

## SECTION 15135 - METERS AND GAUGES

## PART 1 GENERAL

## 1.1 DESCRIPTION OF WORK:

- A. Extent of meters and gauges required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of meters and gauges specified in this section include the following:
  - 1. Temperature Gauges and Fittings:
    - a. Glass Thermometers.
    - b. Remote Reading Dial Thermometers.
    - c. Dial Type Insertion Thermometers.
    - d. Photo Voltaic Digital Thermometers
    - e. Thermometer Wells.
    - f. Temperature Gauge Connector Plugs.
  - 2. Pressure Gauges and Fittings:
    - a. Pressure Gauges.
    - b. Pressure Gauge Cocks.
    - c. Pressure Gauge Connector Plugs.
  - 3. Flow Measuring Meters:
    - a. Venturi Tube Flow Measuring Elements.
    - b. Calibrated Balance Valves.
    - c. Portable Flow Meter Read-out Kits.
- C. Meters and gauges furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

## 1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of meters and gauges, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
  - 1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
  - 2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.
- C. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

## 1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
- B. All flow measuring devices to be provided shall be reviewed and approved by the test & balance contractor and the temperature control contractor for proper scale, rangeability and function prior to submitting shop drawings. The test & balance contractor and temperature control contractor shall provide a typed letter stating this review has been completed and included with shop drawing submittals.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data and product data in Maintenance Manual; in accordance with requirements of Division 15.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. Glass Thermometers:
    - a. Ernst Gauge Co.
    - b. Marshalltown Instruments, Inc.
    - c. Terice (H.O.) Co.
    - d. Weiss Instruments, Inc.
  - 2. Remote Reading Dial Thermometers:
    - a. Ametek/U.S. Gauge.
    - b. Marsh Instrument Co.; Unit of General Signal.
    - c. Terice (H.O.) Co.
    - d. Weiss Instruments, Inc.
    - e. Versa Gauge
  - 3. Photo Voltaic Digital Thermometers:
    - a. Versa Gauge
    - b. Weiss Instruments
  - 4. Dial Type Insertion Thermometers and Wells:
    - a. Marsh Instrument Co.; Unit of General Signal.
    - b. Taylor Instrument Co.
    - c. Terice (H.O.) Co.
    - d. Weiss Instruments, Inc.
  - 5. Temperature Gauge Connector Plugs:
    - a. Fairfax Company
    - b. Peterson Equipment Co.

- c. Universal Lancaster
  - d. Sisco
  - e. MG Piping Products Co.
6. Pressure Gauges:
- a. Ametek/U.S. Gauge.
  - b. Marsh Instrument Co.; Unit of General Signal.
  - c. Marshalltown Instruments, Inc.
  - d. Terice (H.O.) Co.
  - e. Weiss Instruments, Inc.
  - f. MG Piping Products Co.
  - g. Versa Gauge
7. Pressure Gauge Connector Plugs:
- a. Fairfax Company
  - b. Peterson Equipment Co.
  - c. Universal Lancaster
  - d. Sisco
  - e. MG Piping Products Co.
8. Venturi Tube Flow Measuring Elements:
- a. Gerand
  - b. Barco/Aeroquip Corp.
  - c. Presso
  - d. Flow Design Inc.
9. Calibrated Balancing Valves:
- a. Armstrong+
  - b. "Flowset" - Flow Design, Inc.
  - c. Presso.
  - d. Tour and Anderson, Inc.
  - e. Gerand "Balvalve Indicator"
  - f. Bell and Gossett (To Match Existing Only)

## 2.2 GLASS THERMOMETERS:

- A. General: Provide glass thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9 inches long.
- C. Adjustable Joint: Die cast aluminum, finished to match case, 180 degrees adjustment in vertical plane, 360 degrees adjustment in horizontal plane, with locking device.
- D. Tube and Capillary: Mercury filled, magnifying lens, 1 percent scale range accuracy, shock mounted.
- E. Scale: Satin faced, non-reflective aluminum, permanently etched markings.

