

**DIVISION 23: HEATING, VENTILATING, AND
AIR-CONDITIONING**

23 0500 COMMON WORK RESULTS FOR HVAC

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SECTION 23 0501**COMMON HVAC REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Common requirements and procedures for HVAC systems.
 - 2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
 - 3. Furnish and install sealants relating to installation of systems installed under this Division.
 - 4. Furnish and install Firestop Penetration Systems for HVAC system penetrations as described in Contract Documents.
 - 5. Furnish and install sound, vibration, and seismic control elements.
- B. Products Furnished But Not Installed Under This Section:
 - 1. Sleeves, inserts, and equipment for mechanical systems installed under other Sections.
- C. Related Requirements:
 - 1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 2. Section 07 9213: 'Elastometric Joint Sealant' for quality of sealants used at building exterior.
 - 3. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustical sealants.
 - 4. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
 - 5. Section 26 2913: 'Enclosed Controllers' for magnetic starters and thermal protective devices (heaters) not factory mounted integral part of mechanical equipment.
 - 6. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
 - 7. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.
 - 1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
 - 2) Include name, address, and phone number of each supplier.
 - 2. Shop Drawings:
 - a. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
 - b. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.

- c. Drawing of each temperature control panel identifying components in panels and their function.
 - d. Other shop drawings required by Division 23 trade Sections.
- B. Informational Submittals:
- 1. Qualification Statement:
 - a. HVAC Firm:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
 - b. Installer:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
- C. Closeout Submittals:
- 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
 - 1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
 - a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.
 - b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
 - (1) List of HVAC equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
 - (2) Manufacturer's maintenance instructions for each piece of HVAC equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
 - (3) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
 - (4) Manual for Honeywell T7350 thermostat published by Honeywell.
 - c) Provide operating instructions to include:
 - (1) General description of each HVAC system.
 - (2) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
 - (3) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.
 - b. Warranty Documentation:
 - 1) Include copies of warranties required in individual Sections of Division 23.
 - c. Record Documentation:
 - 1) Manufacturers documentation:
 - a) Copies of approved shop drawings.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
- 1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 - 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
 - 3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
 - 1. Company:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in HVAC installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
 - 2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Accept valves on site in shipping containers with labeling in place.
- B. Storage And Handling Requirements:
 - 1. In addition to requirements specified in Division 01:
 - a. Stored material shall be readily accessible for inspection by Architect until installed.
 - b. Store items subject to moisture damage, such as controls, in dry, heated spaces.
 - c. Provide temporary protective coating on cast iron and steel valves.
 - d. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - 2. Protect bearings during installation. Thoroughly grease steel shafts to prevent corrosion.

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.
- B. Special Warranty:
 - 1. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
 - 2. If HVAC sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local HVAC sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
- B. Pipe And Pipe Fittings:
 - 1. Use domestic made pipe and pipe fittings on Project.
 - 2. Weld-O-Let and Screw-O-Let fittings are acceptable.

- C. Sleeves:
 - 1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
 - 2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
- D. Valves:
 - 1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers:
 - 1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

- A. Drawings:
 - 1. HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 - 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over HVAC Drawings.
 - 3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- B. Verification Of Conditions:
 - 1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
 - 2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
 - 3. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
 - 4. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.3 PREPARATION

- A. Changes Due To Equipment Selection:
 - 1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
 - 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 - 3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.

4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

3.4 INSTALLATION

- A. Interface With Other Work:
 1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
 2. Electrical: Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
 3. Testing And Balancing:
 - a. Put HVAC systems into full operation and continue their operation during each working day of testing and balancing.
 - b. Make changes in pulleys, belts, fan speeds, and dampers or add dampers as required for correct balance as recommended by Testing And Balancing Agency and at no additional cost to Owner.
- B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.
- C. Locating Equipment:
 1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps, filters, starters, motors, control components, and to clear openings of doors and access panels.
 2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to interferences anticipated and encountered.
 3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
 4. Determine exact route and location of each pipe and duct before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, steam, steam condensate, and drains shall normally have right-of-way.
 - 2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
 - b. Offsets, Transitions, and Changes in Direction:
 - 1) Make offsets, transitions, and changes in direction in pipes and ducts as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - 2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.
- D. Piping:
 1. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
 - a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
 - b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
 - 1) Arrange so as to facilitate removal of tube bundles.
 - 2) Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - a) Make connections of dissimilar metals with di-electric unions.
 - b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.

- 3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
 - 4) Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
 - 5) Install piping to insure noiseless circulation.
 - 6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
- c. Do not install piping in shear walls.
2. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
 - b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 - c. Make changes in direction with proper fittings.
 - d. Expansion of Thermoplastic Pipe:
 - 1) Provide for expansion in every 30 feet (9 meters) of straight run.
 - 2) Provide 12 inch (300 mm) offset below roof line in each vent line penetrating roof.
 3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
 - a. Sleeves through floors shall extend 1/4 inch (6 mm) above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
 - b. Sleeves through floors and foundation walls shall be watertight.
 4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
 5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
 - a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
 - b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
 - c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.
- E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.
- F. Sealants:
1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
 2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.5 REPAIR / RESTORATION

- A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
 1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.

2. Surface finishes shall exactly match existing finishes of same materials.

3.6 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.
- B. Non-Conforming Work:
 1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
 2. Repeat tests on new material, if requested.

3.7 SYSTEM START-UP

- A. Off-Season Start-up:
 1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
 2. Notify Owner seven days minimum before scheduled start-up.
 3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner's representatives in operation and maintenance of system.
 4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.
- B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
 1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.
 2. Make adjustments to insure that:
 - a. Equipment alignments and clearances are adjusted to allowable tolerances.
 - b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.
 - c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
 - d. Miscellaneous alignments, tightenings, and adjustments are completed so systems are tight and free from leakage and equipment performs as intended.
 3. Motors and accessories are completely operable.
 4. Inspect and test electrical circuitry, connections, and voltages to be properly connected and free from shorts.
 5. Adjust drives for proper alignment and tension.
 6. Make certain filters in equipment for moving air are new and of specified type.
 7. Properly lubricate and run-in bearings in accordance with Manufacturer's directions and recommendations.

3.8 CLEANING

- A. Clean exposed piping, ductwork, and equipment.
- B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.
- C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

3.9 CLOSEOUT ACTIVITIES

- A. Instruction Of Owner:
 - 1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of mechanical systems utilizing Operation And Maintenance Manual when so doing:
 - a. Minimum Instruction Periods:
 - 1) HVAC: Four (4) hours.
 - 2) Temperature Control: Two (2) hours.

3.10 PROTECTION

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.
- B. Do not operate pieces of equipment used for moving supply air without proper air filters installed properly in system.
- C. After start-up, continue necessary lubrication and be responsible for damage to bearings while equipment is being operated up to Substantial Completion.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common hanger and support requirements and procedures for HVAC systems.
- B. Related Requirements:
 - 1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 2. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
 - 3. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Class Two Quality Standard Approved Manufacturers. See Section 01 6200:
 - a. Anvil International, Portsmouth, NH www.anvilintl.com.
 - b. Cooper B-Line, Highland, IL www.cooperbline.com.
 - c. Erico International, Solon, OH www.erico.com.
 - d. Hilti Inc, Tulsa, OK www.hilti.com.
 - e. Minerallac, Hampshire, IL www.minerallac.com.
 - f. Thomas & Betts, Memphis, TN www.superstrut.com.
 - g. Unistrut, Wayne, MI www.unistrut.com.

