SECTION 230519 METERS AND GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following meters and gauges for mechanical systems:

1. Thermometers.
2. Gauges.
3. Test plugs.
4. Flowmeters.
5. Flow Totalizer for Make-up Water.

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, gauges, flowmeters, and thermal-energy meters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gauge, 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 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
5. Or approved equivalent.

B. Case: Die-cast aluminum, 7 inches long.

C. Tube: Red or blue reading, 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: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

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.

2.3 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. KOBOLD Instruments, Inc.
3. Marsh Bellofram.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Or approved equivalent.

B. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Metal or plastic.

I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. 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 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H. O. Co.
9. Weiss Instruments, Inc.
10. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
11. Winters Instruments.
12. Or approved equivalent.

B. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with for panel mounting.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Metal.

I. Connector: Bottom union type.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.5 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Ernst Gauge Co.
3. Eugene Ernst Products Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equivalent.

B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

C. Case: Liquid-filled type, stainless steel with 5-inch diameter.

D. Element: Bimetal coil.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Stainless steel.

I. Connector: Adjustable angle type.

J. Stem: Metal, for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.6 THERMOWELLS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gauge Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equivalent.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.7 PRESSURE GAUGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gauge 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. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equivalent.

B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.

3. Pressure Connection: Brass, NPS 1/4, 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 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.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Direct or Remote-Mounting, Dial-Type Pressure Gauges: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, 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 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.
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gauge Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.8 TEST PLUGS

A. Manufacturers:

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.
8. Or approved equivalent.

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.

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 shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gauge and adaptor, two thermometer(s), and carrying case. Pressure gauge, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gauge: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- Insert other diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

2.9 INSERTION, ELECTROMAGNETIC FLOWMETER

A. Manufacturers:
1. Onicon F3500.
2. Or approved equivalent.

B. Description: Provide an insertion electromagnetic flowmeter complete with NIST traceable, wet calibrated flow-measuring element, integral transmitter, installation valves, installation depth gauge and calibration certificate. Flowmeter shall be wet tappable, allowing insertion and removal from the flow stream without system shutdown.

C. Application Range: This contractor shall be responsible for selecting the flowmeter options submitted based on the application, refer to section for 230519.3.4 “Flowmeter Schedule by Application.” Flowmeter shall be constructed, calibrated, and scaled for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid characteristics which include but are not limited to pressure, temperature, conductivity, and viscosity.

D. Sensing Technology: Electromagnetic velocity-measuring element.

E. Design: Electromagnetic sensing element shall utilize two sets of diametrically opposed electrodes to measure the average flow rate velocity.

F. Construction: Wetted components shall be constructed of 316L stainless steel with attached tag indicating calibration information.

G. Maximum Pressure Rating: 400 psig.

H. Maximum Temperature Rating: 200 deg F.

I. End Connections for NPS 1.25" and Larger: 1" Male NPT Hot Tap Adapter fitting. Installation through 1" full port isolation valve, minimum.

J. Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served.

K. Accuracy: Flowmeter shall provide calibrated outputs directly from the integral transmitter, throughout the operating range with the accuracy stated as follows:
1. Plus or minus 1.0% of rate from 2.0 to 20.0 ft/sec velocity (10:1 turndown).
2. Plus or minus 0.02 ft/sec below 2 ft / sec

L. Calibration: Each flowmeter shall receive a wet calibration, within the expected operating range, against a primary volumetric standard that is traceable to NIST.

M. Optional Local Display: Local display shall provide instantaneous flow rate information and totalized flow information and shall be factory configured for connection to a specific flowmeter.

N. Operating and Installation Instructions: Installation and operating instructions shall be provided for each flowmeter. Refer to section 230519.3.4 "Flowmeter Schedule by Application" for additional installation requirements.

O. Warranty: Each flowmeter shall be covered by the manufacturer's three-year warranty.

2.10 CLAMP-ON, ULTRASONIC FLOW METER

A. Manufacturers:
1. Onicon F4300.
2. Or approved equivalent.

B. Description: Provide a clamp-on transit time ultrasonic flowmeter complete with matched transducers, self- aligning installation hardware and triaxial transducer cables and calibration certificate.

C. Application: This contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be constructed, calibrated, and scaled for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid characteristics which include but are not limited to pressure, temperature and viscosity.