- F. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation. Sampling tube type with duct flange for air duct installations.
- G. Range: Conform to the following:
  1. Hot Water: 30 degrees - 240 degrees F with 2 degrees F scale divisions (0 degrees - 160 degrees C) with 2 degrees C scale divisions).
  2. Chilled Water: 0 - 100 degrees F with 2 degrees F scale divisions (0 degrees - 100 degrees C with 1 degrees C scale divisions).
  3. Steam and Condensate: 50–400 degrees F with 2 degrees scale divisions (10-205 degrees C with 1 degrees scale divisions).
  4. Duct work: 0-160 degrees F with 2 degrees scale divisions.

### 2.3 PHOTO VOLTAIC DIGITAL THERMOMETERS:

- A. Case: High image ABS, with photovoltaic power cell and digital readout.
- B. Range: Selectable between -40-300 degrees F/ -40-150 degrees F, displayed to 0.1 degrees.
- C. Accuracy: 1 percent of reading or 1 degrees F, whichever is greater. Recalibratable via internal potentiometer. Not affected by ambient temperature.
- D. Ambient light required: 10 lux.
- E. Display update: 10 seconds.
- F. Stem: Compatibly with standard thermowell for piping applications, or sampling tube with flange for air duct applications.

### 2.4 REMOTE READING DIAL THERMOMETERS:

- A. General: Provide remote reading dial thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Type: Vapor tension.
- C. Case: Drawn steel or brass, glass lens, 4-1/2 inch diameter.
- D. Movement: Brass, precision geared.
- E. Tubing: Bronze double braided armor over copper capillary, length to suit installation.
- F. Bulb: Copper with separable socket for liquids, averaging element for air.
- G. Accuracy: + or - one scale division.
- H. Range: Conform to the following:
  1. Hot Water: 30 degree - 240 degree F (0 degree - 115 degree C).
  2. Chilled Water: 30 degree - 180 degree F (0 degree - 85 degree C).
  3. Air: 30 degree - 180 degree F (0 degree - 85 degree C).

### 2.5 DIAL TYPE INSERTION THERMOMETERS:

- A. General: Provide dial type insertion thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Type: Bi-metal, stainless steel case and stem, 1 inch diameter dial, dust and leak proof, 1/8 inch diameter stem with nominal length of 5 inch.
- C. Accuracy: 0.5 percent of dial range.

- D. Range: Conform to the following:
1. Hot Water: 0 degrees - 220 degrees F (-10 degrees - 110 degrees C).
  2. Chilled Water: 25 degrees - 125 degrees (-10 degrees - 110 degrees C).
- 2.6 THERMOMETER WELLS:
- A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2 inch extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.
- 2.7 TEMPERATURE GAUGE CONNECTOR PLUGS:
- A. General: Provide temperature gauge connector plugs pressure rated for 500 psi and 200 degrees F (93 degrees C). Construct of brass and finish in nickel-plate, equip with 1/2inch NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 inch O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.
- 2.8 PRESSURE GAUGES:
- A. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Type: General use, 1 percent accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection.
- C. Case: Drawn steel or brass, glass lens, 4-1/2inch diameter.
- D. Connector: Brass with 1/4inch male NPT. Provide protective syphon when used for steam service.
- E. Scale: White coated aluminum, with permanently etched markings.
- F. Range: Conform to the following:
1. Vacuum: 30 inches Hg - 15 psi.
  2. Water: 0 - 100 psi.
  3. Steam: 0 - 200 psi.
- 2.9 PRESSURE GAUGE COCKS:
- A. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Gauge cock shall be 1/4 inch female NPT on each end ball valve as specified in Section 15100 - Valves.
- B. Syphon: 1/4 inch straight coil constructed of brass tubing with 1/4 inch male NPT on each end.
- C. Snubber: 1/4 inch brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
- 2.10 VENTURI TUBE FLOW MEASURING ELEMENTS:
- A. Primary flow measuring elements shall consist of venturi tubes. Arrange piping in accordance with manufacturer's published literature. In horizontal pipes, place connections slightly above horizontal centerline of pipe.