B. Performance:

- 1. Design Criteria:
 - a. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size	Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller	10 mm	50 mm and smaller
1/2 inch	2-1/2 to 3-1/2 inches	13 mm	63 mm to 88 mm
5/8 inch	4 to 5 inches	16 mm	100 mm to 125 mm
3/4 inch	6 inches	19 mm	150 mm
7/8 inch	8 to 12 inches	22 mm	200 mm to 300 mm

- b. Support rods for multiple pipes supported on steel angle trapeze hangers shall be in accordance with following table:

c.

Rods		Number of Pipes per Hanger for Each Pipe Size						
No.	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

Rods		Number of Pipes per Hanger for Each Pipe Size						
No.	Diameter	50mm	63mm	75mm	100mm	125mm	150mm	200mm
2	10 mm	Two	0	0	0	0	0	0
2	13 mm	Three	Three	Two	0	0	0	0
2	16 mm	Six	Four	Three	Two	0	0	0
2	19 mm	Nine	Seven	Five	Three	Two	Two	0
2	22 mm	Twelve	Nine	Seven	Five	Three	Two	Two

1) Size trapeze angles so bending stress is less than 10,000 psi (69 Mpa).

C. Materials:

1. Hangers, Rods, Channels, Attachments, And Inserts:
 - a. Galvanized and UL approved for service intended.
 - b. Support horizontal piping from clevis hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
 - c. Class Two Quality Standards:
 - 1) Support insulated pipes with clevis hanger equal to Anvil Fig 260 or roller assembly equal to Anvil Fig 171 with an insulation protection shield equal to Anvil Fig 167. Gauge and length of shield shall be in accordance with Anvil design data.
 - 2) Except uninsulated copper pipes, support uninsulated pipes from clevis hanger equal to Anvil Fig 260. Support uninsulated copper pipe from hanger equal to Anvil Fig CT-65 copper plated hangers and otherwise fully suitable for use with copper tubing.
 - d. Riser Clamps For Vertical Piping:
 - 1) Class Two Quality Standard: Anvil Figure 261.
 - e. Furnace / Fan Coil Support Channel:
 - 1) Class One Quality Standard: Unistrut P1000.
 - 2) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.
 - f. Swivel Attachment:
 - 1) Class One Quality Standard: Unistrut EM3127.
 - 2) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3- EXECUTION

3.1 INSTALLATION

D. Piping:

1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:
 - 1) Support metal piping at 96 inches (2 400) mm on center maximum for pipe 1-1/4 inches (32 mm) or larger and 72 inches (1 800 mm) on center maximum for pipe 1-1/8 inch (28 mm) or less.

- 2) Support thermoplastic pipe at **48 inches (1 200 mm)** on center maximum.
- 3) Provide support at each elbow. Install additional support as required.
- c. Supports for Vertical Piping:
 - 1) Place riser clamps at each floor or ceiling level.
 - 2) Securely support clamps by structural members, which in turn are supported directly from building structure.
 - 3) Provide clamps as necessary to brace pipe to wall.
- d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
- e. Expansion of Thermoplastic Pipe:
 - 1) Provide for expansion in every **30 feet (9 meters)** of straight run.
 - 2) Provide **12 inch (300 mm)** offset below roof line in each vent line penetrating roof.

END OF SECTION

SECTION 23 0553**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Furnish and install identification of HVAC equipment and piping as described in Contract Documents.
- B. Products Furnished But not Installed Under This Section:
1. Paint identification for gas piping used in HVAC equipment.
- C. Related Requirements:
1. Section 22 0529: 'Hangers And Supports For Plumbing' for installation of paint identification for gas piping used with HVAC equipment.

PART 2 - PRODUCTS**2.1 SYSTEMS**

- A. Description:
1. Abbreviations for Pipe Stencils and Equipment Identification and Band Colors for Pipe Identification:
 - a. Apply stenciled symbols and continuous painting as follows:

Pipe Type	Pipe Color	Symbol
Gas	Yellow	GAS
- B. Materials:
1. Paint:
 - a. Paints specified are from Pittsburgh Paint & Glass (PPG), Pittsburgh, PA www.ppgaf.com or PPG Canada Inc, Mississauga, ON (800) 263-4350 or (905) 238-6441.
 - b. One Coat Primer:
 - 1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
 - 2) 6-205 Metal Primer under dark color paint.
 - 3) 6-6 Metal Primer under light color paint.
 - c. Finish Coats: Two coats 53 Line Acrylic Enamel.
 - d. Class Two Quality Standard. See Section 01 6200.
 - 1) Paint of equal quality from other Manufacturers may be used.
 - 2) Maintain specified colors, shades, and contrasts.
 2. Labels:
 - a. Equipment Identification:
 - 1) Black formica, with white reveal when engraved.
 - 2) Lettering to be **3/16 inch (5 mm)** high minimum.

PART 3 - EXECUTION**3.1 APPLICATION**

- A. Labels:
1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
 - a. Boilers and hot water heating specialties.
 - b. Pumps.
 2. Engrave following data from Equipment Schedules on Drawings onto labels:
 - a. Equipment mark.
 - b. Area served.
 - c. Thermostat zone number, when different from equipment mark.
 - d. Panel and breaker from which unit is powered.
- B. Painting:
1. Leave equipment in like-new appearance.
 2. Only painted legends, directional arrows, and color bands are acceptable.
 3. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
 - a. Adjacent to each item of equipment.
 - b. At point of entry and exit where piping goes through wall.
 - c. On each riser and junction.
 - d. Every **25 feet (7.620 m)** on long continuous lines.
 - e. Stenciled symbols shall be **one inch (25 mm)** high and black.

END OF SECTION

SECTION 23 0719**HVAC PIPING INSULATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install insulation on above ground hot water heating piping and fittings as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 0501: 'General HVAC Requirements'.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:
 - 1. Keep materials and work dry and free from damage.
 - 2. Replace wet or damaged materials at no additional cost to Owner.

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Armacell, Mebane, NC www.armacell.com.
 - b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
 - c. Foster Products Corp, Oakdale, MN www.fosterproducts.com.
 - d. Johns-Manville, Denver, CO www.jm.com.
 - e. Knauf, Shelbyville, IN www.knauffiberglass.com.
 - f. Manson, Brossard, BC, Canada www.isolationmanson.com.
 - g. Nitron Industries, Thousand Oaks, CA www.nitronindustries.com.
 - h. Owens-Corning, Toledo, OH www.owenscorning.com or Owens-Corning Canada Inc, Willowdale, ON (416) 733-1600.
 - i. Ramco, Lawrenceville, NJ www.ramco.com.
 - j. Nomac, Zebulon, NC www.nomaco.com.
 - k. Speedline Corp, Solon, OH www.speedlinepvc.com.
- B. Materials:
 - 1. Hot-Water-Heat Piping Systems:
 - a. Thickness:
 - 1) Pipe:
 - a) 1-1/2 inch (38 mm).for pipe sizes ≤ 1.5 inch (38 mm) diameter.
 - b) 2 inch (50 mm).for pipe sizes > 1.5 inch (38 mm) diameter.
 - 2) Pipe Fittings:
 - a) 1-1/2 inch (38 mm).for pipe sizes ≤ 1.5 inch (38 mm) diameter.
 - b) 2 inch (50 mm).for pipe sizes > 1.5 inch (38 mm) diameter.
 - 3) Heavy density fiberglass with fire retardant vapor barrier jacket with self-sealing laps.
 - 4) Performance Standard: Fiberglass heavy density with ASJ-SSL jacket by Owens-Corning.
 - 5) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:

- a) Manson.
- b) Johns Manville.
- c) Owens-Corning.
- b. Vapor Barrier Adhesive: As recommended by Insulation Manufacturer.
- c. Covers For Valves And Fittings:
 - 1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Zeston by Johns Manville.
 - b) Speedline.
- d. Shields: 22 ga (0.92 mm) by 12 inch (300 mm) long galvanized steel.
- e. Hydraulic Setting Insulating Cement:
 - 1) Class Two Quality Standard: Ramco Finishing Cement 1200.
- f. Weather Barrier Mastic:
 - 1) Water based vinyl-acrylic mastic coating.
 - 2) Class Two Quality Standard: Childers / Foster CP-10 / CP-11.
- g. Canvas: 4 oz (113 grams).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before application of insulating materials, brush clean surfaces to be insulated and make free from rust, scale, grease, dirt, moisture, and any other deleterious materials.
- B. Use drop cloths over equipment and structure to prevent adhesives and other materials spotting the work.

