PENETRATIONS PACKAGE DETAILING EACH PENETRATION AND PRODUCTS TO BE USED TO THE PERMITTING AUTHORITY FOR THE ACTUAL SYSTEMS TO BE USED.

SEQUENCE OF OPERATION CHILLED WATER PLANT

STARTING AND STOPPING OF EQUIPMENT SHALL BE ACCOMPLISHED THRU A "HAND-OFF-AUTO" SWITCH LOCATED ON FACE OF THE CHILLER PLANT MANAGER. AN ALARM SHALL BE POSTED TO THE DDC SYSTEM ANYTIME THE CW SYSTEM HOA SWITCH IS INDEXED TO THE "HAND" OR "OFF" POSITIONS. WITH THE CW SYSTEM HOA SWITCH IN THE "AUTO" POSITION, THE CHILLED WATER SYSTEM SHALL BE ENABLED BY THE DDC SYSTEM AND STARTED UNDER ITS OWN SEQUENCE SUBJECT TO SAFETIES AND OVERLOADS.

THE CHILLED WATER SYSTEM SHALL BE STARTED AUTOMATICALLY WHENEVER ANY OF THE FOLLOWING CONDITIONS OCCUR:

- A) THE OUTSIDE TEMPERATURE IS 60 DEGREES F (ADJUSTABLE) OR ABOVE DURING THE OCCUPIED PERIOD.
- B) ANY SPACE TEMPERATURE IS ABOVE SET POINT.
- C) ANY SPACE REQUIRES HUMIDITY CONTROL.

PUMP CONTROL: UPON CHW SYSTEM STARTUP, THE DDC SYSTEM SHALL START CHP-1 OR CHP-2. THE DDC SHALL ALTERNATE CHP'S DAILY BASED ON RUNTIME, WHENEVER THE CHW SYSTEM IS IN OPERATION THE DDC SHALL MODULATE PUMP SPEED WITH THE VFD TO MAINTAIN CONSTANT DIFFERENTIAL PRESSURE INSIDE THE BUILDING. SETPOINT SHALL BE DETERMINED BY TEST AND BALANCE CONTRACTOR AS THE LOWEST DIFFERENTIAL PRESSURE REQUIRED TO OBTAIN DESIGN FLOW AT ALL UNITS. THE DDC SHALL LIMIT CHANGES IN FLOW AFTER CHILLER STARTUP TO 10% PER MINUTE. IF A PUMP FAILS TO OPERATE WHEN ENABLED, THE DDC SYSTEM SHALL START THE ALTERNATE PUMP AND POST AN ALARM. THE DDC SHALL MONITOR TOTAL FLOW, THE DDC SHALL MONITOR DIFFERENTIAL PRESSURE OF EACH PUMP AND SHUT DOWN THE PUMP WHEN DIFFERENTIAL PRESSURE EXCEEDS 95% OF SHUTOFF HEAD AND POST AN ALARM.

PUMP SPEED RESET: THE DDC SHALL RESET THE DIFFERENTIAL PRESSURE SETPOINT DOWN WHEN NO CHILLED WATER VALVES ARE OPEN 100%. THE DDC SHALL REDUCE THE SETPOINT IN STEPS EQUAL TO 10% OF THE ORIGINAL VALUE DETERMINED BY TEST AND BALANCE DOWN TO A MINIMUM 50% OF THE ORIGINAL VALUE DETERMINED BY TEST AND BALANCE DOWN TO A MINIMUM OF 50% OF THE ORIGINAL VALUE (ADJUSTABLE). THE DDC SHALL MAKE CHANGES (INCREASES OR DECREASES) IN SETPOINT IN FIVE MINUTE INTERVALS. THE DDC SHALL REVERSE SETPOINT ADJUSTMENT WHEN MORE THAN 10% OF THE CHW VALVES ARE 100% OPEN FOR MORE THAN 5 MINUTES (ADJUSTABLE).

CHILLER CONTROL SUMMARY: THE DDC SYSTEM SHALL ENABLE THE CHILLERS BASED ON BUILDING LOAD AND EACH CHILLER SHALL OPERATE THROUGH ITS INTERNAL CONTROLS TO MAINTAIN CHILLED WATER SUPPLY TEMPERATURE AT SETPOINT OF 42°F. UPON ENABLE OF A CHILLER, THE CONDENSER WATER SYSTEM SHALL BE ENABLED BY THE DDC. THE DDC SHALL START THE CHILLER WITH THE LEAST RUNTIME AS THE LEAD UNIT EACH DAY. UPON A CALL FOR COOLING THE DDC SHALL OPEN THE CHV AND CWV FOR THE LEAD CHILLER AND START THE CHP. UPON PROOF OF FLOW, THE CHILLER SHALL OPERATE TO MAINTAIN LEAVING WATER AT SETPOINT. THE DDC SHALL MONITOR CHW FLOW THROUGH EACH CHILLER. THE DDC SHALL MAINTAIN A MINIMUM FLOWRATE OF 80 GPM IN THE CHILLER WHEN IT IS ENABLED AND OPERATING. THE DDC SYSTEM SHALL MONITOR ALARM STATUS OF EACH CHILLER AND POST AN ALARM IN THE EVENT A CHILLER IS ENABLED AND NOT OPERATING. THE DDC SHALL MONITOR ALL POINTS AVAILABLE THROUGH THE MANUFACTURERS FACTORY MOUNTED CHILLER MICROPROCESSOR CONTROL THROUGH BACNET PROTOCOL.

CHILLER CONTROL:

GENERAL: THE DDC PROGRAM SHALL BE FULLY EDITABLE AND SET-UP VIA POINT AND CLICK ON A STANDING WINDOW SCREEN. IT SHALL NOT REQUIRE SPECIAL SOFTWARE TOOLS OR A BAS TECHNICIAN TO OPERATE AND MODIFY CHILLER SEQUENCING CONTROL.

THE DDC SHALL PERFORM THE FOLLOWING CONTROL STRATEGIES:

1. CHILLER PLANT SYSTEM SCHEDULING
2. CHILLER SEQUENCING
3. CHILLER MINIMUM FLOW BY-PASS VALVE CONTROL
4. COLOR GRAPHIC BASED CHILLER PLANT STATUS SCREENS
5. COLOR GRAPHIC BASED CHILLER STATUS SCREENS
6. SYSTEM AND CHILLER DIAGNOSTIC MESSAGES
7. SYSTEM AND CHILLER REPORTS

CHILLER SEQUENCING FOR VARIABLE PRIMARY FLOW CHILLED WATER SYSTEMS:

1. THE SYSTEM SETPOINT SHALL BE 42 DEGREES F AND EDITABLE BY THE OPERATOR.
2. WHEN THE "CHW ADD ERROR" VALUE EXCEEDS 1.5 F (OPERATOR ADJUSTABLE) CONTINUOUSLY FOR 15 MINUTES (OPERATOR ADJUSTABLE) THE CHILLER SEQUENCING SOFTWARE SHALL INITIATE THE START OF THE NEXT CHILLER IN THE SEQUENCE.

