

## **SECTION 23 05 19 - 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. Thermometers.
  - 2. Gages.
  - 3. Test plugs.
  - 4. Flowmeters.
  - 5. Thermal-energy meters.
- B. Related Sections:
  - 1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

#### **1.3 DEFINITIONS**

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers gages flowmeters and thermal-energy meters indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer gage flowmeter and thermal-energy meter, signed by product manufacturer.
- D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in emergency, operation, and maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Palmer - Wahl Instruments Inc.
  - 2. Terice, H. O. Co.
  - 3. Weiss Instruments, Inc.
  - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 7 inches (178 mm) long.
- C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Rigid, straight type.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

### **2.2 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ernst Gage Co.
  - 2. Eugene Ernst Products Co.
  - 3. Marsh Bellofram.
  - 4. Miljoco Corp.
  - 5. Terice, H. O. Co.
  - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
  - 7. Winters Instruments.
- B. Case: Plastic, 7 inches (178 mm) long.
- C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Rigid, straight type

- G. Stem: Metal, for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

## **2.3 DUCT-TYPE, LIQUID-IN-GLASS THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Miljoco Corp.
  - 2. Palmer - Wahl Instruments Inc.
  - 3. Trerice, H. O. Co.
  - 4. Weiss Instruments, Inc.
- B. Case: Metal or plastic, 7 inches (178 mm) long.
- C. Tube: Red or blue reading, mercury or organic filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Rigid, angle type.
- G. Stem: Metal, for installation in mounting bracket and of length to suit installation.
- H. Mounting Bracket: Flanged fitting for attachment to duct and made to hold thermometer stem.
- I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

## **2.4 THERMOWELLS**

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

## **2.5 PRESSURE GAGES**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AMETEK, Inc.; U.S. Gauge Div.
  - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  - 3. Ernst Gage Co.
  - 4. Eugene Ernst Products Co.
  - 5. KOBOLD Instruments, Inc.
  - 6. Marsh Bellofram.
  - 7. Miljoco Corp.

8. Noshok, Inc.
  9. Palmer - Wahl Instruments Inc.
  10. REO TEMP Instrument Corporation.
  11. Terice, H. O. Co.
  12. Weiss Instruments, Inc.
  13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
  14. WIKA Instrument Corporation.
  15. Winters Instruments.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Liquid-filled type, drawn steel or cast aluminum plastic, 4-1/2-inch (114-mm) diameter.
  2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
  3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
  4. Movement: Mechanical, with link to pressure element and connection to pointer.
  5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
  6. Pointer: Red or other dark-color metal.
  7. Window: Glass or plastic.
  8. Ring: Metal or plastic.
  9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
  10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
  11. Range for Fluids under Pressure: Two times operating pressure.
- C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.
1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch (114-mm) diameter with holes for panel mounting.
  2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
  3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
  4. Movement: Mechanical, with link to pressure element and connection to pointer.
  5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
  6. Pointer: Red or other dark-color metal.
  7. Window: Glass or plastic.
  8. Ring: Metal or plastic.
  9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
  10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
  11. Range for Fluids under Pressure: Two times operating pressure.
- D. Pressure-Gage Fittings:
1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
  2. Syphons: NPS 1/4 (DN 8) coil of brass tubing with threaded ends.
  3. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

## 2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flow Design, Inc.
  2. MG Piping Products Co.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Co.
  6. Trerice, H. O. Co.
  7. Watts Industries, Inc.; Water Products Div.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200 deg F (minus 7 to plus 93 deg C) shall be CR.
  2. Insert material for air or water service at minus 30 to plus 275 deg F (minus 35 to plus 136 deg C) shall be EPDM.
- E. Test Kit: Furnish **one** test kit(s) containing one pressure gage and adaptor, **one** thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be 0 to 200 psig (0 to 1380 kPa).
  2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F (minus 4 to plus 52 deg C).
  3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F (minus 18 to plus 104 deg C).
  4. Carrying case shall have formed instrument padding.

## 2.7 WAFER-ORIFICE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ABB, Inc.; ABB Instrumentation.
  2. Armstrong Pumps, Inc.
  3. Badger Meter, Inc.; Industrial Div.
  4. Bell & Gossett; ITT Industries.
  5. Meriam Instruments Div.; Scott Fetzer Co.
- B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.

- C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
- D. Pressure Rating: 300 psig (2070 kPa).
- E. Temperature Rating: 250 deg F (121 deg C).
- F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (150-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
  - 1. Scale: Gallons per minute (Liters per second).
  - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- H. Operating Instructions: Include complete instructions with each flowmeter.

## **2.8 VENTURI FLOWMETERS**

- A. Allowable Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong Pumps, Inc.
  - 2. Badger Meter, Inc.; Industrial Div.
  - 3. Bailey-Fischer & Porter Co.
  - 4. Flow Design, Inc.
  - 5. Gerand Engineering Co.
  - 6. Hyspan Precision Products, Inc.
  - 7. Leeds & Northrup.
  - 8. McCrometer, Inc.
  - 9. Preso Meters Corporation.
  - 10. Victaulic Co. of America.
- B. Description: Differential-pressure design for installation in piping; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data.
- D. Pressure Rating: 250 psig (1725 kPa).
- E. Temperature Rating: 250 deg F (121 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 or welded.
- H. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.

- I. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (150-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
  - 1. Scale: Gallons per minute (Liters per second).
  - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- J. Operating Instructions: Include complete instructions with each flowmeter.