3.2 INSTALLATION

- A. Hot Water Heating System:
 - 1. Pipes:
 - a. Butt joints firmly together.
 - b. Seal vapor barrier longitudinal seam overlap with vapor barrier adhesive.
 - c. Wrap butt joints with 4 inch (100 mm) strip of vapor barrier jacket material cemented with vapor barrier adhesive.
 - d. Finish with bands applied at mid-section and at each end of insulation.
 - 2. Valves And Fittings:
 - a. Insulate by one of following methods:
 - 1) With hydraulic setting insulating cement, or equal, to thickness equal to adjoining pipe insulation.
 - 2) With segments of molded pipe insulation securely wired in place.
 - b. Finish fittings and valves with canvas coated with weather barrier mastic or securely fitted Zeston covers.
 - 3. Pipe Hangers: Provide shields at each pipe hanger to protect pipe insulation from crushing.

3.3 FIELD QUALITY CONTROL

- A. Non-Conforming Work:
 - 1. Method of installing insulation shall be subject to approval of Architect. Sloppy or unworkmanlike installations are not acceptable.

3.4 CLEANING

- A. Leave premises thoroughly clean and free from insulating debris.

3.5 PROTECTION

- A. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

END OF SECTION

SECTION 23 0800**DEMOLITION AND REPAIR****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Under this section remove obsolete piping and mechanical equipment and relocate, reconnect or replace existing piping affected by demolition or new construction. Remove concealed piping abandoned due to demolition or new construction, or cap piping flush with existing surfaces.

1.3 DRAWINGS AND EXISTING CONDITIONS

- A. All relocations, reconnections and removals are not necessarily indicated on the drawings. As such, the Contractor shall make adequate allowance in his proposal for this work as no extra charges will be allowed for these items.

PART 2 - PRODUCTS – Not Used**PART 3 - EXECUTION****3.1 TEMPORARY CONNECTIONS**

- A. Where existing piping must remain in service to supply occupied areas during construction, provide temporary piping, connections, and equipment to maintain service to such areas. All shall be performed in a neat and safe manner to prevent injury to the building or its occupants.

3.2 DRILLING, CUTTING, PATCHING

- A. All Required drilling, cutting, block-outs and demolition work required for the removal and/or installation of the mechanical system is the responsibility of this Contractor.
- B. No joists, beams, girders, trusses or columns shall be cut by any Contractor without written permission from the Architect.
- C. The patching, repair, and finishing to existing or new surfaces is the responsibility of this Contractor, unless specifically called for under sections of specifications covering these materials.
- D. Disconnect all equipment that is to be removed or relocated. Relocate any existing equipment that obstructs new construction.

3.3 EXISTING PIPING TO REMAIN IN USE

- A. Where affected by demolition or new construction, relocate, replace, extend, or repair piping and equipment to allow continued use of same. Use methods and materials as specified for new construction.

3.4 MATERIALS AND EQUIPMENT REMOVED

- A. All obsolete materials, piping, and equipment shall become the property of the Contractor and be removed from the site promptly.

END OF SECTION

SECTION 23 0950 – COMBUSTIBLE GAS DETECTOR CONTROLS**PART 1 - GENERAL**

1.1 Provide a complete installation of a toxic gas detection system including stand-alone dual sensors and audible/visual alarm devices that can monitor two different gases.

1.2 The system shall include, but not be limited to, the following:

- A. Future expandability
- B. Display of toxic gas concentration
- C. Ability to modify alarm set points
- D. Automatic and Manual fan start/stop
- E. Display of alarm status

PART 2 - PRODUCTS

2.1 DETECTORS E³ POINT MODEL E3SA, E3SAH OR E3SAR, E3SARH WITH E3SRM REMOTE SENSOR OR E3DA (DUCT MOUNT)

- A. Transmitter will be powered by 24 V AC/DC (E3SA) or 120 Vac (E3SAH). The gas transmitter must be capable of monitoring a second gas when equipped with an E3SRM remote sensor. The gas transmitter will incorporate an electrochemical cell for toxic gas monitoring and catalytic bead sensor for combustible gases. Unit sensing cell must compensate for variation in relative humidity and temperature to maintain high levels of accuracy.
- B. The transmitter will be capable of transmitting gas concentrations to a DDC system through its 4-20 mA output. For local activation of fans or louvers (or other equipment), two on-board DPDT relays 5 A, 30 Vdc or 250 Vac (restrictive load) will be activated at programmable set points (and programmable time delays). An LCD display will provide local gas concentration readings.
- C. Transmitter will be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -4°F to 104°F.
- D. Unit will be certified to ANSI/UL 61010-1 label and CAN/CSA-C22.2 No. 61010. Transmitter must be manufactured in and ISO 9001-2000 production environment.
- E. The transmitter should have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing.
- F. For local activation of audible alarms, the transmitter shall have an on-board device able to generate an audible output of 85 dBA @ 10 ft.
- G. Detector alarm levels are to be activated and the unit is to be installed in accordance with the following parameters:

GASES	1 ST ALARM SET POINT	2 ND ALARM	3 RD ALARM	MOUNTING HEIGHT	COVERAGE RADIUS
Propane (C ₃ H ₈)	25%LEL	50% LEL	90% LEL above	1 ft (30cm) finished floor	23 ft (7 m)

2.2 ACCESSORIES

- A. Strobe and Horn type STAS for 24 Vac, FHS-240 for 24 Vdc or STACKSTAS for 120 Vac:

Strobe & Horn unit will be capable of operating within relative humidity ranges of 0-100% and temperature ranges of -30° F to 150° F . Rating of horn will be no less than 72dBA at 10 feet. Intensity of light will be no less than 40W and will flash at frequency of 1 per second. Unit will be certified by CSA. Honeywell Analytics.

- B. Power Transformer type T100VA, T200VA, T300VA or Class 2 device type T100 VAC2, T200VAC2, or T300VAC2:
1. Transformer shall have an input voltage of 120 V AC and an output voltage of 24 Vac with a VA range of 50-300. Operating frequency shall be 60 Hz. Unit will provide insulation systems up to 130° C. Unit will operate at sound levels of less than 40 dBA. Transformers shall be of fused type.
- C. Detector Guards E3PT – GUARD:
1. The grid is made of a 9-gauge steel wire. The guard must be designed to allow calibration without removing the guards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install hazardous gas monitoring equipment including sensors, audible alarms, as shown on Contract Drawing, and as recommended by manufacturer of equipment, and as required by authorities having jurisdiction.
- B. Install conduit and wiring from sensors to control panel and to the fan starters/HVAC control panel as recommended by manufacturer of equipment.

