
SECTION 230519 – METERS AND GAUGES FOR HVAC PIPING

Latest Edition 08-10-2024 See Underlined Text for Latest Edits

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

1.2 SUMMARY

- A. This section includes the requirements for thermometers, and gauges using the following: < Edit for project>
 - 1. Vapor actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Digital Thermostats.
 - 4. Thermowells.
 - 5. Dial-type pressure gauges.
 - 6. Gauge attachments.
 - 7. Test plugs.
 - 8. Flow meter stations.
 - 9. HVAC water meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, specified options, and warranty information.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.

1.6 WARRANTY/GUARANTEES

- A. See Division 23 Specification Section “Basic Mechanical Requirements – HVAC” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Meters and gauges shall be designed and selected, for the intended use, in accordance with the requirements of this specification.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide HVAC pumps by one (1) of the following:
1. Thermometers:
 - a. Terrice, H.O. Company.
 - b. Weiss Instruments, Inc.
 - c. Weksler Instrument Corp.
 2. Pressure Gauges:
 - a. Terrice, H.O. Company.
 - b. Weiss Instruments, Inc.
 - c. Weksler Instrument Corp.
 3. Test Plugs:
 - a. Terrice, H.O. Company.
 - b. Flow Design Inc.
 - c. Peterson Equipment Company Inc.
 4. Flow Meter Stations:
 - a. Pro Hydronics Inc.
 - b. Griswold.
 - c. Preso.
 - d. Taco Accu Flo.
 - e. Dwyer
 5. HVAC Drain and Fill Meters:
 - a. Onicon.
 - b. Flexim Ultrasonic.

2.2 THERMOMETERS

- A. General Requirements: Provide Standard or Digital thermometers as manufactured by Terrice - Basis of Design or approved equal.

B. Standard Thermometers: Thermometers shall be either vapor actuated or liquid in glass type thermometers suitable for direct or remote mount installation as specified. Provide thermometers were indicated on the drawings and details.

1. Standard Thermometers – Service and Scale Range: < Edit for project >
 - a. Heating Water: 30°F to 240°F, with two (2) degree scale divisions.
 - b. Condenser Water: 30°F to 180°F, with two (2) degree scale divisions.
 - c. Chilled Water: 0°F to 100°F, with two (2) degree scale divisions.
 - d. Steam and Condensate: 50°F to 400°F, with five (5) degree scale divisions.
 - e. Ice Storage Glycol: -40°F to 110°F, with two (2) degree scale divisions.
 - f. Heat recovery Glycol: 0°F to 160°F, with two (2) degree scale divisions.
 - g. Chilled Glycol: 0°F to 100°F, with two (2) degree scale divisions.

C. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers: Use direct mounted vapor actuated type thermometers as indicated below:

1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel four and one half (4-1/2) inch nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Brass, precision geared.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in °F.
6. Pointer: Dark-colored metal.
7. Window: Glass.
8. Ring: Metal.
9. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
10. Accuracy: +/-1% of scale range.

D. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers: Use remote mounted vapor actuated type thermometers as indicated below:

1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel four and one half (4-1/2) inch nominal diameter with back flange and holes for panel mounting.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in °F.
6. Pointer: Dark-colored metal.

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7. Window: Glass.
 8. Ring: Metal.
 9. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 10. Accuracy: Plus, or minus one (1) percent of scale range.
- E. Liquid-in-Glass Metal-Case, Industrial-Style Thermometers: Use liquid-in-glass type thermometers as indicated below:
1. Standard: ASME B40.200.
 2. Case: Cast aluminum; nine (9) inches nominal size unless otherwise indicated.
 3. Case Form: Adjustable angle unless otherwise indicated.
 4. Tube: Glass with magnifying lens and red or blue organic liquid.
 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in °F.
 6. Window: Glass.
 7. Stem: Copper-plated steel, aluminum, or brass for a separable and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 8. Accuracy: +/-1% of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- F. Digital Thermometers – Hydronic Systems: Trerice Model SX9, seven (7) inch adjustable angle, Solar Threm light powered digital thermometer with large 9/16-inch LCD °F/°C display, cast aluminum case NEMA – 4X/IP 65, Range minus 40°F to 300°F. Stem style and length to suit project requirements.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Brass or stainless-steel thermometer well.
3. Pressure Rating: Not less than piping system design pressure.
4. Stem length: To extend two (2) inches into fluid or center of pipe, whichever, is shorter.
5. Extension for Insulated Piping: Two (2) inches nominal, but not less than thickness of insulation.
6. Threaded Cap Nut: With chain permanently fastened to well and cap.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAUGES

A. General Requirements:

1. Provide pressure gauges were indicated on the drawings and as specified.
2. Service and Scale Range in pounds per square inch (PSI):
 - a. HVAC Water Systems: Zero (0) to two (2) times operating pressure.
 - b. Steam Systems: 0 to 100 psig, with ten (10) figure intervals with 1 psi scale divisions.

<Engineer to provide a schedule of operating pressures on the HVAC drawings >

3. Standard: ASME B40.100.
4. Case: Liquid-filled type; cast aluminum or drawn steel; four and one half (4-1/2) inch nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Match pressure connection size in first subparagraph below with gauge attachment size.
7. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
8. Movement: Mechanical, with link to pressure element and connection to pointer.
9. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
10. Pointer: Dark-colored metal.
11. Window: Glass, Acrylic or Lexan.
12. Ring: Metal.
13. Accuracy: Grade A, +/- 1% of scale range.

B. Gage Attachments: Provide gage attachments as indicated below:

1. Syphons: One quarter (1/4) inch straight coil of brass tubing with threads on each end.
2. Gauge Valves: Provide gauge valves (specialty valves) as specified in Division 23 Specification Section “Valves for HVAC Piping Systems”.

2.5 TEST PLUGS

- A. Description: Nickel plated brass body test plug in one half (1/2) inch fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig minimum.
- D. Core Inserts: Two (2) self-sealing valve types, suitable for inserting a one eighth (1/8) inch (3mm) outside-diameter probe from a dial thermometer or pressure gage.

- E. Core Material: According to the following for fluid and temperature range:
 - 1. Air, Water, Glycol Oil, and Gas: 20°F to 200°F, neoprene rubber.
 - 2. Air and Water: -30°F to 275°F (-35°C to 136°C), ethylene-propylene-diene-terpolymer (EDPM) rubber.
- F. Test Plug Cap: Gasketed and threaded cap, with retention chain.
- G. Test Kit: Provide test kit consisting of one (1) pressure gage and gage adapter with probe, two (2) bimetal dial thermometers and a carrying case
- H. Pressure Gage and Thermometer Ranges: Approximately two (2) times systems operating conditions.
- I. Body: Length as required to extend beyond insulation.

2.6 FLOW METER STATIONS

- A. General: Provide Flow Metering Stations (FMS) and accessories, for balancing all Hydronic Systems where indicated on the drawings, Details, Diagrams, etc. Flow Metering Stations shall be either, the Venturi Type, Pitot Tube Type or a combination of both types as specified hereinafter. Each Metering Station shall be fully assembled and include a Polycarbonate Tag. Each tag shall include the Manufacturers Model Number, Serial Number and 'CV' Flow Rate. Include the manufacturer's pressure differential tables with indicated selections for each FMS. Select each FMS so the design flow rate is within a pressure differential range of ten (10) inch wg through one hundred ten (110) inches wg.
- B. Piping Systems one half (1/2) inch through two (2) inch: For connections to reheat coils, chilled beam units, fan coil units, and cabinet type heaters provide Venturi Type Flow Meter Stations and accessories as indicated. All components shall be by the same manufacturer with thread end connections by one (1) of the following:
 - 1. Venturi/ Ball Valve: Venturi/Ball Valve Type Flow Meter Stations shall be of Brass Construction, with Female Threaded End Connections, one quarter (1/4) inch P & T Connections with Quick Connects, Integral Brass Full Port Ball Valve with Stainless Steel Ball and Stem, Memory Stop, Integral Union with 'O' Ring Seal on Inlet side, Teflon Seals, conforming to ASTM B283-06.B.
 - 2. Strainer/Ball Valve: Strainer/Ball Valve shall be a one assembly with a strainer having a removable stainless steel strainer and hose end drain valve with a chain and cap, the ball valve shall be a full port valve with stainless steel ball and stem. Also include a brass P/T Port with a cap and chain.
 - 3. Union/PT Assembly: Union/PT assembly shall be forged brass with a P/T Port with a cap and chain.