"CHW ADD ERROR" = CHW SUPPLY TEMP - CHW SETPOINT TEMP

PRIOR TO THE START OF ANOTHER CHILLER THE CHILLER SEQUENCING SOFTWARE SHALL UNLOAD ALL OPERATING CHILLERS. (THIS IS DONE TO PREVENT FLOW DISTURBANCES CAUSED BY THE STARTING OF ANOTHER PUMP FROM AFFECTING CHILLER OPERATION. FOLLOWING CONFIRMATION OF THE ADDITIONAL CHILLER OPERATION ALL CHILLERS SHALL BE ALLOWED TO RELOAD.)

LAC CHILLERS SHALL START IN A SIMILAR MANNER TO THE LEAD CHILLER START SEQUENCE.

3. THE DDC SHALL CONSIDER STOPPING A CHILLER WHENEVER THE LOAD ON OPERATING CHILLERS DROPS TO A LEVEL LOW ENOUGH SO THAT A CHILLER CAN BE TURNED OFF AND THE REMAINING CHILLER CAN CARRY THE LOAD.

THE LOAD ON THE OPERATING CHILLER(S) SHALL BE DETERMINED BASED ON THE MONITORED ACTUAL CURRENT DRAW (% AMPS) [ACTUAL POWER DRAW (% KW)].

WHEN ALL OPERATING CHILLERS LOADS ARE LESS THAN THE SYSTEM CALCULATED "SUBTRACT CHILLER LOAD" (SCL) OF 85% (OPERATOR EDITABLE) FOR 15 MINUTES (OPERATOR EDITABLE) THE SYSTEM SHALL SUBTRACT A CHILLER.

THE CHILLER SEQUENCING SOFTWARE SHALL CALCULATE THE "SUBTRACT CHILLER LOAD" (SCL) SUCH THAT WHEN THE NEXT CHILLER IS SUBTRACTED THE REMAINING OPERATING CHILLERS SHALL BE LOADED TO THE SPECIFIED "LOAD ON REMAINING CHILLERS" (LRC). THE EQUATION FOR CALCULATING THE SUBTRACT CHILLER LOAD IS:

SCL = (LRC X (NOC - 1)) / NOC

SCL - SUBTRACT CHILLER LOAD

LRC - LOAD ON REMAINING CHILLERS

NOC - NUMBER OF OPERATING CHILLERS

4. THE DDC SHALL NOT CLOSE A CHILLER ISOLATION VALVE OR SHUTDOWN THE SYSTEM PUMP UNTIL ALL CHILLER COMPRESSORS ARE PROVEN OFF.

CHILLED WATER PLANT ENERGY MANAGEMENT. THE DDC SHALL CALCULATE AND DISPLAY A REAL-TIME KW/TON FOR THE ENTIRE CHILLED WATER PLANT INCLUDING CHILLERS, PUMPS, COOLING TOWER FANS, AND CONDENSER WATER PUMPS. THE DDC SHALL UTILIZE THIS DATA TO STAGE CHILLERS TOGETHER OR SEPARATELY DURING PART LOAD CONDITIONS TO MAXIMIZE ENERGY EFFICIENCY.

CHILLER FAILURE: UPON SENSING A CHILLER FAILURE THE CHILLER SEQUENCING SOFTWARE SHALL LOCKOUT THAT CHILLER, CLOSE ITS VALVE, AND IMMEDIATELY INITIATE THE START OF THE NEXT CHILLER IN THE ROTATION SEQUENCE.

CHILLER MINIMUM FLOW BY-PASS VALVE CONTROL:

THE "CHILLER MINIMUM FLOW BY-PASS VALVE" SHALL BE A NORMALLY OPEN VALVE. THE "CHILLER MINIMUM FLOW BY-PASS VALVE" SHALL BE MODULATED TO THE FULLY OPEN POSITION WHEN THE SYSTEM IS SHUTDOWN. THIS SHALL BE DONE TO PREVENT WATER HAMMER WHEN A PUMP IS STARTED AND TO ALLOW FOR MINIMUM FLOW IN THE EVENT THE CHILLER CALLS FOR PUMP OPERATION.

FOLLOWING THE CONFIRMED START OF THE LEAD CHILLER AND WHENEVER SYSTEM IS ENABLED CHILLER SEQUENCING SYSTEM SHALL MODULATE THE "CHILLER MINIMUM FLOW BY-PASS VALVE" SUCH THAT THE CHILLED WATER FLOW THROUGH ANY OPERATING CHILLER(S) SHALL NOT DROP BELOW THE MANUFACTURERS RECOMMENDED MINIMUM FLOW.

THE CHILLER MINIMUM AND MAXIMUM FLOW SHALL BE DETERMINED BY DIRECT MEASUREMENT USING A HIGH ACCURACY VENTURI FLOW METER ON EACH CHILLER. THE FLOW METER SETPOINT SHALL BE DETERMINED BASED ON THE MANUFACTURERS RECOMMENDED MINIMUM AND MAXIMUM CHILLER FLOW RATE.

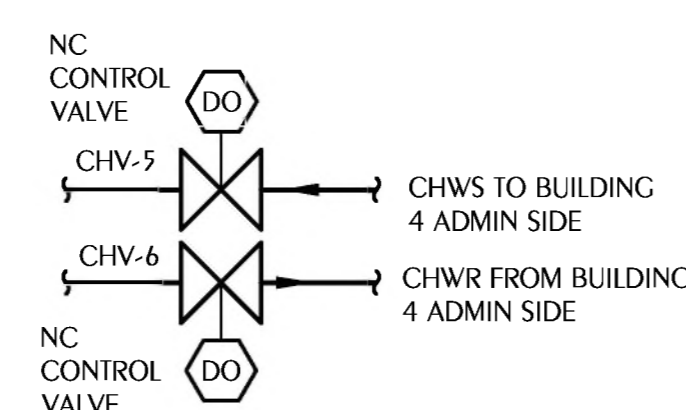
CHILLER SYSTEM OPERATOR INTERFACE - DDC APPLICATION OPERATIONAL STATUS SCREEN TO INCLUDE:

- A. CHILLER SYSTEM STATUS (OFF/SOFT START/NORMAL/AMBIENT LOCKOUT/SHUTDOWN IN PROGRESS)
- B. CHILLER PLANT SUPPLY WATER SETPOINT
- C. CHILLED WATER SYSTEM SUPPLY WATER TEMPERATURE
- D. CHILLED WATER SYSTEM RETURN WATER TEMPERATURE
- E. INDIVIDUAL CHILLER FAILURE RESET
- F. ALL CHILLER FAILURE RESET
- G. SYSTEM PUMP FAILURE RESET
- H. MANUAL ADDITION OF CHILLER
- I. MANUAL SUBTRACTION OF CHILLER
- J. MANUAL ROTATION OF CHILLER SEQUENCE

EMERGENCY CONDITIONS:

CH-2 SHALL BE INTERLOCKED WITH TRANSFER SWITCH. WHEN TRANSFER SWITCH IS ACTIVATED, CH-1 SHALL BE LOCKED OUT.