3.2 SEQUENCE OF OPERATION:

- A. If any C3H8 sensor detects 25% LEL gas, the exhaust fan operates. Low Alarm indicators light for point in alarm. If hazardous gas not cleared after 30 minutes or the level reaches 50% LEL, High Alarm indicator lights on the main panel and remote strobe & horn activate, Audible Alarm to sound and contacts to operate the exhaust fans.

3.3 COMMISSIONING

- A. After installation, test and calibrate equipment to demonstrate operation of functions described above under sequence of operation by manufacturers certified service technician.
- B. Provide testing kits (including gas bottles) for testing and calibration by Commission technician.

3.4 WARRANTY:

- A. Limited Warranty – Honeywell Analytic, Inc. warrants to the original purchaser and/or ultimate customer (“Purchaser”) of Vulcain products (“Product”) that if any part thereof proves to be defective in material or workmanship within twelve (12) months, such defective part will be repaired, or replaced free of charge, at Honeywell Analytics’ discretion if shipped prepaid to Honeywell Analytics at 4005 Matte Blvd. Unit G, Brossard, Quebec, Canada, J4Y 2P4, in a package equal to or in the original container. The product will be returned freight prepaid and repaired or replaced if it is determined by Honeywell Analytics that the part failed due to defective materials or workmanship. The repair or replacement or any such defective part shall be Honeywell Analytics sole and exclusive responsibility and liability under this limited warranty.

END OF SECTION 23 0950

SECTION 23 1123**FACILITY PROPANE-GAS PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Perform excavation and backfill required for work of this Section.
 - 2. Furnish and install gas piping and fittings within building and from building to tank farm including 2nd stage regulator as described in Contract Documents.
- B. Related Requirements:
 - 1. Sections Under 09 9000 Heading: Painting of exterior piping.
 - 2. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A53/A53M-12, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
 - b. ASTM A234/A234M-11a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
 - c. ASTM D2513-12ae1, 'Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings'.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Welders:
 - a. Welders shall be certified and bear evidence of certification thirty (30) days before commencing work on project.
 - b. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test. This shall be done at no cost to Owner. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.
 - 2. Pipe Installers:
 - a. Polyethylene pipe installers shall be properly trained and certified in procedure for joining polyethylene pipe.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:
 - 1. Do not store polyethylene pipe so it is exposed to sunlight.

PART 2 - PRODUCTS

2.1 SYSTEM

- A. Manufacturers:
1. Manufacturer Contact List:
 - a. BrassCraft, Novi, MI www.brasscraft.com.
 - b. Cimberio Valve Co Inc, Malvern, PA www.cimberio.com.
 - c. ConBraCo Industries, Inc, Matthews, NC www.conbraco.com or ConBraCo / Honeywell Ltd, Scarborough, ON (416) 293-8111.
 - d. Dormont Manufacturing Company, Export, PA www.dormont.com.
 - e. Jenkins-NH-Canada, Brantford, ON www.jenkins-nh-canada.com.
 - f. Jomar International, Madison Heights, MI www.jomar.com.
 - g. California Valves (formally KOSO) by Pacific Seismic Products Inc, Lancaster, CA, Distributed by Strand Earthquake Consultants www.strandearthquake.net.
 - h. Watts Regulator Co, North Andover, MA www.wattsreg.com or Watts Industries (Canada) Inc, Burlington, ON (888) 208-8927.
- B. Materials:
1. Above-Ground Pipe And Fittings:
 - a. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of A53/A53M.
 - b. Welded forged steel fittings meeting requirements of ASTM A234/A234M or standard weight malleable iron screwed.
 2. Below-Ground Pipe And Fittings: Polyethylene pipe and fittings meeting requirements of ASTM D2513 with No. 14 coated copper trace wire.
 3. Valves:
 - a. 125 psi (862 kPa) bronze body ball valve, UL listed.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) CIM 102.1 by Cimbrio Valve.
 - 2) Apollo Series 80-100 by ConBraCo.
 - 3) 'Red Cap' R602 by Jenkins NH Canada.
 - 4) Model T-204 by Jomar International.
 - 5) Model B-6000-UL by Watts Regulator.
 4. Cocks:
 - a. Gauge Cocks: Conbraco Series 50-56 bronze gauge cock.
 5. Flexible Connector:
 - a. Type 304 stainless steel corrugated tube coated for corrosion protection.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Dormont Supr-Safe.
 - 2) BrassCraft Procoat.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel pipe installed through air plenums, in walls, and pipes 2-1/2 inches (64 mm) and larger shall have welded fittings and joints. Other steel pipe may have screwed or welded fittings.
- B. Lay underground pipe in accordance with Manufacturer's recommendations and local gas utility company regulations and specifications.
1. Provide 24 inch (610 mm) minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of polyethylene line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.
 2. Place tracer wire along side of polyethylene pipe from meter to point where pipe rises inside building.

3. Place 4 inches (100 mm) of sand around gas line buried underground.
 4. Do not install gas piping under building floor slabs-on-grade.
- C. On lines serving gas-fired equipment, install gas cocks adjacent to equipment outside of equipment cabinet and easily accessible.
- D. Install 6 inch (150 mm) long minimum dirt leg, with pipe cap, on vertical gas drop serving each gas-fired equipment unit.
- E. Use fittings for changes of direction in pipe and for branch runouts.

3.2 FIELD QUALITY CONTROL

- A. Field tests:
1. Subject all portions of gas piping system, in sections or in entirety, to air pressure of 75 psig (0.52 MPa) and prove airtight for 4 hours.
 2. Disconnect equipment not suitable for 75 psig (0.52 MPa) pressure from piping system during test period.

END OF SECTION

SECTION 23 2113**HYDRONIC PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install hydronic heating and cooling piping and specialties as described in Contract Documents.

- B. Related Requirements:
 - 1. Section 23 0501: Common HVAC Requirements.
 - 2. Section 23 0719: HVAC Piping Insulation.
 - 3. Section 23 5239: Steel Fire-Tube Boilers.
 - 4. Division 26: Electrical service and connections.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A53/A53M-11, 'Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless'.
 - b. ASTM A234/A234M-11, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
 - 2. American National Standards Institute / American Society of Mechanical Engineers:
 - a. ANSI / ASME B16.22-2001 (R2005), 'Wrought Copper and Copper Alloy Solder Joint Pressure Fittings'.

1.3 SUBMITTALS

- A. Maintenance Materials Submittals:
 - 1. Tools:
 - a. Use glycol tester to verify specified glycol concentrations in system. Leave tester with Owner at conclusion of Project.
 - b. Tester shall be Misco 7084VP by Misco Products Division, Cleveland, OH www.misco.com.

PART 2 - PRODUCTS**2.1 SYSTEMS**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Armstrong International, Three Rivers, MI www.armstrong-intl.com.
 - b. Bell & Gossett, Morton Grove, IL www.bellgossett.com.
 - c. Center Line by Crane Valve, Conroe, TX www.cranvalve.com.
 - d. Conbraco Industries, Matthews, NC www.conbraco.com.
 - e. Crane, Cullman, AL www.cranvalve.com.
 - f. Dow Chemical, Midland, MI www.dow.com.
 - g. Febco, Denver, Co www.repmasters.com.
 - h. Hammond Valve, New Berlin, WI www.hammondvalve.com.