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4. Flexible Hose Assembly: Not permitted at UMB
 5. Basis of Design: The basis of design are products by NuTech Hydronic Specialties as follows:
 - a. NuTech Hydronic Specialties:
 - 1) Venturi/ Ball Valve: Model MB
 - 2) Strainer/Ball Valve: Model SV
 - 3) Union/PT Assembly: Model UB
 6. Other Acceptable Manufactures: Subject to compliance products by one (1) of the following manufacturers are also acceptable:
 - a. Flow Design Inc.:
 - 1) Venturi/ Ball Valve: Model US-SBS
 - 2) Strainer/Ball Valve: Model YC - SBS
 - 3) Union/PT Assembly: Model UP w/ SS2511 P/T Port
 - b. Griswold Quickset:
 - 1) Venturi/ Ball Valve: Model QS0 through QS3
 - 2) Strainer/Ball Valve: Model Isolator 'S'
 - 3) Union/PT Assembly: Model Isolation Union w/ CPTA
 - c. HCI Hydronic Components:
 - 1) Venturi/ Ball Valve: Model Terminator B SS
 - 2) Strainer/Ball Valve: Model Terminator Y SS
 - 3) Union/PT Assembly: Model Terminator U
 - d. PRO Hydronic Specialties L.L.C.:
 - 1) Venturi/ Ball Valve: Model CBV050L & H through CBV 070L & H, and CBV 100 through CBV200
 - 2) Strainer/Ball Valve: Model CBYU
 - 3) Union/PT Assembly: Model AU
- C. Flanged Piping Systems two and one half (2-1/2) inch through twelve (12) inch: Venturi Type Flow Meter Stations shall be of Carbon Steel Construction with 150# Flanged Connections, one quarter (1/4) inch S/S P & T Connections with Quick Connects, Integral Cast Iron Full Port Lug Type Butterfly Valve with 10 Position Memory Stop Plate, PTFE Seats and Seals Teflon Seals. Each Metering Station shall be fully assembled and include a Polycarbonate Tag. Each tag shall include the Manufacturers Model Number, Serial Number and 'CV' Flow Rate. Contractor must provide a shut off valve for each FMS, see

Valve Specifications. Flanged Flow Metering Stations shall be as follows: <Delete if not Required>