SHUTOFF SWITCH SHALL BE LOCATED IN ROOM 04-440 TEACHER LOUNGE. PROVIDE SIGN ABOVE SWITCH STATING "IN EVENT OF WEATHER EMERGENCY, SWITCH SHALL BE ACTIVATED." UPON ACTIVATION OF SWITCH, DDC SHALL CLOSE CHV-3, CHV-4, CHV-5, AND CHV-6 AND POST AN ALARM.



DIRECT DIGITAL CONTROLS GENERAL NOTES

1. THE CONTRACTOR SHALL PROVIDE A COMPLETE NEW DDC SYSTEM TO PERFORM THE INDICATED SEQUENCES, ALL OTHER FUNCTIONS REQUIRED BY THE CONTRACT DOCUMENTS, AND ALL OTHER FUNCTIONS REQUIRED FOR A COMPLETE AND FUNCTIONAL SYSTEM. SYSTEM SHALL TIE INTO EXISTING SCHNEIDER ELECTRIC FRONT END.
2. ALL SEQUENCES ARE SUBJECT TO SAFETIES. DDC CONTRACTOR SHALL PROVIDE ALL NECESSARY AND CUSTOMARY SAFETIES. ALL DDC SENSORS LOCATED IN NORMALLY UNOCCUPIED AREAS (HALLWAYS, CORRIDORS, RESTROOMS, ETC) SHALL BE CEILING MOUNTED.
3. ALL WIRING SHALL BE IN CONDUIT. ALL CONDUIT SHALL BE IN ACCORDANCE WITH ELECTRICAL SPECIFICATIONS, REQUIREMENTS FOR 120 VAC CIRCUITS.
4. ALL CONTROL TUBING SHALL BE RUN IN CONDUIT. ALL CONDUIT SHALL BE IN ACCORDANCE WITH ELECTRICAL SPECIFICATIONS, REQUIREMENTS FOR 120 VAC CIRCUITS.
5. ALL WELLS SHALL BE 3/16 STAINLESS STEEL AND SHALL BE INSTALLED IN NEW THREDOLETS. IN CHILLED WATER PIPING PROVIDE NEW WELLS WITH EXTENDED NECK TO SUIT INSULATION THICKNESS.
6. THE DDC CONTRACTOR IS CO-RESPONSIBLE, ALONG WITH THE TAB CONTRACTOR FOR COORDINATING THE PROPER INSTALLATION OF WELLS, PRESSURE TAPS, AND P/T TAPS IN ALL LOCATIONS INDICATED AND OTHERWISE AS REQUIRED FOR A COMPLETE AND FULLY FUNCTIONAL SYSTEM.
7. THE DDC CONTRACTOR AND THE TAB CONTRACTOR SHALL UTILIZE P/T'S TO CALIBRATE INSTRUMENTS TO CERTIFIED PRESSURE GAGES, PRESSURE METERS AND THERMOMETERS.
8. CONDUIT SHALL BE RUN PERPENDICULAR AND PARALLEL TO BUILDING LINES IN A FIRST CLASS WORKMANSHIP LIKE MANNER.
9. PROVIDE TWO PORTABLE LAPTOP COMPUTERS WITH ALL NECESSARY SERVICE SOFTWARE INSTALLED.
10. PROVIDE OPERATING SCHEDULE FOR EACH AHU. PROVIDE SEPARATE OPERATING SCHEDULE FOR OUTSIDE AIR FOR EACH AHU.
11. PROVIDE SUB-METER FOR EACH MECHANICAL EQUIPMENT, LIGHTING, AND THE MAIN BUILDING ELECTRICAL PANELS. REFER TO ELECTRICAL SINGLE LINE RISER DIAGRAM AND FLOOR PLANS FOR QUANTITIES AND LOCATIONS.
12. PROVIDE DUCT ACCESS DOOR AT EACH AIRFLOW MEASURING STATION TO ALLOW SERVICE AND INSPECTION OF DUCT MOUNTED UNIT.
13. PROVIDE PUSH BUTTON LOCATED INSIDE SRO OFFICE AND THE MAIN ADMINISTRATION (FINAL LOCATION TO BE DETERMINED BY OWNER) TO SHUT DOWN ALL AHU'S AND CLOSE OUTSIDE AIR DAMPERS UPON ACTIVATION. THE BUTTON SHALL BE LOCATED INSIDE AN ENCLOSURE WITH A AUDIBLE ALARM UPON OPENING THE ENCLOSURE. TO SHUT DOWN THE EQUIPMENT, THE ENCLOSURE MUST BE OPENED AND THE BUTTON ACTIVATED. THE BUTTON SHALL REMAIN ACTIVATED UNTIL PHYSICALLY RELEASED FROM THE ACTIVATED POSITION. UPON RELEASE, THE DDC SHALL DELAY STARTUP OF THE EQUIPMENT FOR 30 MINUTES (ADJUSTABLE).
14. THIS PROJECT SHALL INCLUDE COMMISSIONING OF THE HVAC, CONTROLS, AND RELATED ELECTRICAL SYSTEMS. THE SERVICES OF THE COMMISSIONING AUTHORITY ARE PROVIDED UNDER SEPARATE CONTRACT. UNDER THIS CONTRACT, THE PRIME CONTRACTOR, SUBCONTRACTORS, AND EQUIPMENT MANUFACTURERS SHALL PROVIDE LABOR AND MATERIAL AS REQUIRED TO ASSIST AND PARTICIPATE IN THE COMMISSIONING PROCESS FOR THE SCOPE OF WORK AS DESCRIBED IN SECTION 230800 OF THE PROJECT SPECIFICATIONS.

CAMPUS DDC TEMPERATURE MONITORING NOTES

1. PROVIDE ONE (1) TEMPERATURE SENSOR INSIDE EACH FREEZER, COOLER, DATA ROOM, AND DRY STORAGE.
2. MONITOR TEMPERATURE IN EACH UNIT. IDENTIFY GRAPHICALLY ON THE OVERALL CAMPUS PLAN.
3. ALARM UPON SENSOR FAILURE OR "OUT OF RANGE" FOR EACH UNIT. "OUT OF RANGE" SHALL BE DEFINED AS FOLLOWS:
 - FREEZER: 0 DEGREES F OR HIGHER (ADJUSTABLE)
 - COOLER: 40 DEGREES F OR HIGHER (ADJUSTABLE)
 - DRY STORAGE: 72 DEGREES F OR HIGHER (ADJUSTABLE)
 - DATA: 75 DEGREES F OR HIGHER (ADJUSTABLE)
4. WHEN THE ALARM IS SET THE DDC SHALL EMAIL AND TEXT NUMBERS ASSIGNED BY THE SCHOOL DISTRICT.
5. THE DDC SHALL MAINTAIN A TREND FOR 30 DAYS OF DATA COLLECTED AT 15 MINUTE INTERVALS.