- i. Handy & Harman Products Div, Fairfield, CT www.handyharman.com.
 - j. Harris Products Group, Mason, OH www.harrisproductsgroup.com.
 - k. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
 - l. Mueller Steam Specialty, Saint Pauls, NC www.muellersteam.com
 - m. Nibco Inc, Elkhart, IN www.nibco.com.
 - n. Stockham, Cullman, AL www.stockham.com.
 - o. Taco Inc, Cranston, RI www.taco-hvac.com.
 - p. Thrush Co Inc, Peru, IN www.thrushco.com.
 - q. Victaulic Company of America, Easton, PA www.victaulic.com.
 - r. Watts Regulator Co, North Andover, MA www.wattsreg.com.
- B. Materials
1. Steel Pipe:
 - a. Types of Pipe:
 - 1) Schedule 40 Black Carbon Steel Pipe meeting requirements of ASTM A53/A53M, Type E or F.
 - a) Uses: Chemical Treatment for chilled water and hot water space heating
 - 2) Schedule 40 Mechanical Grooved Pipe:
 - a) Uses: Chilled water and hot water space heating.
 - 3) Schedule 80 Black Steel Pipe meeting requirements of ASTM A53/A53M, Type F, Weight Class XS.
 - a) Uses: Drain, overflow, and vent piping in connection with heating and cooling systems, including pump base drain lines, safety valve drains, condensate return receiver vents, safety valve vents, and tank vents.
 - b. Fittings:
 - 1) Schedule 40 Black Carbon Steel Pipe: Standard weight wrought carbon steel meeting requirements of ASTM A234/A234M.
 - 2) Schedule 40 Mechanical Grooved Pipe: Fittings by Victaulic.
 - 3) Schedule 80 Black Steel Pipe: **300 psi (2.07 MPa)** Welded.
 - c. Connections:
 - 1) Less than **One inch (25 mm)**: Threaded.
 - 2) **One to 2-1/2 inches (25 to 64 mm)**:
 - a) Screwed.
 - b) Roll grooved by Victaulic.
 - 3) **2-1/2 inch (64 mm) And Larger**:
 - a) Welded.
 - b) Roll grooved system by Victaulic.
 - 4) Gaskets For Roll Grooved Joints:
 - a) Class Two Quality Standards:
 - b) Victaulic Grade E, EPDM, temperature rated minus **30 deg F to 230 deg F (minus 34 deg C to 110 deg C)**.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 2. Circuit Balancing Valves And Venturis:
 - a. Function capability of flow measurement.
 - b. Flow balancing.
 - c. Positive shut off.
 - d. Valves shall have two scales, one for pre-setting valve and one for determining flow rate during actual balancing.
 - e. Provide provisions for connecting differential pressure meter. Each meter connection shall have shut off valves.
 - f. Include tamper proof and memory features.
 - g. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Armstrong: CBV.
 - 2) Bell & Gossett: Circuit Setter Plus.
 - 3) Flow Design Inc: Accusetter.
 - 4) Taco: Circuit Setter Series ACUF.
 3. Pressure Reducing Valve:

- a. Diaphragm type designed for closed loop pressurization. Factory set at **12 psi (83 kPA)** with adjustable range of eight to **25 psi (172 kPA)**. Rated at **125 psig (862 kPa)** working pressure and **225 psi (1.55 MPa)** maximum operating temperature.
 - b. Cast iron body, brass trim, and built in strainer. **3/4 inch (19 mm)** NPT connections.
 - c. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Armstrong: RD50.
 - 2) Bell & Gossett: Model No. B712.
 - 3) ConBraCo: 36C.
 - 4) Taco: 335.
 - 5) Thrush: 12F.
4. Valves:
- a. Reduced Pressure Back Flow Preventer Valve:
 - 1) Designed to provide separation of hot water heating system water from domestic cold water supply in accordance with Code.
 - 2) Rated flow at **30 psi (207 kPa)**, pressure drop rated for **175 psi (1.21 MPa)** inlet pressure, and **140 deg F (60 deg C)** maximum operating temperature.
 - 3) Brass body construction with **3/4 inch (19 mm)** NPT connections.
 - 4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) ConBraco: 40-200.
 - b) Febco: 825DBV.
 - c) Watts: 909RPDA.
 - b. Manual Air Vent Valve:
 - 1) Designed to provide manual venting at baseboard units with screwdriver type slot.
 - 2) Rated for **125 psig (862 kPa)** working pressure and **225 deg F (107 deg C)** maximum operating temperature.
 - 3) Brass body construction with chrome plated exterior and **1/8 inch (3 mm)** MNPT connection
 - 4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) Bell & Gossett: 4V.
 - b) Taco: 417 COINVENT.
 - c) Thrush: 5.
 - c. Butterfly Valves:
 - 1) Operable in any quadrant, shall operate properly with flow in either direction, and fully suitable for throttling and tight shut-off service.
 - 2) Full lug-wafer type with lugs tapped on both sides.
 - 3) **150 psig** working pressure and **minus 20 deg F to 250 deg F (minus 29 deg C to 121 deg C)**.
 - 4) Body: Ductile iron or cast iron.
 - 5) Seat: EPT Nordel or EPDM (rubber lined).
 - 6) Stem:
 - a) 304, 316, or 416 stainless steel.
 - b) Diameter not to be reduced at bearings.
 - 7) Disc: Bronze or bronze alloy, bubble tight at **150 psig (1.03 MPa)**.
 - 8) Bushings: Reinforced teflon, nylon, or sintered bronze with PTFE.
 - 9) Operating Mechanisms: Infinite throttling handle with provision for locking in any position and with position stop.
 - 10) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) Centerline: Series 200.
 - b) ConBraCo Apollo: 143 Series.
 - c) Crane: Quartermaster.
 - d) Milwaukee: ML233E.
 - e) Nibco: LD or GD.
 - f) Victaulic: Series 300 (With grooved pipe only).
 - d. Manual Air Vent Ball Valve:
 - 1) Designed for use as a high point vent.
 - 2) Rated for **150 lb (68 kg)** working pressure water, oil, gas, and steam.
 - 3) Bronze body with solder end connections, teflon stem and seats, and bubble tight shut off. **3/8 inch (9.5 mm)** size with tee handle.
 - 4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.

- a) ConBraCo Apollo: 70-200.
- b) Hammond: 8701.
- c) Milwaukee: BA150-TH.
- d) Nibco: S580-70.
- e. Check Valves:
 - 1) Swing Check Valves:
 - a) Provision for re-grinding without removal of the valve from the line.
 - b) **2 Inch (50 mm)** And Smaller: All bronze, **125 psi (0.862 MPa)** swp at **350 deg F (177 deg C)**.
 - c) **2-1/2 Inch (64 mm)** And Larger: Flanged iron body, bronze mounted, **125 psig (862 kPa)** swp at **450 deg F (232 deg C)**.
 - d) Quality Standards:
 - (1) **2 Inch (50 mm)** And Smaller: Stockham B319, Milwaukee 509-T.
 - (2) **2-1/2 Inch (64 mm)** And Larger: Stockham G931, Milwaukee F2974.
 - e) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - (1) Crane.
 - (2) Milwaukee.
 - (3) Stockham.
 - (4) Victaulic.
 - 2) Non-Slam Check Valves:
 - a) Silent, spring loaded.
 - b) **125 psi (0.862 MPa)** swp.
 - c) Silent, semi-steel body.
 - d) Bronze trim and discs.
 - e) Bronze seats with center guide and renewable with reseating with special tools.
 - f) Guided spring.
 - g) Operable in horizontal, vertical, angular, or upside down position.
 - h) Quality Standards: ITT by Bell & Gossett, Victaulic Series 716.
 - i) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - (1) Bell & Gossett.
 - (2) Milwaukee.
 - (3) Mueller.
 - (4) Nibco.
 - (5) Victaulic.
- f. Ball Valves:
 - 1) Designed for shut off service.
 - 2) High temperature service type rated at **150 deg F (66 deg C)** steam working pressure and **350 deg F (177 deg C)** maximum temperature.
 - 3) Three piece swing out bronze body construction with full port, screwed end connections, and teflon seats.
 - 4) Provide extended stem on insulated line.
 - 5) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) ConBraCo Apollo: 82-100.
 - b) Hammond: 8604.
 - c) Milwaukee: BA-300.
 - d) Nibco: T595-Y.
 - e) Victaulic: Series 726.
 - f) Watts: B6800.
- g. Combination Ball Valve, Hose Connection, And Cap:
 - 1) Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - a) ConBraCo Apollo: 78-100.
- h. Triple Duty Valve:
 - 1) Straight Pattern
 - 2) Non-slam check valve.
 - 3) Balance valve with calibrated adjustment.
 - 4) Shut-off valve.
 - 5) Category Four Approved Products. See Section 01 6200 for definitions of Categories.