- B. Provide each primary element with integral tab, or metal tag on stainless steel wire, extending outside pipe covering on which is stamped or clearly printed in plainly visible position the following information:
    - 1. Manufacturer's name and address.
    - 2. Serial number of meter to which element is to be connected.
    - 3. Name, number, or location of equipment served.
    - 4. Specified rate of flow.
    - 5. Multiplier (including unity, where applicable) to be applied to meter reading.
  - C. Provide taps with Schraeder or Hanson type fittings. Provide tap extensions to accommodate insulation.
  - D. Manufacturer shall certify venturi tubes for actual piping configuration. Any necessary piping changes required for certification shall be provided without cost to Owner. Insert type tubes may be furnished, provided they meet specification requirements in other respects.
  - E. Provide venturi with throat diameter such that specified rate of flow will register scale reading of between 20 percent and 80 percent of full scale value.
  - F. Venturi sizes and beta ratios shall be selected so that design flow rates shall read between 20 percent and the full scale range on a linear meter (e.g. between 10 inches and 50 inches on a 0-50 inches meter), with permanent pressure loss of not more than 25 percent of indicated flow rate differential pressure.
  - G. Provide venturi tubes of solid brass or bronze. Tubes larger than 2 inches shall have flanges or butt weld connections and may be cast iron or steel. Steel tubes may be fabricated or cast with cadmium or zinc-plating. Line throats of cast iron tubes with bronze and plate cast iron portion with cadmium.
  - H. Tubes shall be calibrated and tested by independent testing laboratory and performance data furnished with shop drawings.
  - I. Connections for attachment to portable flow meter hoses shall be readily accessible.
- 2.11 CALIBRATED BALANCE VALVES:
- A. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout port with a quick connect valve designed to minimize system fluid loss during monitoring process. Provide balance valves with preformed insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.
  - B. Design, variable orifice type:
    - 1. Globe-type valve.
    - 2. Multiple turns of handwheel from full closed to full open.
    - 3. Bubble-tight shut-off.
    - 4. Schraeder type taps upstream and downstream.
    - 5. Memory stop device to allow valve to be returned to balanced position after being closed.
    - 6. Provide slide rule type flow calculator, include in Operation and Maintenance Manual.
  - C. Design, valve and venturi type:

1. Ball or butterfly type valve.
2. Bubble-tight shut-off.
3. Fixed venturi, upstream of valve.
4. Schraeder type taps on venturi, upstream and downstream.
5. Memory stop device to allow valve to be returned to balanced position after being closed.
6. Provide metal tag with flow curve for each valve.

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| EDIT NOTE: Choose A, B, and C above OR D below: |
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- D. Match Owner's existing balance valves.

#### 2.12 FLOW METER READ-OUT KITS:

- A. Provide flow meter read-out kits with bellows type differential pressure element and minimum 5 inch diameter indicating dial.
- B. Design pressure elements for full scale pressure differential of 50 inches or 100 inches water gauge. Design shall incorporate rupture-proof metal beryllium or stainless steel bellows and torque tube drive requiring no lubrication. Design forged bodies for not less than 150 percent of maximum surge pressure, fully protected against surges, with full provision for venting and draining. Provide integral, adjustable pulsation dampers.
- C. Dials of portable meters shall have square root scales not less than 12 inches in developed length. Dials shall read from 0 to 10 gpm to which multiplier is to be applied, as required; also provide with uniform scale reading from 0 inches to 10 inches w.g., to which multiplier of 10 to be applied (100 inches at full scale), or from 0 inches to 5 inches w.g., to which multiplier of 10 is to be applied (50 inches at full scale).
- D. Engineer and manufacture in accordance with ASME recommendations for flowmeters. Provide portable meters with overall accuracy of + 5 percent.
- E. Provide flow meter with factory-fabricated carrying case with integral carrying handle. Case shall be fitted to hold meter and following accessories.
  1. Two 10 feet lengths of connecting hose with suitable female connectors for connecting to venturi tube pressure tap nipples. Design hose for operating pressure of minimum of 150 percent of maximum system operating pressure.
  2. Completely assembled 3-value manifold with 2 block valves and vent and drain valves shall be piped and mounted on base, which shall be designed for use laying flat on stationary base.
  3. Bound set of descriptive bulletins, installation and operating instructions, parts list, and set of curves showing flow verses pressure differential for each orifice or venturi tube with which meter is to be used.
  4. Metal instruction plate, secured inside cover, illustrating use of meter. Deliver meter with case to Owner.