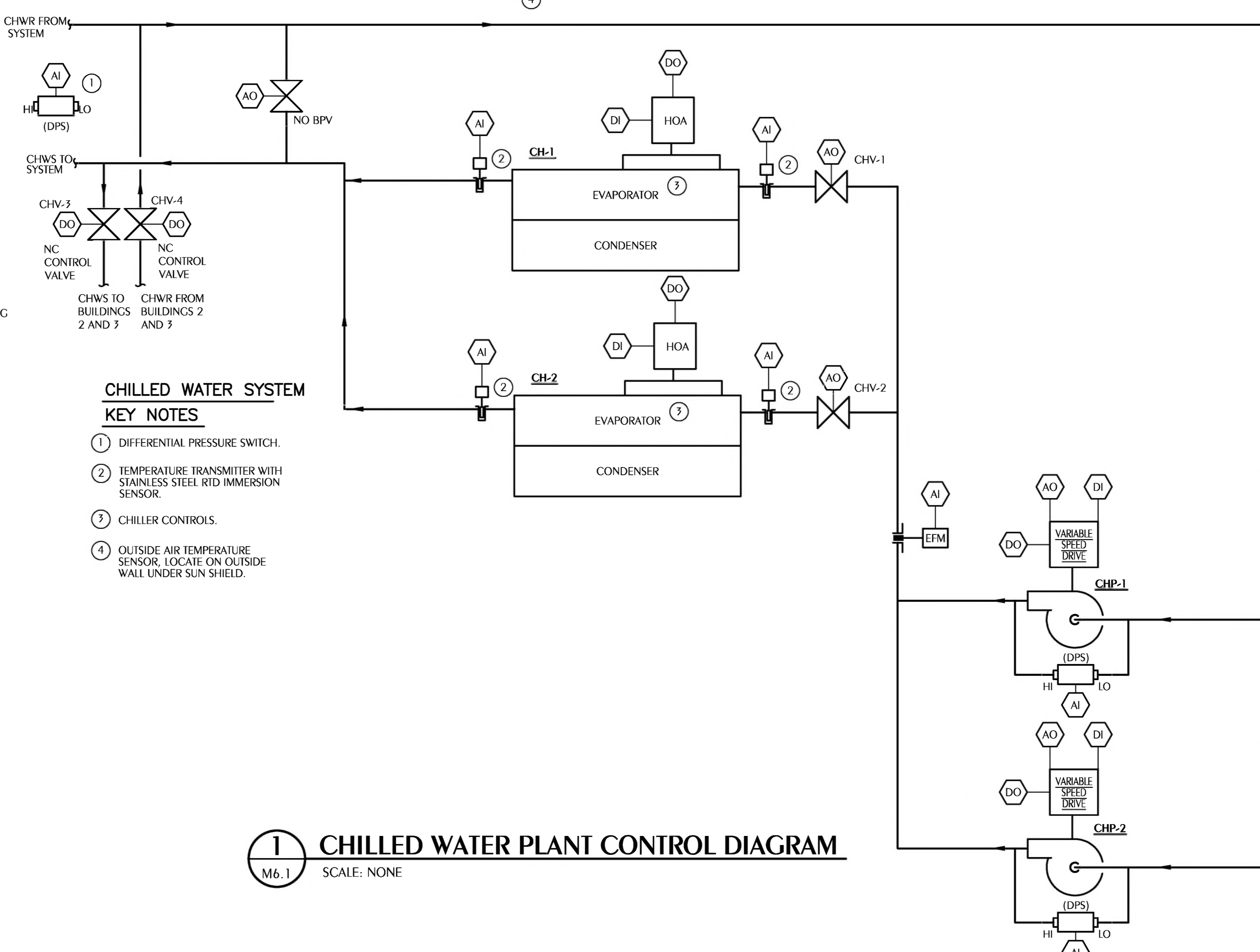
BACnet MONITORED SYSTEMS

DIVISION 22 AND 26 SYSTEMS

THE DDC SHALL MONITOR SYSTEM CONTROLLERS PROVIDED BY OTHERS THROUGH A FACTORY BACnet INTERFACE. THE DDC SHALL READ AND IDENTIFY ALL POINTS TRANSMITTED BY THE FACTORY CONTROLLER. THE DDC SHALL INCLUDE A SYSTEM GRAPHIC FOR EACH CONTROLLED DEVICE WITH BACnet ADJUSTABLE SET POINTS IDENTIFIED AND ADJUSTABLE FROM THE GRAPHIC. THE FOLLOWING SYSTEMS ARE TO BE INCLUDED:

GAS WATER HEATERS
BUILDING LIGHTING CONTROLS

COORDINATE WITH THE EQUIPMENT AND CONTROLLERS PROVIDED BY OTHERS.



1 M6.1 CHILLED WATER PLANT CONTROL DIAGRAM
SCALE: NONE

CHILLED WATER SYSTEM POINTS LIST

SYSTEM POINT DESCRIPTION	ANALOG		DIGITAL		SYSTEMS FEATURES																	
	INPUT	OUTPUT	INPUT	OUTPUT	ALARMS	PROGRAMS																
CHILLER	TEMPERATURE	DIFFERENTIAL PRESSURE	FLOW RATE	DDC	SETPOINT (O/I)	VFD SPEED	OPEN/CLOSE	HOA STATUS	STATS (ON/OFF)	STATUS (OPEN/CLOSE)	START/STOP	LOCK OUT	ENABLE/DISABLE	SENSOR FAIL	LOW ANALOG	SENSOR FAIL	FLOW FAIL	DIAGNOSTICS	DIAGNOSTICS	TIME SCHEDULING	MODE CONTROL	ALTERNATE
CHILLER PLANT	X																					
CH-1		X				X			X	X	X			X	X	X	X	X	X	X	X	X
CH-2		X				X			X	X	X			X	X	X	X	X	X	X	X	X
CHP-1		X		X		X			X	X	X			X	X	X	X	X	X	X	X	X
CHP-2		X		X		X			X	X	X			X	X	X	X	X	X	X	X	X
CH-1 CHWS	X									X	X			X	X	X						
CH-1 CHWR	X									X	X			X	X	X						
CH-2 CHWS	X									X	X			X	X	X						
CH-2 CHWR	X									X	X			X	X	X						
OA TEMP			X											X								
CHV-1			X																			
CHV-2			X																			
CHV-3										X	X			X	X	X						
CHV-4										X	X			X	X	X						
CHV-5										X	X			X	X	X						
CHV-6										X	X			X	X	X						
BYPASS VALVE			X																			
CHW		X	X																			

REVISIONS	NO.	DATE	DESCRIPTION

DATE	DESCRIPTION

PROJECT NAME/LOCATION
MOWAT MIDDLE SCHOOL CAFETERIA AND ADMINISTRATION ADDITION
PANAMA CITY, FLORIDA
SHEET TITLE:
HVAC CONTROLS