- a) Armstrong: FTV-S.
- b) Bell & Gossett: 3DS.
- c) Taco: MPV.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping:
 - 1. Use either steel or copper pipe and fittings, but not both.
 - 2. Use teflon tape and pipe dope for lubricating threads on all threaded connections. To join copper pipes, apply flux, heat joints to remove excess flux and solder, and cool joints in accordance with Manufacturer's recommendations.
 - 3. Install unions on downstream side of shut-off valves, specialty valves, and meters, and on both sides of coils, baseboard units, and other heating equipment. Also install unions on both ends of radiation piping where piping goes from floor level into steel pipe troughs in floor slab.
 - 4. Anchor or hang piping so pipe weight does not rest on flexible connectors.
 - 5. Install roll grooved systems in accordance with Manufacturer's requirements.
- B. Labels:
 - 1. Label valves, pumps, flow meters, and other equipment items with equipment mark number shown on Drawings or with space served. (Chapel, etc.)
 - 2. Label head / feet and flow gpm for pumps.
 - 3. Label flow gpm for flow meters.
 - 4. Labels shall be 2 inch (50 mm) by 3 inch (76 mm) laminated plastic, black with white engraved letters, and attached with brass, beaded chain.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Subject hydronic piping systems, in sections or entirety, to water pressure of 125 psig (862 kPa) and prove tight for period of four hours. Disconnect equipment not suitable for 125 psig (862 kPa) pressure from piping system during test period.

3.3 CLEANING

- A. Remove and clean strainers, including those at air separators and suction diffusers, before preliminary balancing of each water system and before final balancing of each water system.
- B. Cleaning of Hot Water Heating System Piping:
 - 1. Give Architect seven days written notice of date of cleaning procedures.
 - 2. Hot Water Heating System:
 - a. After it has been determined system is tight and has been flushed, heat system water to 160 deg F (71 deg C) and circulate for 24 hours.
 - b. After cleaning, drain system, clean strainers, fill with fresh water, and thoroughly flush until pH of water is 8.

END OF SECTION

SECTION 23 2114**HYDRONIC PIPING SYSTEM SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install hydronic piping system specialties described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 0501: Common HVAC Requirements.
 - 2. Section 23 0513: Common Motor Requirements for HVAC Equipment.

PART 2 - PRODUCTS**2.1 ACCESSORIES**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Armstrong Pumps Inc, North Tonawanda, NY www.armstrongpumps.com.
 - b. Ashcroft, Stratford, CT www.ashcroftinc.com.
 - c. Aurora Pump, North Aurora, IL www.aurorapump.com.
 - d. Bell & Gossett, Morton Grove, IL www.bellgossett.com.
 - e. Center Line by Crane Valve, Conroe, TX www.cranevalve.com.
 - f. ConBraCo Industries, Matthews, NC www.conbraco.com.
 - g. Crane Valves, Cullman, AL www.cranevalve.com.
 - h. Essex Brass Corp, Warren, MI www.essexbrass.com.
 - i. Flex-Hose Corp, East Syracuse, NY www.flexhose.com.
 - j. Grundfos Pumps Corp, Fresno, CA www.us.grundfos.com.
 - k. Hyspan Precision Products, Chula Vista, CA www.hyspan.com.
 - l. John C. Ernst Co Inc, Sparta, NJ www.john-ernst.com.
 - m. Marsh Instruments, Newell, WV www.marshbellofram.com.
 - n. Metraflex Co, Chicago, IL www.metralflex.com.
 - o. Powell Valves, Cincinnati, OH www.powellvalves.com.
 - p. Taco Inc, Cranston, RI www.taco-hvac.com.
 - q. Thrush Company Inc, Peru, IN www.thrushco.com.
 - r. HO Trerice Co, Oak Park, MI www.hotco.com.
 - s. Unistrut Corp, Wayne, MI www.tyco-unistrut.com.
 - t. Universal Metal Hose, Chicago, IL www.universalmetalhose.com.
 - u. Weinman Pumps, Piqua, OH www.cranepumps.com.
 - v. Weiss Instruments Corp, Holtsville, NY www.weissinstruments.com.
 - w. Weksler Instruments Corp, Boca Raton, FL www.wekslerglass.com.
- B. Materials:
 - 1. Cocks:
 - a. Gauge Cocks:
 - 1) Brass Tee handle.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) Ashcroft: 1082.
 - b) Ernst: 123BR.
 - c) Trerice: 865.
 - d) Equal by MarshBellofram, Powell, or Weksler.

- b. Balancing Cocks: Use a specified ball valve.
2. Pumps:
 - a. In-Line Booster Pumps:
 - 1) Horizontal, oil-lubricated type for 125 psig (862 kPa) working pressure, bronze body, and brass impeller.
 - 2) Shaft: Ground and polished heat treated steel with hardened integral thrust collar and supported by oil lubricated sleeve bearings.
 - 3) Mechanical seal to have ceramic type seats and be suitable for continuous 225 deg F (107 deg C) service.
 - 4) Coupler: Flexible or spring type.
 - 5) Motor:
 - a) As specified in Section 23 0513 and be non-overloading at any point on pump curve.
 - b) Drip-proof, quiet operating, sleeve bearing, and rubber mounted type motor with built-in thermal overload protectors.
 - 6) Uses: Domestic water heat exchanger.
 - 7) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) Armstrong: Series 1060.
 - b) Bell & Gossett: Series 60.
 - c) Taco: Series 1600.
 - d) Or as provided with Boilers
3. Gauges:
 - a. Thermometers:
 - 1) 9 inch (230 mm) adjustable, angle, red reading, mercury type with cast aluminum case and 3-1/2 inch (89 mm) chrome-plated brass separable socket.
 - 2) Range: 30 deg F to 240 deg F (minus 1 deg C to 115 deg C).
 - 3) Performance Standard: BX by HO Tetrice.
 - 4) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
 - a) HO Tetrice.
 - b) Weiss A9VU35.
 - c) Weksler.
 - b. Pressure Gauges:
 - 1) Cast aluminum case.
 - 2) Chrome plated ring.
 - 3) Clear glass window.
 - 4) Phosphor bronze alloy steel bourdon tube.
 - 5) 1/2 percent scale range accuracy.
 - 6) 4-1/2 inch (115 mm) diameter dial face.
 - 7) Pressure Ranges:
 - a) Suit service intended.
 - b) High-pressure limit of gauges approximately 200 percent of expected maximum pressure at gauge location.
 - c) Gauges at pump suction: 0 psig to 100 psig (0.00 MPa to 0.69 MPa).
 - d) Other gauges: Have low-pressure limit of 0 psig (0.00 MPa).
 - 8) Performance Standard: No. 500 by HO Tetrice.
 - 9) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) MarshBellofram.
 - b) HO Tetrice.
 - c) Weiss.
 - d) Weksler.
4. Flexible Connectors:
 - a. Braided sleeve over corrugated flexible inner tube, both of type 321 stainless steel.
 - b. Minimum length of 12 inches (305 mm).
 - c. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Anaconda by Universal Metal Hose.
 - 2) U S Hose Corp.
5. Bellows Type Expansion Joints And Guides:
 - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories.

