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**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:

- 1. Bimetallic-actuated thermometers.
- 2. Filled-system thermometers.
- 3. Liquid-in-glass thermometers.
- 4. Light-activated thermometers.
- 5. Thermowells.
- 6. Dial-type pressure gages.
- 7. Gage attachments.
- 8. Test plugs.
- 9. Test-plug kits.
- 10. Sight flow indicators.

- B. Related Sections:

- 1. Division 21 Section "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
- 2. Division 21 fire-suppression piping Sections for fire-protection pressure gages.
- 3. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
- 4. Division 22 Section "Domestic Water Piping" for water meters inside the building.

**1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gage, from manufacturer.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

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**2.01 BIMETALLIC-ACTUATED 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Ashcroft Inc.
  - 2. Ernst Flow Industries.
  - 3. Marsh Bellofram.
  - 4. Miljoco Corporation.
  - 5. Nanmac Corporation.
  - 6. Noshok.
  - 7. Palmer Wahl Instrumentation Group.
  - 8. REOTEMP Instrument Corporation.
  - 9. Tel-Tru Manufacturing Company.
  - 10. Terice, H. O. Co.
  - 11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 12. Weiss Instruments, Inc.
  - 13. WIKA Instrument Corporation - USA.
  - 14. Winters Instruments - U.S.
- C. Standard: ASME B40.200.
- D. Case: Liquid-filled type(s); stainless steel with 3-inch (76-mm) or 5-inch (127-mm) nominal diameter.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C).
- 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.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus or minus 1 percent of scale range.

**2.02 FILLED-SYSTEM THERMOMETERS**

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

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1. 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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Ashcroft Inc.
  - b. Marsh Bellofram.
  - c. Miljoco Corporation.
  - d. Palmer Wahl Instrumentation Group.
  - e. REOTEMP Instrument Corporation.
  - f. Trerice, H. O. Co.
  - g. Weiss Instruments, Inc.
3. Standard: ASME B40.200.
4. Case: Sealed type, cast aluminum or drawn steel 4-1-1/2-inch (114-mm).
5. Element: Bourdon tube or other type of pressure element.
6. Movement: Mechanical dampening type, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
12. 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.
13. Accuracy: Plus or minus 1 percent of scale range.
- B. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
  1. 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:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. AMETEK, Inc.; U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Marsh Bellofram.
    - d. Miljoco Corporation.
    - e. Palmer Wahl Instrumentation Group.
    - f. REOTEMP Instrument Corporation.
    - g. Trerice, H. O. Co.
    - h. Weiss Instruments, Inc.
    - i. WIKA Instrument Corporation - USA.
  3. Standard: ASME B40.200.
  4. Case: Sealed type, cast aluminum or drawn steel 4-1/2-inch (114-mm) nominal diameter with back flange and holes for panel mounting.

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5. Element: Bourdon tube or other type of pressure element.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Connector Type(s): Union joint, back or bottom; with ASME B1.1 screw threads.
12. 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.
13. Accuracy: Plus or minus 1 percent of scale range.

**2.03 LIQUID-IN-GLASS THERMOMETERS**

**A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:**

1. 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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Terice, H. O. Co.
3. Standard: ASME B40.200.
4. Case: Cast aluminum; 6-inch (152-mm) nominal size.
5. Case Form: Back angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
8. Window: Glass or plastic.
9. Stem: Aluminum or brass and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

**B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:**

1. 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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings; or comparable product by one of the following:
  - a. Flo Fab Inc.
  - b. Miljoco Corporation.
  - c. Palmer Wahl Instrumentation Group.

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- d. Tel-Tru Manufacturing Company.
  - e. Trerice, H. O. Co.
  - f. Weiss Instruments, Inc.
  - g. Winters Instruments - U.S.
- 
- 3. Standard: ASME B40.200.
  - 4. Case: Cast aluminum, 7-inch (178-mm) nominal size unless otherwise indicated.
  - 5. Case Form: Adjustable angle unless otherwise indicated.
  - 6. Tube: Glass with magnifying lens and blue or red organic liquid.
  - 7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
  - 8. Window: Glass.
  - 9. Stem: Aluminum and of length to suit installation.
- 
- a. Design for Thermowell Installation: Bare stem.
- 
- 10. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
  - 11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

**2.04 THERMOWELLS**

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 or CSA.
- 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.