NO.	DATE	DESCRIPTION

DATE	DESCRIPTION

PROJECT NAME/LOCATION
MOWAT MIDDLE SCHOOL CAFETERIA AND ADMINISTRATION ADDITION
 PANAMA CITY, FLORIDA
 SHEET TITLE:
HVAC CONTROLS

**SEQUENCE OF OPERATION
 VARIABLE VOLUME AHU**

STARTING AND STOPPING OF EQUIPMENT SHALL BE ACCOMPLISHED THROUGH A "HAND-OFF-AUTO" SWITCH LOCATED ON FACE OF DDC CONTROL PANEL. AN ALARM SHALL BE POSTED TO THE DDC SYSTEM ANYTIME THE HOA SWITCH IS INDEXED TO THE "HAND" OR "OFF" POSITIONS. WITH THE HOA SWITCH IN THE "AUTO" POSITION, THE UNIT SHALL BE STARTED AUTOMATICALLY BY THE DDC SYSTEM AND ALL CONTROLS ACTIVATED SUBJECT TO FIRE ALARM RELAY, SAFETIES AND OVERLOADS.

OCCUPIED MODE: OPEN OUTSIDE AIR DAMPER AND START EXHAUST FANS INDICATED WHENEVER THE BUILDING IS IN OCCUPIED MODE.

COOLING COIL FREEZE PROTECTION: THE DDC SYSTEM SHALL CLOSE THE OUTSIDE AIR DAMPER ANYTIME THE COOLING COIL ENTERING AIR TEMPERATURE FALLS BELOW 40°F LONGER THAN 5 MINUTES. THE LOW LIMIT FREEZE STAT SHALL STOP THE AHU FAN MOTOR ANYTIME THE COOLING COIL ENTERING AIR TEMPERATURE FALLS BELOW 33°F.

DISCHARGE TEMPERATURE CONTROL: THE DDC SYSTEM SHALL MODULATE THE CHILLED WATER VALVE AS REQUIRED TO MAINTAIN THE DISCHARGE AIR TEMPERATURE AT SET POINT (REFER TO AHU SCHEDULE). WHEN MINIMUM SPEED IS REACHED AND THERE IS A CALL FOR HEATING FROM ANY ZONE, THE DDC SHALL RESET SUPPLY AIR TEMPERATURE UP IN 2°F INCREMENTS EVERY FIVE MINUTES TO A MAXIMUM OF 65°F. THE DDC SHALL REVERSE SUPPLY AIR RESET UPON A CALL FOR COOLING OR WHEN RETURN AIR RH RISES ABOVE 60%. THE DDC SHALL HAVE A SEPARATE SET POINT FOR UNOCCUPIED HUMIDITY CONTROL, ADJUSTABLE FROM THE GRAPHIC.

FAN SPEED CONTROL: WITH STATIC PRESSURE RESET; MAX TU DAMPER POSITION

THE DDC SYSTEM SHALL CONTROL THE FAN SPEED THROUGH THE VARIABLE FREQUENCY DRIVE (VFD) TO MAINTAIN SUPPLY DUCT STATIC PRESSURE AT SETPOINT. THE FAN SPEED SHALL BE REDUCED DOWN TO A MINIMUM SPEED SETPOINT (TO BE SET IN THE VFD) DETERMINED TO PROVIDE SUFFICIENT PRESSURE TO DELIVER THE MINIMUM AIRFLOW OF ALL VAV TERMINAL UNITS OR THE SCHEDULED MINIMUM OUTSIDE AIRFLOW SETPOINT (WHICHEVER SPEED IS GREATER). UPON SYSTEM START-UP THE STATIC PRESSURE SETPOINT SHALL BE SET TO THE MIDDLE OF THE STATIC PRESSURE RESET RANGE AND SHALL BE RESET EVERY 15 MINUTES (ADJUSTABLE) BASED ON THE FOLLOWING LOGIC:

MAX TU DAMPER POSITION METHOD: SETPOINT SHALL BE RESET BETWEEN THE MIN AND THE MAX SETPOINTS (DETERMINED DURING CX) BASED ON ALL OF THE ASSOCIATED VAV TERMINAL UNIT AIR DAMPER POSITIONS. IF THERE ARE NO VAV TERMINAL UNITS WITH DAMPERS OPEN GREATER THAN 80% (ADJUSTABLE) THEN THE SETPOINT SHALL BE DECREASED BY THE STATIC PRESSURE RESET INCREMENT (0.10" W.C., ADJUSTABLE). IF THERE ARE ANY VAV TERMINAL UNITS WITH ITS DAMPER OPEN GREATER THAN 90% THEN THE SETPOINT SHALL BE INCREASED BY THE STATIC PRESSURE RESET INCREMENT. NOTE THAT TU WHICH SERVE ONLY "SUPPORT" SPACES SHALL NOT BE INCLUDED IN THIS LOGIC.

OUTSIDE AIR CONTROL: THE DDC SYSTEM, WITH OA DUCT MOUNTED FLOW MEASURING STATION, SHALL MODULATE RA DAMPER AS REQUIRED TO MAINTAIN OUTSIDE AIR QUANTITY AT SET POINT REGARDLESS OF THE TOTAL AIR FLOW OF THE AIR HANDLING UNIT AT ANYTIME. READOUT OF OUTSIDE AIR QUANTITY SHALL BE IN CFM. OUTSIDE AIR DAMPER SHALL BE OPENED TO ITS BALANCED POSITION DURING OCCUPIED CYCLES. UPON FAILURE THE OA DAMPER SHALL BE NORMALLY CLOSED. WHENEVER THE AHU OPERATES DURING UNOCCUPIED MODE, THE OA DAMPER SHALL REMAIN CLOSED.

UNOCCUPIED MODE: THE OA DAMPER SHALL SHUT AND THE FAN SHALL CYCLE UPON A CALL FOR COOLING OR HEATING FROM ANY SPACE.

INTERLOCKED EXHAUST FANS: INTERLOCKED EXHAUST FANS SHALL OPERATE ONLY DURING OCCUPIED TIMES.

MONITORED ZONES: PROVIDE ROOM TEMPERATURE SENSOR IN DATA CLOSETS, DRY STORAGE, FREEZER AND COOLER. THE DDC SHALL MONITOR SPACE TEMPERATURES IN ALL AREAS. DDC SHALL PROVIDE A TEXT AND EMAIL ALERT WHEN FREEZER OR COOLER TEMP DROPS BELOW A USER DEFINED AND ADJUSTABLE ALARM SET POINT.

**SEQUENCE OF OPERATION
 SINGLE DUCT TERMINAL UNIT**

EACH TERMINAL UNIT SHALL BE PROVIDED WITH A UNIT CONTROL MODULE (UCM). THE UCM SHALL BE FIELD OR FACTORY MOUNTED. THE ELECTRICAL CONTRACTOR SHALL PROVIDE 120V POWER TO EACH TERMINAL UNIT.