- 1) Series 8500 by Hyspan.
- 2) Model HP by Metraflex.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide pressure snubbers on pump gauges.
- B. Connect to pipe with **1/4 inch (6 mm)** connections utilizing cocks.
- C. Install flexible connectors in straight line without offset.
- D. Install expansion joints in supply and return lines **1-1/2 inches (38 mm)** in diameter and larger every **50 feet (15 meters)** of pipe length without change of direction. Install guides in accordance with Manufacturer's recommendations.
- E. Install **1/2 inch (12.7 mm)** male hose end connection to manual air vent line. Locate in accessible areas, but not in walkway.

END OF SECTION

SECTION 23 3400 - EXHAUST FANS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0100 apply to this Section.

1.2 SUMMARY

- A. Furnish and install exhaust fans as described in Contract Documents.

1.3 QUALITY ASSURANCES

- A. Requirements of Regulatory Agencies:
 - 1. Bear AMCA seal and UL label.

PART 2 - PRODUCTS**2.1 CENTRIFUGAL IN-LINE FANS**

- A. Non-overloading design and of arrangement indicated.
- B. Constructed of low carbon steel and painted with an approved rust resistant coating or all aluminum as shown.
- C. Fan performance shall be based on tests conducted in accordance with the AMCA Standard test code of air moving devices and shall be licensed to bear the AMCA Certified Air and Sound Rating Seal. Fans shall have a sharply rising pressure characteristic extending through the operating range and continuing to rise well beyond the efficiency peak to assure quiet and stable operation under all conditions. Horsepower characteristics shall be truly self-limiting and shall reach a peak in the normal selection area.
- D. Wheel diameters shall be in accordance with the standard sizes adopted by AMCA for centrifugal in-line type fans. Inlets shall be fully streamlined and housings shall be suitably braced to prevent vibration or pulsation. Housings shall be arc welded steel throughout.
- E. Fan wheel shall include die formed AIRFOIL blades designed for maximum efficiency and quiet operation. Blades shall be continuously welded to back plate and welded to wheel cone. Class 2 fan with inlet and outlet bell fittings.
- F. Wheels shall be statically and dynamically balanced and assembled fan shall be tested for balance at specified speed at the factory prior to shipment. Such tests shall be performed with an IRD analyzer to measure radial and axial displacements.
- G. Bearings are to be ball or roller anti-friction type, and shall be equipped with extended lubrication lines to grease fittings outside of the fan housing. Shafts shall operate at no more than 70% of first critical speed to assure smooth operation.
- H. Accessories for in-line fans to include belt guard, inlet and outlet flanges, and other accessories as called for in the plans.
- I. All fans shall be equipped with an adjustable motor base integral with the fan housing. This motor base shall be completely welded and consist of frame and reinforcing side sheets to assure maximum strength and rigidity.
- J. Submittals for approval of equipment shall include copies of outline drawings, AMCA Certified

Sound Ratings, and percentage pressure-volume performance curves showing point of operation.

- K. Approved Manufacturers:
 - 1. Barry
 - 2. Cook
 - 3. Penn
 - 4. Twin City

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Anchor fan units securely to structure or curb.

END OF SECTION

SECTION 23 5134**FLUES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install flues as described in Contract Documents.
- B. Related Requirements:
 - 1. Sections Under 09 9000 Heading: Painting.
 - 2. Section 23 0501: 'Common HVAC Requirements'.

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Acme Engineering & Manufacturing Corp, Muskogee, OK www.acmefan.com.
 - b. AMPCO, Holland, MI www.americanmetalproducts.com.
 - c. Breidert Air Products, Jacksonville, FL www.breidert.com.
 - d. Metal-Fab Inc, Wichita, KS www.mtifab.com.
 - e. Metlvent by Hart & Cooley, Holland, MI www.hartandcooley.com.
 - f. Selkirk Metalbestos, Logan, OH www.selkirkusa.com.
 - g. Simpson Dura-Vent Co, Vacaville, CA www.duravent.com.
- B. Materials:
 - 1. Flues:
 - a. Double wall, factory-fabricated sectional type 'B', of aluminum construction designed to handle combustion products of fuel being used. Provide with inspection cap as required by local code, roof flashing, and clean-out.
 - b. Size flues according to local codes except:
 - 1) No vertical flue shall have an area of less than 12-1/2 sq inches (80.65 sq cm), 4 inches (100 mm) in diameter.
 - 2) In no case shall vent connector be smaller than outlet collar provided by Manufacturer.
 - c. Horizontal flue connectors shall be double wall.
 - d. Fittings shall be pre-fabricated double wall.
 - e. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Ameri-Vent by AMPCO.
 - 2) Metal-Fab Inc.
 - 3) Metlvent by Hart & Cooley.
 - 4) Selkirk Metalbestos.
 - 5) Simpson Dura-Vent.
 - 2. Vent Caps:
 - a. Non-backdraft type for installation on top of flue, aluminum construction.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Mastervent Type MVR by Acme Engineering & Manufacturing.
 - 2) Ameri-cap by AMPCO.
 - 3) Type L by Breidert Air Products.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Height of flue above roof shall be as shown on Drawings unless local code requires it be higher.
- B. Every portion of flue connector shall have rise of **one inch (25 mm)** per **1 foot (300 mm)** minimum from appliance to vertical flue.
- C. Length of horizontal flues or flue connectors shall not be longer than 75 percent of height of vertical flue between point at which horizontal flue enters vertical flue to top of vertical flue. In no case shall horizontal run exceed **15 feet (4.57 m)**.
- D. When two or more flue connections enter common vertical flue, smaller flue connector shall enter at higher level. Do not enter flue connectors in same horizontal plane.
- E. Every gas appliance flue shall have a 'backdraft preventer' installed at top of flue.

END OF SECTION

SECTION 23 5315 – HEATING BOILERS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install heating boilers as described in Contract Documents.

1.3 QUALITY ASSURANCE

- A. Boiler shall be AGA design certified for a minimum boiler efficiency of 95% and bear appropriate seal. The Boiler shall modulate 20-100% of full fire and shall be constructed to comply with the efficiency requirements of the latest addition of ASHRAE Std. 90.1.
- B. The unit(s) shall be design-certified to comply with the current edition of the Harmonized ANSI Z21.13 / CSA 4.9 Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers. The unit(s) shall be designed and constructed in accordance with ASME Boiler & Pressure Vessel Code, Section IV requirements for 160 psi (1103 kPa) maximum working pressure and shall bear the ASME "h" Stamp and be listed by the National Board. The boiler shall be equipped with an ASME certified pressure relief valve set at 75psi 517 (kPa).