## **2.9 TURBINE FLOWMETERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Badger Meter, Inc.; Industrial Div.
  - 2. Bailey-Fischer & Porter Co.
  - 3. Data Industrial Corp.
  - 4. Engineering Measurements Company.
  - 5. ERDCO Engineering Corp.
  - 6. Fischer, George Inc.
  - 7. Hoffer Flow Controls, Inc.
  - 8. ISTECH Corporation.
  - 9. Midwest Instruments & Controls Corp.
  - 10. ONICON Incorporated.
  - 11. SeaMetrics Inc.
  - 12. Sponsler Company, Inc.
  - 13. Thermo Measurement Ltd.
  - 14. Venture Measurement.
- B. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute (liters per second).
- C. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and integral direct-reading scale.
- D. Pressure Rating: 150 psig (1035 kPa) minimum.
- E. Temperature Rating: 180 deg F (82 deg C) minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
- G. Accuracy: Plus or minus 2-1/2 percent.

## **2.10 PITOT-TUBE FLOWMETERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Dieterich Standard Inc.
  - 2. Meriam Instruments Div.; Scott Fetzer Co.
  - 3. Preso Meters Corporation.
  - 4. Taco, Inc.
  - 5. Veris Industries.

- B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute (liters per second).
- C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.
- D. Pressure Rating: 150 psig (1035 kPa) minimum.
- E. Temperature Rating: 250 deg F (121 deg C) minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
- G. Integral Transformer: For low-voltage power connection.
- H. Accuracy: Plus or minus 1 percent for liquids and gases.

## **2.11 FLOW INDICATORS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Brooks Instrument Div.; Emerson Electric Co.
  - 2. Dwyer Instruments, Inc.
  - 3. Ernst Gage Co.
  - 4. Eugene Ernst Products Co.
  - 5. McCrometer, Inc.
  - 6. OPW Engineered Systems; Dover Corp.
  - 7. Penberthy, Inc.
- B. Description: Instrument for installation in piping systems for visual verification of flow.
- C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator and threaded or flanged ends.
- D. Pressure Rating: 125 psig (860 kPa).
- E. 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.

## **2.12 INSERTION-TURBINE, THERMAL-ENERGY METER SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Data Industrial Corp.
  - 2. ONICON Incorporated.
  - 3. Thermo Measurement Ltd.



- B. Description: Flow sensor, strainer, two temperature sensors, transmitter, meter, and connecting wiring.
- C. Flow Sensor: Insertion-type turbine or paddle-wheel element with corrosion-resistant-metal body and transmitter.
  - 1. Pressure Rating: 125 psig (860 kPa) .
  - 2. Temperature Range: 40 to 250 deg F (5 to 121 deg C).
- D. Meter: Solid-state integrating type with integral battery pack.
  - 1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
  - 2. Accuracy: Plus or minus 1 percent.
  - 3. Battery Pack: Five-year lithium battery.
- E. Strainer: Full size of main line piping.

## **PART 3 - EXECUTION**

### **3.1 THERMOMETER APPLICATIONS**

- A. Install liquid-in-glass thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler and chiller.
  - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
  - 4. Inlet and outlet of each hydronic heat exchanger.
  - 5. Inlet and outlet of each hydronic heat-recovery unit.
  - 6. Inlet and outlet of each thermal storage tank.
  - 7. Outside-air, return-air, and mixed-air ducts.
- B. Install direct-mounting, vapor-actuated dial thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler and chiller.
  - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
  - 4. Inlet and outlet of each hydronic heat exchanger.
  - 5. Inlet and outlet of each hydronic heat-recovery unit.
  - 6. Inlet and outlet of each thermal storage tank.
- C. Install remote-mounting, vapor-actuated dial thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler and chiller.
  - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
  - 4. Inlet and outlet of each hydronic heat exchanger.
  - 5. Inlet and outlet of each hydronic heat-recovery unit.
  - 6. Inlet and outlet of each thermal storage tank.
- D. Install bimetallic-actuated dial thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler and chiller.
  - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.

4. Inlet and outlet of each hydronic heat exchanger.
  5. Inlet and outlet of each hydronic heat-recovery unit.
  6. Inlet and outlet of each thermal storage tank.
- E. Install liquid-filled-case-type, bimetallic-actuated dial thermometers at suction and discharge of each pump.
- F. Provide the following temperature ranges for thermometers:
1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions (Minus 1 to plus 115 deg C, with 1-degree scale divisions).
  2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions).
  3. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions (Minus 40 to plus 43 deg C, with 2-degree scale divisions).

### **3.2 GAGE APPLICATIONS**

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.
- C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

### **3.3 INSTALLATIONS**

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending a minimum of one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
- E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- F. Install remote-mounting pressure gages on panel.
- G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- H. Install needle-valve and syphon fitting in piping for each pressure gage for steam.
- I. Install test plugs in tees in piping.
- J. Install flow indicators, in accessible positions for easy viewing, in piping systems.

- K. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- L. Install flowmeter elements in accessible positions in piping systems.
- M. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- N. Install wafer-orifice flowmeter elements between pipe flanges.
- O. Install permanent indicators on walls or brackets in accessible and readable positions.
- P. Install connection fittings for attachment to portable indicators in accessible locations.
- Q. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- R. Assemble components and install thermal-energy meters.
- S. Mount meters on wall if accessible; if not, provide brackets to support meters.

### **3.4 CONNECTIONS**

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy-meter transmitters to meters.

### **3.5 ADJUSTING**

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

### **END OF SECTION**