UNIT AIRFLOW SHALL BE MONITORED BY AN INTEGRAL MULTIPLE POINT, AVERAGING FLOW SENSING DEVICE AND A TRANSDUCER TO MAINTAIN AIRFLOW WITHIN 5% OF RATED CFM DOWN TO A MINIMUM CFM AS SCHEDULED, INDEPENDENT OF CHANGES IN SYSTEM STATIC PRESSURE.

COOLING MODE: THE UCM SHALL MONITOR THE ZONE TEMPERATURE AGAINST ITS SET POINT (74°F ADJUSTABLE) AND MODULATE THE DAMPER TO MEET THE ZONE SETPOINT. IF THE TU CALLS FOR FULL COOLING AND CANNOT REACH MAXIMUM AIRFLOW FOR FIVE MINUTES, THE DDC SHALL RESET THE AHU STATIC PRESSURE UP 0.15".

HEATING MODE: THE DAMPER SHALL MODULATE TO THE HEATING AIRFLOW (SEE TU SCHEDULES) AND THE HOT WATER VALVE SHALL MODULATE AS REQUIRED TO MAINTAIN SPACE TEMPERATURE (COOLING SET POINT MINUS 3°F).

THE ZONE TEMPERATURE SENSOR WITH SET POINT ADJUSTMENT SHALL BE PROVIDED WITH NIGHT SETBACK OVERRIDE, AND A COMMUNICATIONS JACK. UPPER AND LOWER ZONE TEMPERATURE SET POINTS SHALL BE SET BY THE DDC.

OCCUPIED/UNOCCUPIED MODE: CONTROLS CONTRACTOR SHALL CONSULT WITH OWNER FOR SPACE TEMPERATURE SETPOINTS.

OVERRIDE MODE: THE OVERRIDE TIMER SHALL PLACE THE TU AND AHU IN OCCUPIED MODE FOR ONE HOUR (ADJUSTABLE).

ION SENSOR: TU-4.1, 1.6, AND 4.2 SHALL BE EQUIPPED WITH A SUPPLY AIR MOUNTED ION SENSOR WITH ADJUSTABLE SETPOINT AND DIGITAL OUTPUT. THE DDC SHALL POST AN ALARM WHEN THE ION COUNT FALLS BELOW THE SETPOINT. INITIAL SETPOINT MINIMUM SHALL BE 5000 IONS/CC/SEC. DUCT SETPOINT SHALL BE CONFIRMED BY SPACE ION MEASUREMENTS AT A MINIMUM OF 2000 IONS/CC/SEC IN THE SPACE SERVED.

**SEQUENCE OF OPERATION
 SINGLE ZONE VARIABLE VOLUME AHU**

STARTING AND STOPPING OF EQUIPMENT SHALL BE ACCOMPLISHED THROUGH A "HAND-OFF-AUTO" SWITCH LOCATED ON FACE OF DDC CONTROL PANEL. AN ALARM SHALL BE POSTED TO THE DDC SYSTEM ANYTIME THE HOA SWITCH IS INDEXED TO THE "HAND" OR "OFF" POSITIONS. WITH THE HOA SWITCH IN THE "AUTO" POSITION, THE UNIT SHALL BE STARTED AUTOMATICALLY BY THE DDC SYSTEM AND ALL CONTROLS ACTIVATED SUBJECT TO FIRE ALARM RELAY, SAFETIES AND OVERLOADS.

OCCUPIED MODE: OPEN THE OUTSIDE AIR DAMPERS AND START EXHAUST FANS INDICATED ON FAN SCHEDULE WHENEVER THE BUILDING IS IN OCCUPIED MODE.

PREHEAT CONTROL: ANYTIME THE MIXED AIR TEMPERATURE FALLS BELOW 40°F WITH NO CALL FOR COOLING, THE DDC SHALL REST THE MINIMUM AIRFLOW TO MAINTAIN 50°F MIXED AIR TEMPERATURE.

COOLING COIL FREEZE PROTECTION: THE DDC SYSTEM SHALL CLOSE THE OUTSIDE AIR DAMPER ANYTIME THE MIXED AIR TEMPERATURE FALLS BELOW 40°F LONGER THAN 5 MINUTES. THE LOW LIMIT FREEZE STAT SHALL STOP THE AHU FAN MOTOR ANYTIME THE COOLING COIL ENTERING AIR TEMPERATURE FALLS BELOW 33°F.

DISCHARGE TEMPERATURE CONTROL: THE DDC SYSTEM SHALL MODULATE THE CHILLED WATER VALVE AS REQUIRED TO MAINTAIN THE DISCHARGE AIR TEMPERATURE AT SET POINT (REFER TO AHU SCHEDULES) UNTIL MINIMUM SPEED IS REACHED. WHEN MINIMUM SPEED IS REACHED AND THERE IS A CALL FOR HEATING, THE DDC SHALL RESET SUPPLY AIR TEMPERATURE UP IN 2°F INCREMENTS EVERY FIVE MINUTES TO A MAXIMUM OF 65°F (ADJUSTABLE). THE DDC SHALL REVERSE SUPPLY AIR RESET UPON A CALL FOR COOLING OR WHEN ROOM AIR DEWPOINT RISES ABOVE 57°F.