D. Design: Flowmeter shall consist of a processor / transmitter, matched pair of transducers and mounting hardware including pipe clamps and mounting bracket for the line size and material specified.

E. Sensing Technology: Ultrasonic transit time velocity-measurement utilizing non-wetted transducers matched for the specific applications in terms of pipe size and pipe material.

F. Enclosure: Wall mount, NEMA4X polycarbonate with clear shatterproof enclosure

G. Mounting Connections: For NPS 1/2" and larger

H. Ratings:

I. Maximum Pressure Rating: N/A

J. Maximum Temperature Rating: 250 deg F

K. Operation and Configuration:

L. Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served.

M. Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:

N. Plus or minus 1.0% of flow rate from 1 to 20 ft/sec velocity.

O. Calibration: Each flow meter shall be individually calibrated against a N.I.S.T. traceable standard and receive a certificate of calibration. Each flow meter shall be factory programmed based on the application data specified at time of order.

P. Transmitter and Display: Provide an operator interface consisting of five push-buttons. Display shall visually indicate instantaneous flow rate and total fluid volume. Output signals shall be RS485 serial network protocol, BACnet MS/TP or MODBUS RTU, native to the transmitter, two (2) programmable pulse outputs configured for totalizing pulse, flow direction or flow alarm indication and one (1) analog output signal.

Q. Options: Flow meter shall be capable of operating from 24V ac/dc or 120V ac mains power.

R. Listings and Certifications: Meter shall have CE approval.

S. Operating and Installation Instructions: Installation and operating instructions shall be provided for each flowmeter.

T. Warranty: Each flowmeter shall be covered by the manufacturer’s three-year warranty.

2.11 FLOW INDICATORS

A. Manufacturers:

1. Brooks Instrument Div.; Emerson Electric Co.
2. Dwyer Instruments, Inc.
3. Ernst Gauge Co.
4. Eugene Ernst Products Co.
5. McCrometer, Inc.
6. OPW Engineered Systems; Dover Corp.
7. Penberthy, Inc.
8. Or approved equivalent.

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.

E. Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.12 FLOW TOTALIZER FOR MAKE-UP WATER

A. Manufacturers:

1. Omega.
2. Arma-tex.
3. KEP.
4. Or approved equivalent.

B. Description: Long-life pulse output water meter for remote rate indication and totalization. Meter shall include the following factory features:

1. Strainer(s).
2. Locking nuts.
3. Gaskets.
4. Coupling pieces.
5. Five (5) feet of 3-conductor copper wire.

C. Accuracy: From 10% of continuous to maximum flow: ±1.5% of rate; below 10% of continuous flow: 2% of rate.

D. Fluid Temperature Range: 32 to 190 deg F.

E. Pressure Drop (@ Continuous Flow): 2.9 PSI

F. Maximum Pressure: 150 PSIG

G. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.

H. Additional Requirements:

1. The flow totalizer shall be packaged with a remote rate meter/totalizer. Remote rate meter/totalizer shall have a field-determined final installation location. The rate meter/totalizer shall have high and low setpoints for alarm to the direct digital control system. Provide all required communication equipment for integration of signal to direct digital control system.

    a. Communication and control may be accomplished via RS232 output, analog output (scaleable) of 4 to 20 mA, 0 to 20 mA or 0 to 10V.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each hydronic zone or equipment as noted on plans.

B. Install liquid-filled-case-type, bimetallic-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
3. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
4. Condenser Water: 0 to 160 deg F, with 2-degree scale divisions.
5. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
6. Glycol: 0 to 160 deg F, with 2-degree scale divisions.
7. Steam and Condensate: 30 to 300 deg F, with 5-degree scale divisions.
8. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.2 GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gauges at chilled- and condenser-water inlets and outlets of chillers.

C. Install dry-case-type pressure gauges 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 to center of pipe and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

E. Install remote-mounting pressure gauges on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gauge for fluids (except steam).

G. Install needle-valve and syphon fitting in piping for each pressure gauge for steam.

H. Install test plugs in tees in piping.

I. Install flow indicators, in accessible positions for easy viewing, in piping systems.

J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

K. Install flowmeter elements in accessible positions in piping systems.

L. 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.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings for attachment to portable indicators in accessible locations.

O. Install flowmeters at discharge of hydronic system pumps or as shown on dwgs.

P. Assemble components and install thermal-energy meters.

Q. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy-meter transmitters to meters.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION 230519