1. Pro Hydronic Specialties L.L.C. Models CBVF250H/L through CBVF400H/L and CBVF500 through CBVF 1200H.
 2. Griswold Quickset Models 3QFM through 3QFU.
 3. Preso CV Series, Models CV – 250 through CV – 600 and CV - 800 through CV - 1200.
 4. Preso Type B-Plus, Models B+50N through B+200N.
- D. Grooved Piping Systems two and one half (2-1/2) inch through twelve (12) inch: Venturi Type Flow Meter Stations shall be of Carbon Steel Construction, with Groove End Connections, and one quarter (1/4) inch S/S P & T Connections with Quick Connects. Each Metering Station shall be fully assembled and include a Polycarbonate Tag. Each tag shall include the Manufacturers Model Number, Serial Number and ‘CV’ Flow Rate. Contractor must provide a Balancing Valve for each FMS, see Valve Specifications. Flow Metering Stations shall be as follows:
1. Pro Hydronic Specialties L.L.C Models SGV250H/L through SGV400H/L and SGV500 through SGV1200.
 2. Griswold Quickset Models 3QGM through 3QGU.
 3. Preso Type B-Plus, Models B+50N through B+200N.
- E. Welded Piping Systems two and one half (2-1/2) inch through twelve (12) inch: Venturi Type Flow Meter Stations shall be of Carbon Steel Construction, with Weld End Connections, and one quarter (1/4) inch S/S P & T Connections with Quick Connects. Each Metering Station shall be fully assembled and include a Polycarbonate Tag. Each tag shall include the Manufacturers Model Number, Serial Number and ‘CV’ Flow Rate. Contractor must provide a Balancing Valve for each FMS, see Valve Specifications. Weld End Flow Metering Stations shall be as follows:
1. Pro Hydronic Specialties L.L.C. Models SWV250H/L through SWV400H/L and SWV500 through SWV1200.
 2. Griswold Quickset Models 3QWM through 3QWU.
 3. Preso CV Series, Models CV – 250 through CV – 600 and CV - 800 through CV - 1200.
- F. Flanged, Grooved and/or Welded Piping Systems twelve (12) inch through twenty four (24) inch:
1. Preso Type BIN Round Model PBIN Pitot Tube Flow Meter with 316 S/S Probe, “Y” Type Brass Head, one quarter (1/4) inch SAE Brass Ball Type Instrument Valves, 3,000 lb. CS Thread–O-Let for pipe mounting and Maximum Temperature/Pressure Rating of 250°F/ 400 PSIG and be capable of Bi – directional Flow Measurement.

2. Dwyer Series DS-400 Averaging Flow Sensor with 0.75 inch diameter S/S Sensing Tube, quick acting ball valves, S/S nameplate size and Model information and A-160 three eighth (3/8) inch NPT forged steel 3000 psi Thred-o-let.
- G. All Piping Systems two and one half (2-1/2) inch through ten (10) inch: (Contractor Option)
1. Dwyer Series DS-300 Flow Sensor with 0.75 inch diameter S/S Sensing Tube, quick acting ball valves, S/S nameplate size and Model information, A-160 three eighth (3/8) inch NPT forged steel 3000 psi Thred-o-let, A-161 Brass Bushing, and flared adapters.
- H. Portable Gage Kits: Provide One (1) Portable Gage Kit, to the owner, for each type of Flow Metering Station provided for the project. Each kit shall include a six (6) inch dial gage with appropriate H₂O Scale to measure differential pressure, two (2) hoses with quick disconnects, charts, instructions, factory assembled Hi – Lo purge valves, flexible purge tubes and internal manifold valve to prevent over pressurization, within a leak proof assembled round face plate with read-out units clearly visible. Read-out meters with scale multiplying or dampening equipment will not be acceptable. Each Meter shall show an ascending and descending accuracy of at least +/- 1.5 % and shall be manufactured under an ISO 9001:2000 certified quality program. Dial Scale Ranges shall be either 0-20, 0-30, 0-60, or 0-100 depending on size and DP Range of the Flow Meter Stations. Include a copy of the certification with each meter. Portable Gage Kits shall be Model GM as manufactured by Preso, Dwyer, Griswold, or U.S. Industrial Sourcing as specified above.
- I. Where indicated on the contract documents, BAS Flow Meters shall be provided by ATC and installed by the mechanical contractor. See HVAC Specification Section “Building Automation System” for requirements.
- ## 2.7 HVAC SYSTEMS – DRAIN AND FILL WATER METERS
- A. Drain and Fill Water Meters – HVAC Water Systems: Coordinate with the BAS Contractor to provide drain and fill water meters for HVAC Water Systems where indicated on the drawings and as follows:
<Edit for Project>
1. Chilled Water and Heating Water Systems – Water Meter Service:
 - a. System Make Up Water Meter: One (1) each.
 2. Condenser Water System – Water Meter Service:
 - a. Tower Make Up Water Meter: One (1) each.
 - b. Tower Drain/Overflow Meter: One (1) each.
 - c. Tower Chemical Drain/Bleed Meter: One (1) each.
 - d. Tower Filtration System Discharge: One (1) each.