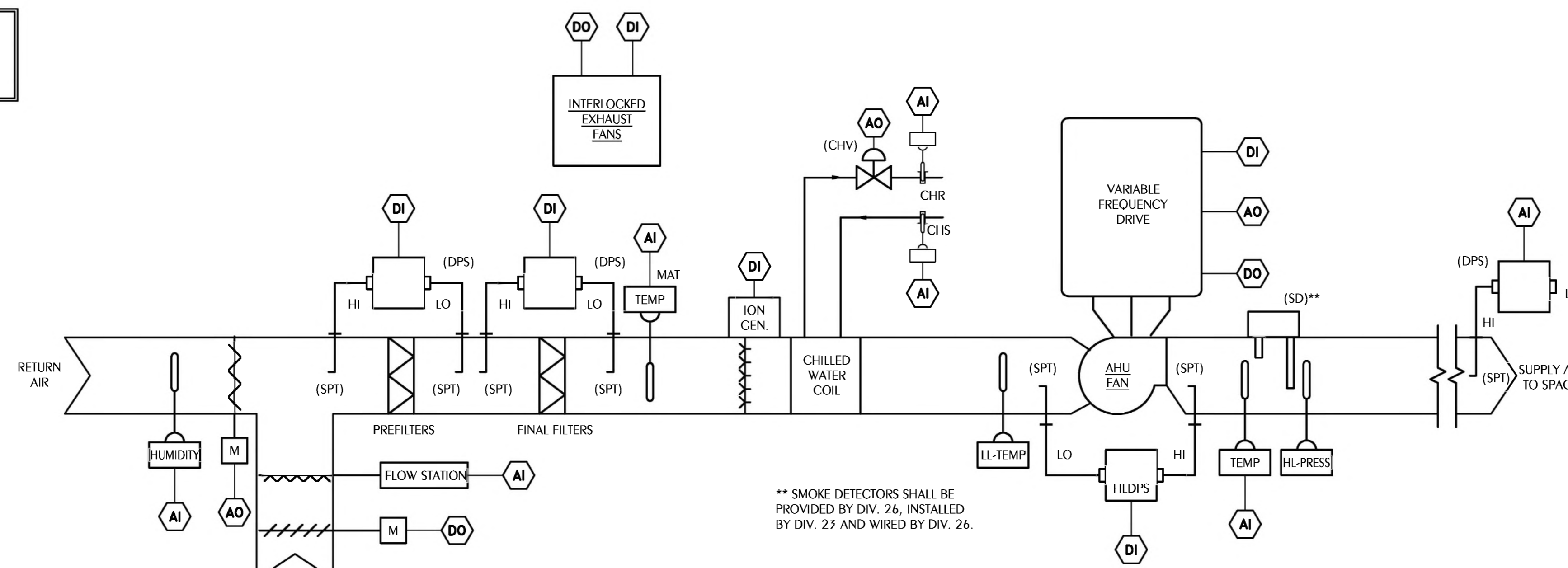
FAN SPEED CONTROL: SUBJECT TO HIGH LIMIT DUCT STATIC PRESSURE SENSOR, AHU AIRFLOW SHALL BE LIMITED TO SCHEDULED MAXIMUM AND MINIMUM VALUES. THE ADJUSTABLE VARIABLE FREQUENCY DRIVE SHALL MODULATE FAN SPEED AS REQUIRED TO MAINTAIN ROOM TEMPERATURE AT SETPOINT (74°F ADJUSTABLE). UPON REACHING MINIMUM SPEED, THE DDC SHALL MODULATE THE HWV AS REQUIRED TO MAINTAIN ROOM TEMP AT SETPOINT. AHU FAN SHALL RUN CONTINUOUSLY DURING OCCUPIED MODE.

OUTSIDE AIR CONTROL: THE DDC SYSTEM, WITH OA DUCT MOUNTED FLOW MEASURING STATION, SHALL MODULATE RA AND OA DAMPERS AS REQUIRED TO MAINTAIN OUTSIDE AIR QUANTITY AT SET POINT REGARDLESS OF THE TOTAL AIR FLOW OF THE AIR HANDLING UNIT AT ANYTIME. READOUT OF OUTSIDE AIR QUANTITY SHALL BE IN CFM. OUTSIDE AIR DAMPER SHALL BE OPENED TO MAINTAIN OA AT THE MINIMUM SCHEDULED DURING OCCUPIED CYCLES. UPON A RISE IN RETURN AIR CO2 CONCENTRATION EXCEEDING THE OA CO2 CONCENTRATION MORE THAN 750PPM, THE DDC SHALL RESET THE OA SETPOINT TO THE MAXIMUM OA VALUES SCHEDULED UNTIL THE DIFFERENCE IN CO2 CONCENTRATIONS FALLS BELOW 650PPM FOR A MINIMUM OF 1 HOUR.

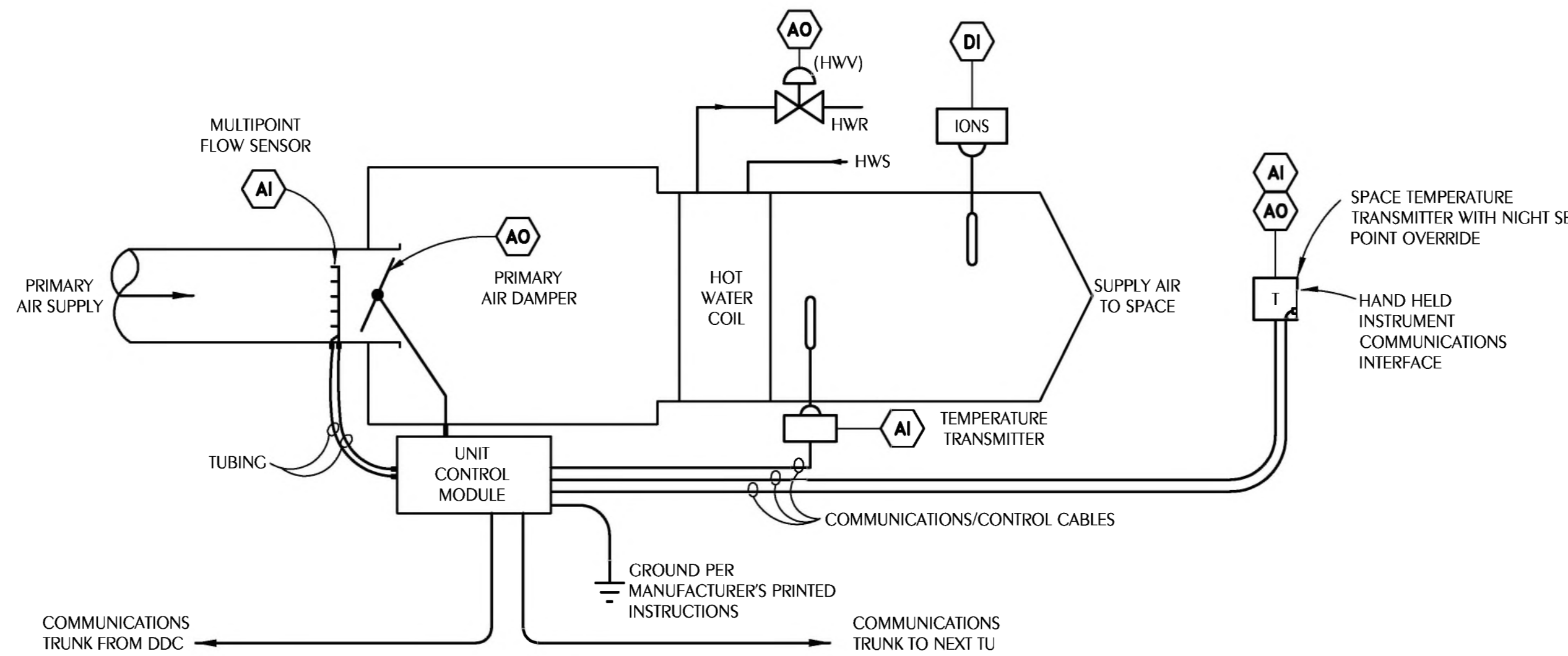
UNOCCUPIED MODE: THE DDC SHALL CYCLE THE FAN AND COOLING OR HEATING COIL AS NECESSARY TO MAINTAIN SETPOINT OF 85°F (ADJUSTABLE). OA DAMPER SHALL BE CLOSED DURING UNOCCUPIED TIME.

OVERRIDE: OVERRIDE SHALL PLACE THE UNIT IN OCCUPIED MODE FOR A PERIOD OF 1 HR.