### PART 3 EXECUTION

#### 3.1 INSPECTION:

- A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.2 INSTALLATION OF THERMOMETERS:

- A. General: Install thermometers in vertical upright position, and tilted so as to be easily read by observer standing on floor.
- B. Application of Thermometers:
  - 1. Use glass thermometers in the following locations:
    - a.
    - b.
    - c.
  - 2. Use photo voltaic thermometers in the following locations:
    - a.
    - b.
    - c.
- C. Locations: Install in the following locations, and elsewhere as indicated:

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| NOTE: COORDINATE WITH DETAILS |
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| <ul style="list-style-type: none"> <li>1. At inlet and outlet of each hydronic zone.</li> <li>2. At inlet and outlet of each hydronic boiler and chiller.</li> <li>3. At inlet and outlet of each hydronic coil in air handling units, and built-up central systems.</li> <li>4. At inlet and outlet of each hydronic heat exchanger.</li> <li>5. At inlet and outlet of each hydronic heat recovery unit.</li> <li>6. At inlet and outlet of each thermal storage tank.</li> <li>7. In discharge duct or plenum of air handling units and built-up central systems.</li> </ul> |
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| EDIT NOTE: Show remote thermometers on plans, or specify locations. Where needed, this function is typically met by digital readouts from the BAS on buildings with DDC. |
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- D. Remote Reading Dial Thermometers: Install on control panels as indicated. Run tubing between panel and thermometer bulb, adequately supported to prevent kinks. Select tubing length so as to not require coiling of tubing.
  - E. Thermometer Wells: Install in piping tee where indicated, in vertical upright position. Fill well with oil or graphite, secure cap.
  - F. Temperature Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap. Provide portable temperature gauge for each plug connection.
- ### 3.3 INSTALLATION OF PRESSURE GAUGES:
- A. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.

- B. Locations: Install in the following locations, and elsewhere as indicated:

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| NOTE: COORDINATE WITH DETAILS |
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1. At suction and discharge of each pump.
2. At discharge of each pressure reducing valve.
3. At water service outlet.
4. At inlet and outlet of water cooled condensers and refrigerant cooled chillers.

- C. Pressure Gauge Cocks: Install in piping tee with snubber. Install syphon for steam pressure gauges.

- D. Pressure Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap. Provide portable pressure gauge for each plug connection.

### 3.4 INSTALLATION OF FLOW MEASURING METERS:

- A. General: Install flow measuring meters on piping systems located in accessible locations at most readable position.

- B. Locations: Install in the following locations, and elsewhere as indicated.

1. At discharge of each pump.
2. At inlet of each hydronic coil.

- C. Wafer-Type Flow Meters: Install between 2 Class 125 pipe flanges, ANSI B16.1 (cast-iron) or ANSI B16.24 (cast- bronze). Provide minimum straight lengths of pipe upstream and downstream from meter in accordance with manufacturer's installation instructions.

- D. Calibrated Balance Valves: Install on piping with readout valves in vertical upright position. Maintain minimum length of straight unrestricted piping equivalent to 3 pipe diameters upstream of valve.

### 3.5 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

- B. Cleaning: Clean windows of meters and gauges and factory- finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION 15135