- B. Water Meter Requirements: See Division 23 Specification Section “Building Automation System – Energy Flow Meters” for the drain and fill water meter requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of meters and gauges in the HVAC piping systems. So far as practical, install meters and gauges as indicated.

3.2 THERMOMETERS

- A. Install direct-mounted thermometers in thermowells at the most readable position and adjust vertical and tilted positions.
- B. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- C. Install thermometers in the following locations:
1. Inlet and outlet of each heat exchanger.
 2. Inlet and outlet of each energy recovery unit.
 3. Inlet and outlet of each chiller.
 4. Inlet and outlet of each thermal storage tank.
Inlet and outlet of each HVAC pump.

<Insert additional locations as required by the project>

- D. For thermometer valves see Division 23 Specification Section “Valves for HVAC Piping Systems”.

3.3 THERMOWELLS

- A. Install thermowells with socket extending a minimum of two (2) inches into fluid or center of pipe, whichever is shorter.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.

3.4 PRESSURE GAUGES

- A. Install pressure gauges in the following locations:

1. Inlet and outlet of each pressure-reducing valve.
 2. Inlet and outlet of each heat exchanger.
 3. Inlet and outlet of each energy recovery unit.
 4. Inlet and outlet of each chiller.
 5. Inlet and outlet of each thermal storage tank.
 6. Suction and discharge of HVAC pumps.
 7. Inlet and outlet of steam control valves.
- < Insert additional locations as required by the project >.

- B. Install direct-mounted pressure gauges in piping tees with pressure gage located on pipe at the most readable position.
- C. Install remote-mounted pressure gauges on panel.
- D. For gage valves see Division 23 Specification Section “Valves for HVAC Piping Systems”.
- E. Install test plugs in piping tees.

3.5 FLOW METER STATIONS

- A. Install flow metering stations (FMS) where indicated on the drawings, details and diagrams, and in accessible locations at the most readable position.
- B. Locations: Install flow measuring elements and meters in the following locations:
 1. At discharge of each pump
 2. At each reheat coil, fan coil unit, heat exchanger, and unit heater.
 3. At inlet of each hydronic coil in built-up central systems, and elsewhere as indicated.
 4. Provide one element or meter to measure total system flow for each hydronic system. In multiple chiller installations, provide meter or element for each chiller.
 5. At each chiller, for chilled water and condenser water.
- C. Differential Pressure Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.
- D. Install connection fittings for attachment to portable flow meters in readily accessible locations.
- E. Permanently Mounted Meters for Flow Elements: Install meters on walls or brackets in accessible locations.
- F. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.
- G. Portable Meters

1. Turn-over portable meters to the Owner upon completion of the project.

3.6 HVAC SYSTEM DRAIN AND FILL WATER METER INSTALLATION

- A. Meters shall be provided by the BAS contractor and installed in the piping systems by the mechanical contractor.
- B. Accessibility: All drain and fill meters shall be installed in accessible locations for maintenance.
- C. Drain Meters: Each drain meter must be installed in a trapped section of pipe to insure accurate flow readings.
- D. Coordinate with the BAS contractor for required interface with the existing BAS System.
- E. Provide unions and isolation valves for each water meter. See Division 23 Specification Section “Valves for HVAC Piping Systems” for required valves.
- F. Mechanical Requirements: See details on the mechanical and/or plumbing drawings for installation requirements.
- G. Electrical Requirements: See Electrical drawings for power requirements.

3.7 CONNECTIONS

- A. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance of thermometers, gauges, machines, and equipment.
- B. Install meters and gauges adjacent to machines and equipment to allow servicing and maintenance.
- C. Connect flow measuring system elements to meters.
- D. Connect flow meter transmitters to meters.
- E. Make electrical connections to power supply and electrically operated meters and devices.

3.8 ADJUSTING

- A. Adjust faces of thermometers and gauges to proper angle for best visibility.
- B. Calibrate meters according to manufacturer's written instructions, after installation.
- C. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.
- D. Cleaning: Clean windows of meters and gauges and factory finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 230519