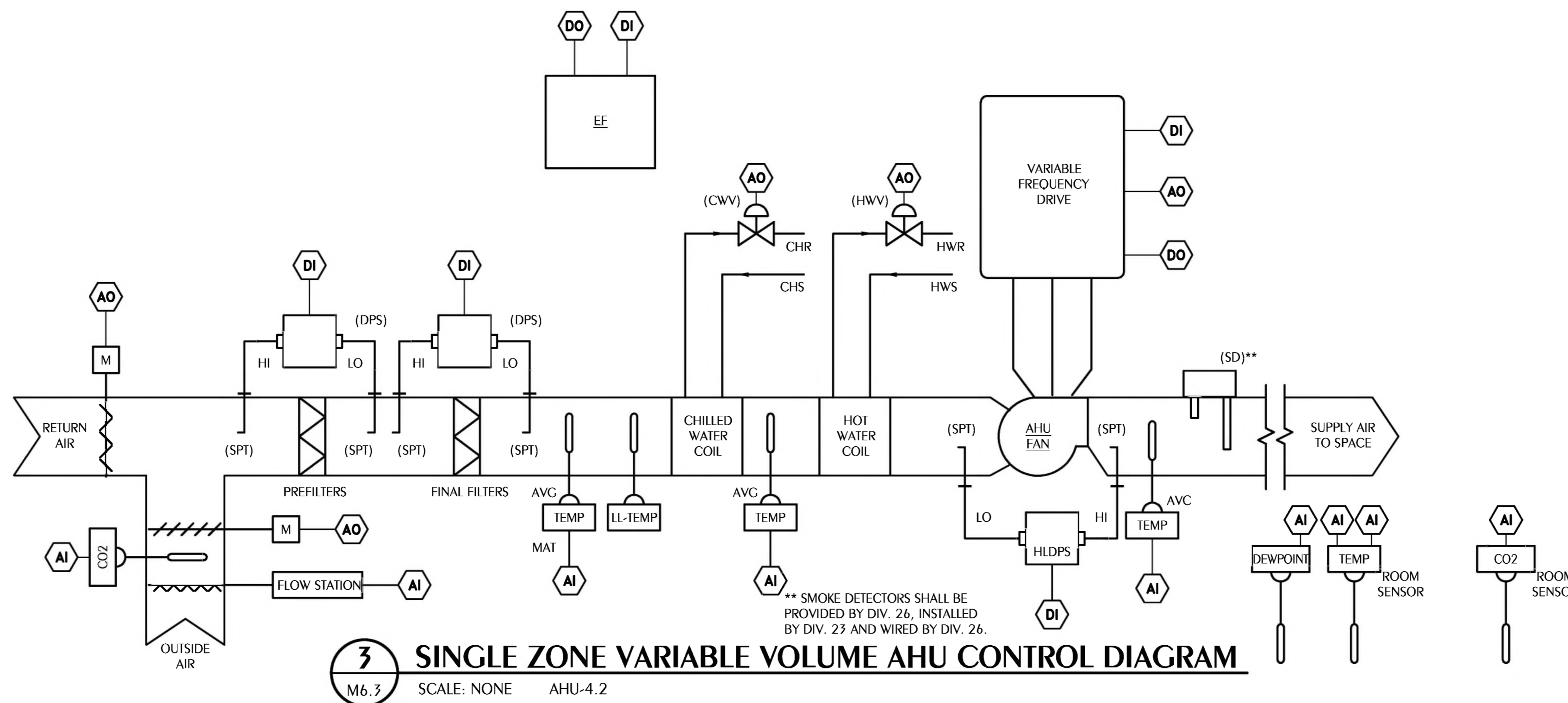
INTERLOCKED EXHAUST FANS: INTERLOCKED EXHAUST FANS SHALL OPERATE ONLY DURING OCCUPIED TIMES.



1 VARIABLE VOLUME AHU CONTROL DIAGRAM
 SCALE: NONE



2 SINGLE DUCT TU CONTROL DIAGRAM
 SCALE: NONE



3 SINGLE ZONE VARIABLE VOLUME AHU CONTROL DIAGRAM
 SCALE: NONE AHU-4.2

VARIABLE VOLUME AHU POINTS LIST

SYSTEM POINT DESCRIPTION	ANALOG		DIGITAL		SYSTEMS FEATURES	
	INPUT	OUTPUT	INPUT	OUTPUT	ALARMS	PROGRAMS
	TEMPERATURE	CHW PRESSURE	STATUS	STATUSES		
CONTROL PANEL	X					
FAN CONTROL		X	X	X	X	
RETURN AIR		X			X	X
BI-POLAR IONIZATION			X		X	
MIXED AIR	X				X	X
CHWC DISCHARGE AIR	X				X	X
COOLING VALVE		X			X	X
CHWS	X				X	X
CHWR	X				X	X
FILTERS			X		X	X
OUTSIDE AIR	X	X			X	X
RETURN AIR DAMPER		X			X	X
DUCT STATIC PRESSURE	X				X	X
OUTSIDE AIR DAMPER			X	X	X	
HILDPS					X	X
EXHAUST FANS			X	X		
DATA CLOSET	X				X	X
DRY STORAGE	X				X	X
FREEZER	X				X	X
COOLER	X				X	X

SINGLE DUCT TU POINTS LIST

SYSTEM POINT DESCRIPTION	ANALOG		DIGITAL		SYSTEMS FEATURES	
	INPUT	OUTPUT	INPUT	OUTPUT	ALARMS	PROGRAMS
	TEMPERATURE	CHW PRESSURE	STATUS	STATUSES		
CONTROL PANEL						
SUPPLY AIR TO SPACE	X			X	X	X
ZONE TEMPERATURE	X		X		X	X
HEATING VALVE		X				
DAMPER		X				
FLOW SENSOR	X				X	

SINGLE ZONE VARIABLE VOLUME AHU POINTS LIST

SYSTEM POINT DESCRIPTION	ANALOG		DIGITAL		SYSTEMS FEATURES	
	INPUT	OUTPUT	INPUT	OUTPUT	ALARMS	PROGRAMS
	TEMPERATURE	CHW PRESSURE	STATUS	STATUSES		
CONTROL PANEL	X					
FAN CONTROL		X	X	X	X	
MIXED AIR	X				X	X
CWC DISCHARGE AIR	X				X	X
UNIT DISCHARGE AIR	X				X	X
ROOM SENSER	X	X	X	X	X	X
PREHEAT VALVE		X				
COOLING VALVE		X				
HEATING VALVE		X				
FILTERS			X		X	X
OUTSIDE AIR	X	X			X	X
RETURN AIR		X			X	X
OUTSIDE AIR DAMPER		X			X	
RETURN AIR DAMPER		X			X	
HILDPS					X	X
EXHAUST FAN (EF-1)			X	X		
TRANSFER FAN (TF-1)			X	X		
RELIEF AIR		X	X	X		
TRANSFER AIR		X	X	X		