

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Bimetallic-actuated thermometers
- 2. Thermowells.
- 3. Dial-type pressure gages.
- 4. Gage attachments.
- 5. Test plugs.
- 6. Sight flow indicators.
- 7. Flow Sensors.

- B. Related Sections:

- 1. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

[Retain first paragraph below if equipment includes wiring.](#)

- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.
- D. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft Inc.
 - 2. Trerice, H. O. Co., EI Series
 - 3. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Sealed types; stainless steel with 3-inch (76-mm) nominal diameter.
- D. External adjustment.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- G. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.
- H. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
- I. Window: Plain glass or plastic.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus or minus 1 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

ASME B40.200 uses the following symbols for thermowell materials: "CNR" for copper nickel (90-10), "CUNI" for copper nickel (70-30), "CRES" for corrosion-resistant steel, "NICU" for nickel copper, "ALBR" for aluminum bronze, and "CSA" for steel. Other materials are allowed.

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25.) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

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

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Trerice, H. O. Co.
 - d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 (DN 8 or DN 15) pipe threads.

- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Peterson Equipment Co., Inc.
 - 3. Trerice, H. O. Co.
 - 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dwyer Instruments, Inc.
 - 2. Emerson Process Management; Brooks Instrument.
 - 3. Ernst Co., John C., Inc.
 - 4. Ernst Flow Industries.
 - 5. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 125 psig (860 kPa).
- E. Minimum Temperature Rating: 200 deg F (93 deg C).
- F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2.8 HYDRONIC FLOW METERS – Standard Use

A. General

1. Certification: A certified calculation, for the maximum and minimum volume flow rates at working conditions of temperature, pressure, additive concentration, if present, and pressure shall be supplied.
2. Calibration: Calibration of the transmitter(s) shall be accomplished following NIST standards. A certification of conformance shall be submitted.
3. Where applicable, shall be able to measure and report bi-directional flow.
4. Range: selected and calibrated for operations between 0 and 110-125% of the maximum operating flow.
5. Accuracy including linearity, hysteresis and repeatability of the transmitter shall be better than 0.5% of the span.
6. Turndown: minimum of 15:1 or as specified for the expected operating range of the system.
7. Pressure limits: 150 psi minimum.
8. Temperature limits: 250 degrees minimum for heating and chilled water.
9. Meter enclosure classification: NEMA 4.
10. Junction Box Enclosure: NEMA 4.
11. Identification tag: rust-proof metal identification tag on a chain showing design flow rates, meter readings or differential pressure outputs at designed flow rates, metered fluid and line size.

B. NPS 12” and Smaller: Use Magnetic inductive flowmeter and amplifier for measuring the flow of conductive liquids, with flanged ends, suitable for in-line installation.

1. Meter Housing material: Carbon steel, welded.
2. Flanges: Carbon steel, ANSI B16.5 Class 150 raised face.
3. Pipe spool material: Type 316 stainless steel.
4. Electrode Material: Type 316 stainless steel.
5. Flowmeter liner:
 - a. Heating/Domestic Hot water: Teflon.
 - b. Chilled/Domestic Cold Water: Polyurethane.
 - c. Steam Condensate: Teflon to 300 degF, Ceramic over 300 degF as suitable for expected conditions.

C. NSP larger than 12”: Use Annular flow sensors.

1. Annular flow sensor: Type 316 stainless steel.

D. Amplifier: Microprocessor based with back-lit LCD display in enclosure suitable for remote wall mounting and with the following:

1. Digital and analog outputs.
2. Bi-directional flow sensing/totalization.
3. Automatic zero point stability.
4. Empty pipe detection.
5. 115VAC, 60HZ power supply.