**2.05 PRESSURE GAGES**

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

- 1. 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:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

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- a. AMETEK, Inc.; U.S. Gauge.
- b. Ashcroft Inc.
- c. Ernst Flow Industries.
- d. Flo Fab Inc.
- e. Marsh Bellofram.
- f. Miljoco Corporation.
- g. Noshok.
- h. Palmer Wahl Instrumentation Group.
- i. REOTEMP Instrument Corporation.
- j. Tel-Tru Manufacturing Company.
- k. Trerice, H. O. Co.
- l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- m. Weiss Instruments, Inc.
- n. WIKA Instrument Corporation - USA.
- o. Winters Instruments - U.S.

- 3. Standard: ASME B40.100.
- 4. Case: Liquid-filled; cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
- 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 6. Pressure Connection: Brass, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 7. Movement: Mechanical, with link to pressure element and connection to pointer.
- 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
- 9. Pointer: Dark-colored metal.
- 10. Window: Glass.
- 11. Ring: Stainless steel.
- 12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

**B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Ernst Flow Industries.
  - d. Flo Fab Inc.
  - e. Marsh Bellofram.
  - f. Miljoco Corporation.
  - g. Noshok.
  - h. Palmer Wahl Instrumentation Group.
  - i. REOTEMP Instrument Corporation.
  - j. Tel-Tru Manufacturing Company.
  - k. Trerice, H. O. Co.
  - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - m. Weiss Instruments, Inc.
  - n. WIKA Instrument Corporation - USA.
  - o. Winters Instruments - U.S.
- 3. Standard: ASME B40.100.

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4. Case: Liquid-filled type; cast aluminum, drawn steel or metal; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter with back flange and holes for panel mounting.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. 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.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass.
11. Ring: Stainless steel.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

**2.06 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 or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

**2.07 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
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Flow Design, Inc.
  2. Miljoco Corporation.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Company, Inc.
  6. Trerice, H. O. Co.
  7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  8. Weiss Instruments, Inc.
- C. Description: Test-station fitting made for insertion into piping tee fitting.
- D. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- E. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
- F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

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- G. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

**2.08 TEST-PLUG KITS**

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Flow Design, Inc.
  2. Miljoco Corporation.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Company, Inc.
  6. Trerice, H. O. Co.
  7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  8. Weiss Instruments, Inc.
- C. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- D. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C)
- E. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C)
- F. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
- G. Carrying Case: Metal or plastic, with formed instrument padding.

**2.01 SIGHT 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Archon Industries, Inc.
  2. Dwyer Instruments, Inc.
  3. Emerson Process Management; Brooks Instrument.
  4. Ernst Co., John C., Inc.
  5. Ernst Flow Industries.
  6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.



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- 7. OPW Engineered Systems; a Dover company.
- 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
- C. Description: Piping inline-installation device for visual verification of flow.
- D. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- E. Minimum Pressure Rating: 125 psig (860 kPa).
- F. Minimum Temperature Rating: 200 deg F (93 deg C).
- G. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- H. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

**PART 3 - EXECUTION**

**3.01 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 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.
- 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.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Inlets and outlets of each domestic water heat exchanger.
  - 3. Inlet and outlet of each domestic hot-water storage tank.
  - 4. Inlet and outlet of each remote domestic water chiller.

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- L. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.

**3.02 CONNECTIONS**

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

**3.03 ADJUSTING**

- A. Adjust faces of meters and gages to proper angle for best visibility.

**3.04 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
  - 1. Liquid-filled, bimetallic-actuated type.
  - 2. Direct-mounted, metal-case, vapor-actuated type.
  - 3. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
  - 1. Liquid-filled, bimetallic-actuated type.
  - 2. Direct-mounted, metal-case, vapor-actuated type.
  - 3. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
  - 1. Liquid-filled, bimetallic-actuated type.
  - 2. Direct-mounted, plastic-case, vapor-actuated type.
  - 3. Industrial-style, liquid-in-glass type.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
  - 1. Liquid-filled, bimetallic-actuated type.
  - 2. Direct-mounted, metal-case, vapor-actuated type.
  - 3. Industrial-style, liquid-in-glass type.
- E. Thermometer stems shall be of length to match thermowell insertion length.

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**3.05 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.
- C. Scale Range for Domestic Cooled-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

**3.06 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at discharge of each water service into building shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.

**3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Water Service Piping: 0 to 200 psi and 0 to 1400 kPa.
- B. Scale Range for Domestic Water Piping: 0 to 200 psi and 0 to 1400 kPa.

**\*\* END OF SECTION \*\***