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Equipped for natural gas.
- B. Approved Manufacturers:
 - 1. Teledyne Laars
 - 2. or approved equal
- C. The water tube heat exchanger shall be stainless steel, rated for 160psi (1103 kPa) working pressure. The heat exchanger shall be a low water volume design, welded construction, with no gaskets, O-rings or bolts in the header. Heat exchanger shall be accessible for visual section and cleaning of all internal surfaces. The boiler shall be fully condensing design with built-in condensate drain and trap. The heater exchanger shall have a limited ten-year warranty.
- D. Each boiler shall be fully test fired, (with water, gas, and venting connected), and all safety components tested, at the factory.
- E. The boiler shall be sealed combustion, and removal of jacket panels shall not affect the combustion seal. The boiler jacket shall be a unitized shell finished with acrylic thermo-set baked at not less than 325°F (163°C). The frame shall be constructed of galvanize steel for strength and protection. Chamber shall include a sight glass for viewing flame. Boiler shall be certified for zero clearance to combustible surfaces.
- F. All water, gas, vent and air connections shall be on the top of the boiler, and the top jacket panels shall be split, such that they are removable without disconnecting the water, gas, vent or air pipes.
- G. Boiler shall operate on 4-13" w.c. gas pressure and shall need no component changes to operate at high altitude, up to 10,000 feet.
- H. The boiler shall use a premix burner with a stainless-steel woven metal fiber wrap, and a negative pressure has valve to burn cleanly, with NOx emissions not exceeding 100om. The boiler shall meet the emissions requirements of SCAQMD 2012.
- I. The boiler shall be designed for vertical or horizontal Category IV venting, up to 100 equivalent feet with 4" PVC, CPVC or stainless steel vent material. Air may be taken from the room, or ducted directly to the boiler, using up to 100 equivalent feet of 4" ABS, PVC, CPVC or galvanized pipe, The boiler shall be shipped with PVC sidewall vent and air terminals, for use with horizontal systems. The first section of CPVC vent pipe shall be shipped with each boiler.

- J. Unit shall be 120VAC, single phase, less than 6 Amps for connection to a 15A breaker. The control circuit shall be 24VAC.
- K. Unit Controls:
1. The boiler control shall be an integrated electronic PID temperature and ignition control with large color touchscreen display and shall control the boiler operation and firing rate. The boiler display shall be visible without the removal of any jacket panels or control panels.
 2. When a display or control is field-replaced, the device shall have the ability to read parameter setpoints from the original set-up, so the system does not have to be re-programmed.
 3. The control shall have the ability to control the boiler pump, system pump, and indirect domestic water pump, each with delay features. The control shall be able to cascade and lead-lag with other NeoTherm controllers, without additional system controllers.
 4. The control shall have the ability to integrate indirect domestic water heating with the boiler system. The control shall have domestic hot water priority and shall have the ability to recognize a domestic water sensor or closure from a tank stat on the same terminals. The boiler shall be shipped with the domestic water heater sensor, as standard equipment.
 5. The control shall have built-in outdoor reset feature with customizable reset curves, based on the outdoor temperature and desired system water temperature. The boiler shall be shipped with the outdoor reset sensor, as standard equipment.
 6. The control shall have the ability to accept a 4-20mA or 0-10VDC input connection from an external control or building automation system, to modulate the flame. The control shall have dry alarm contacts for ignition failure.
 7. The control shall monitor flue gas temperature and shall stop the boiler from firing if temperature is excessive.
 8. The control shall have a cleaning mode that allows the user to wipe the screen without activating any functions from the touchscreen.
 9. The control shall have a variable speed boiler pump control option.
 10. Allowable control adjustments shall include: boiler temperature setpoint; domestic water temperature setpoint; automatic high limit; °F or °C display; setpoint for time of day input; DHW setpoint for time of day input; PID gain parameters; DHW PID gain parameters; manual firing rate control; pump delay time; pump exercise interval; outdoor reset selection; low boiler setpoint temperature (for outdoor reset operation); boiler temperature at high outdoor temperature (for outdoor reset operation); boiler setpoint at low outdoor temperature (for outdoor reset operation); warm weather shutdown; automatic remote signal detection; anti-shortcycle feature enable/disable.
 11. The control shall have installer-level password, and verification feature to ensure that safety-related parameters are not altered by mistake.
- L. Multiple Boilers:
1. In multiple boiler systems the boilers shall be controlled to keep each one in the lowest firing rate possible, based on system demand, to maximize efficiency. For example, the master control shall choose to bring on all boilers at low firing rates, instead of one boiler at a high rate, to meet the system needs.
 2. A control that is chosen as master in a system with multiple controllers shall display an icon of each of the controls that it is controlling. The color of the icon shall indicate if the control is in normal operation, in lockout, in standby mode, in a hold state, or if there is a communication error. In addition to adjustable parameters, the master display shall also be able to show information about the following for each boiler it is monitoring:

• domestic hot water	• fan	• flame detection
• burner control	• domestic water pump	• statistics
• demand and modulation	• boiler pump	• stack limit
• inlet temperature	• system pump	• frost protection
 3. The control shall graphically depict the firing rate of each boiler in system, if the controller is the master of other NeoTherm boilers in a multiple boiler system. The control shall also show information about system, such as outdoor temperature and system temperature, where applicable.
 4. The control shall be able to send information through a modbus connection, including (but not limited to) inlet and outlet water temperatures, stack temperature, DHW temperature and priority,

- central heating temperature, frost protection, warm weather shutdown, status of sensors, fan speed, setpoints, remote control input, burner status, lockout codes, alarm reasons, system pump status, boiler pump status and domestic water pump status.
5. Control diagnostics shall include, at a minimum, the following: ignition failure, grounded flame rod, safety chain interrupt, boiler high limit exceeded, domestic water high limit exceeded, temperature rise limit exceeded, stack limit exceeded, pressure sensor fault, combustion pressure fault, blocked air intake, sensor errors (open or shorted), 24VAC voltage low or high, modulation fault, pump fault, AC input phases reversed, and fan speed proving rate failure.
 6. The control shall have a clock with a battery backup and will allow the user to access the burner run time, and cycle counts for the burner, DHW pump, system pump and boiler pump.
 7. The control shall differentiate between a lockout, a hold, or an alert. If an issue occurs, the system will display a brief description of the issue on the control screen. The user shall be able to tap the display to be presented with a more detailed explanation of the issues.
- M. Standard features shall include:
- High condensing efficiency
 - Modulation down to 20% of full fire (5:1 turndown)
 - Sealed combustion chamber
 - Pre-mix stainless steel burner
 - Low NOx system exceeds the most stringent regulations for air quality – 10ppm NOx
 - Horizontal or vertical direct vent
 - Horizontal vent and air terminals
 - Vent and air pipe lengths of up to 100 equivalent feet (each)
 - Built-in condensate trap
 - Vent temperatures cutoff
 - Indirect water heater priority (sensor included)
 - ASME 160 psi (1102 kPa) working pressure heat exchanger
 - Stainless steel heat exchanger with welded construction
 - ASME "H" stamp
 - 75 psi (517 kPa) ASME rated pressure relief valve
 - Water flow switch
 - Temperature and pressure gauge
 - Drain valve
 - Multiple pump control for boiler pump, system pump and indirect domestic water pump, each with delay
 - Electronic PID modulating control
 - Direct spark ignition
 - Large user-interface and display
 - Alarm output
 - Accepts external 4-20mA (0-10V with optional convertor) modulation signal
 - Outdoor reset (sensor included)
 - On/Off toggle switch
 - Manual reset high limit
 - Burner site glass
 - Flue gas temperature cutoff
 - Zero clearance to combustible surfaces
 - 10-year limited warranty

END OF SECTION

END OF DIVISION 23