- E. Flow Meter Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Meter - Standard Use
 - a. Siemens
 - b. Rosemount Division of Emerson Process Management
 - c. Yokogawa AXF
 - d. ABB
 - e. Onicon
 - 2. BTU Metering when specified:
 - a. Yokogawa AXF
- F. BTU (Energy) Calculator (when required)
 - 1. Acceptable Manufacturer:
 - a. Onicon System-10
 - 2. Communication requirements: Modbus TCP.
 - 3. Additional output: Analog output 4-20mA signal for water flow in gallons per minute.
 - 4. Temperature sensors: water supply and return sensor with stainless steel thermo wells.
- G. Warranty
 - 1. The supplier/manufacturer of the above specified equipment shall guarantee for twenty-four (24) months from equipment startup or thirty (30) months from date of shipment, whichever occurs first, that the equipment shall be free from defects in design, workmanship, or materials.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- 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.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- J. Install rising stem gate valve and syphon fitting in piping for each pressure gage for steam.
- K. Install a pressure gauge, with a pulsation damper and rising stem gate valve, in the condensate pump discharge piping.
- L. Install a single pressure gauge for each chilled water pump, condenser water pump, and hot water heating pump. Each gauge shall be installed with two minimum ½” sensor lines complete with thread-o-lets or soc-o-lets, nipples, brass body ball valves and reducers. One sensor line shall be connected to the pump discharge piping and the other to the suction piping.
- M. Install test plugs in piping tees.
- N. Install flow indicators in piping systems in accessible positions for easy viewing.
- O. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- P. Install flowmeter elements in accessible positions in piping systems.
- Q. Install wafer-orifice flowmeter elements between pipe flanges.
- R. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- S. Install permanent indicators on walls or brackets in accessible and readable positions.
- T. Install connection fittings in accessible locations for attachment to portable indicators.
- U. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic boiler.
 - 2. Two inlets and two outlets of each chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units.
 - 4. Two inlets and two outlets of each hydronic heat exchanger.
 - 5. Inlet and outlet of each thermal-storage tank.
 - 6. Outside-, return-, supply-, and mixed-air ducts.
 - 7. Entering and leaving sides of each heating and cooling coil in the air handling units.
 - 8. Hot deck and cold deck.
- V. Install pressure gages in the following locations:
 - 1. Inlet and discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.
- W. Install flow sensors in the following locations:

1. Chilled water and condenser water lines at chillers.
2. Hot water heating lines at convertors.
3. As indicated on the drawings.

X. Flow Meter Installation

1. The location of the components of the hydronic flow meter shall comply with the straight-run pipe upstream and downstream requirements recommended by the manufacturer(s).
2. The contractor shall comply with all erection and installation methods, techniques, sequence, and procedures requested by the manufacturer's representative.
3. All meters and ancillary equipment shall be installed in such a manner as to provide access for routine inspections, maintenance, and a means of removal.
4. Structural steel supports and miscellaneous steel required for supporting and/or anchoring meters and piping furnished under this standard shall be provided and installed in accordance with Division 5.
5. Inline flow meters shall be installed with upstream and downstream shutoff valves at each end of the metering run.
6. If the flow meter size is smaller than line size (if approved by Mechanical Engineer), the reducers must be on the meter sides of the shutoff valves such that the shutoff valves are line size. Eccentric reducers shall not be used at meter locations on the hydronic systems.
7. For BTU (Energy) meters, install manufacturer supplied temperature sensors according the manufacturer recommendations.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers for hydronic application shall be the following:
 1. Bimetallic-actuated thermometers.
- B. Thermometers for air-duct application shall be the following:
 1. Bimetallic-actuated thermometers.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).
- B. Scale Range for Condenser-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C).
- C. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C).
- D. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F (0 to 200 deg C).
- E. Scale Range for Air Ducts: Minus 40 to plus 110 deg F (Minus 40 to plus 45 deg C).

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled Water, Condenser Water, and Heating Hot Water Systems: 0 to twice the maximum service-fluid pressure expected.
- B. Scale Range for LP Steam System: 0 to 30 psi.
- C. Scale Range for MP Steam System: 0 to 60 psi.
- D. Scale Range for HP Steam System: 0 to 125 psi.
- E. Scale Range for Steam Condensate Return System: 0 to 50 psi.

3.7 FLOWMETER SCHEDULE

Meter Application	Provided by	Installed By	Wired By	Line Size in Inch	Flow Range in lbs/hr	Notes
Steam	MSU	Contractor	MSU			
Chilled Water	Contractor	Contractor	Contractor			
Domestic Water	MSU	Contractor	MSU			
Heating Hot Water	Contractor	Contractor	Contractor			
BTU Calculator	Contractor	Contractor	Contractor			MSU to wire network card
Condensate	MSU	Contractor	MSU	N/A	N/A	

END OF SECTION 230519