SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART I – 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.

B. Section(s) 23 09 13 – Instrumentation and Control Devices for HVAC (and companion sections)

C. Section 23 20 13 – Hydronic Piping

D. Section 23 22 13 – Steam and Condensate Piping

1.2 SUMMARY

A. This section includes the following:
   1. Thermometers
   2. Pressure Gauges
   3. Pressure/Temperature (P/T) Plugs
   4. Venturi Flow Elements

2.2 DEFINITIONS

A. Manufacturers: In Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Basis of Design: Products indicated by manufacturer and model within the contract documents are considered the Basis of Design. This includes plan drawings, drawing details, schedules, specifications, etc. Subject to compliance with requirements, provide the basis of design products unless the manufacturer provisions (below) or substitution provisions within the contract documents are complied with.

   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified. Non basis of design products which are listed by manufacturer name only may be considered for bid. By submitting a bid based on a non-basis of design product, the contractor acknowledges performance of a comprehensive review of the collateral impacts to themselves and to other trades. Contractor use of non-basis of design products shall not be the basis for additional time of costs to the Owner.

   3. Non-listed Products: Subject to compliance with requirements, Products not indicated within the Contract Documents shall not be used unless positively reviewed within a substitution request.

B. Abbreviations:
   1. %: Percent.
   3. ASME: The American Society of Mechanical Engineers.
   4. E.g.: Exempli gratia “for example.”
   5. Etc.: Et cetera “and other similar things”
   6. F: Degrees Fahrenheit.
   7. FPS: Feet per second.

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8. FT or ‘: Feet.
10. In or ": Inches.
11. NPT: National pipe thread.
12. PSC: Professional Service Consultant such as engineer, architect, etc.
13. PSIG: Pounds-per square-inch gauge pressure.
15. UIUC or U of I: The University of Illinois at Urbana-Champaign.

1.3 REFERENCES
A. ASME Standard B40.100 – Pressure Gauges and Gauge Attachments
B. ASME Standard B40.200 – Thermometers, Direct Reading and Remote Reading

1.4 QUALITY ASSURANCE
A. Products and execution shall be in compliance with applicable codes and standards including those referenced above in paragraph entitled REFERENCES
B. Installation and operation shall be in compliance with Manufacturer’s recommendations, requirements, and installation, operations, and maintenance manuals.
C. SUBMITTALS
1. Manufacturer’s data
2. Detailed specifications
3. Dimensioned drawings
4. Selection guide
5. Project application schedule
6. Installation, operation and maintenance manual

PART 2 - PRODUCTS
2.2 STEM TYPE THERMOMETERS FOR PIPELINE AND TANK MOUNTING

[Note to PSC: Thermometers are to be provided at major systems, equipment, and where project requirements may dictate. For example, thermometers are needed at heat transfer devices such as heat exchangers, convectors, and air-handling unit coils but not at pressure devices such as pumps. Thermometers are to be provided at central station equipment but typically not at small unitary and terminal units such as terminal reheat coils, finned tube units, fan coil units and cabinet unit heaters. P/T plugs are typically adequate to serve these smaller units.]

[Note to PSC: It has been the experience of the University that thermometers typically used in the HVAC industry are often inaccurate “out of the box” or lose their accuracy over the life of the instrument. It is the general disposition of the University that, bimetallic dial thermometers are easier to read but do not hold their accuracy as well as liquid-in-glass types. The liquid-in-glass thermometers are difficult to read. Therefore, the liquid-in-glass thermometer is the thermometer of preference for standard HVAC applications. In locations where visibility is challenging, bimetallic dial type may be provided. Such determination is to be made in coordination with the UIUC project team. When utilizing more than one thermometer type, it will be necessary to provide clear direction to the Contractor regarding the application and location of each type.]

A. Liquid-in-Glass Thermometer
1. Case: Cast aluminum
2. Lens
   a. Acrylic, polycarbonate or glass for ranges to 300-degrees-F
   b. Glass for ranges over 300-degrees-F

3. Scale: 9”

4. Accuracy: 1 scale division

5. Stem configuration
   a. Fully adjustable in multiple planes
   b. Extended as required to clear insulation

6. Stem length
   a. Pipe application: Insertion to approximate midpoint of pipe but no less than 1/3-pipe diameter
   b. Tank application: Minimum insertion length of 5”

7. Thermowell
   a. Brass or stainless steel construction as appropriate for process fluid. Rated for 27-FPS fluid velocity
   b. With “lagging extension” for insulated piping
   c. With flange for duct mounting

8. Temperature range: Selected for normal reading near center of scale, for example...
   a. Chilled water: 0-100-degrees-F
   b. Condenser water: 0-160-degrees-F
   c. Heating hot water: 30-240-degrees-F
   d. Steam condensate: 30-300-degrees-F
   e. Steam, low pressure: 50-300-degrees-F
   f. Steam, medium-high pressure: 50-500-degrees-F

9. Manufacturers
   a. Ashcroft
   b. Trerice
   c. Reotemp
   d. Wika
   e. Wexler

B. Bimetallic Dial Thermometer
   1. Case and ring: Hermetically sealed stainless steel, 5”
   2. Lens: Anti-parallax glass
   3. Dial face: Aluminum
   4. Accuracy: 1 scale division, field re-calibrate-able
   5. Connection: 1/2” NPT stainless steel
   6. Stem: 1/4” stainless steel
   7. Bracket
      a. Fully adjustable in multiple planes
8. Extended as required to clear insulation

9. Stem length
   a. Pipe application: Insertion to approximate midpoint of pipe but no less than 1/3-diameter of pipe

10. Tank application: Minimum insertion length of 5"

11. Thermowell:
   a. Brass or stainless steel construction as appropriate for process fluid. Rated for 27-FPS fluid velocity
   b. With "lagging extension" for insulated piping
   c. With flange for duct mounting

12. Temperature range: Selected for normal reading near center of scale, for example...
   a. Chilled water: 0-100-degrees-F
   b. Condenser water: 0-160-degrees-F
   c. Heating hot water: 30-240-degrees-F
   d. Steam condensate: 30-300-degrees-F
   e. Steam, low pressure: 50-300-degrees-F
   f. Steam, medium-high pressure: 50-500-degrees-F

13. Manufacturers
   a. Ashcroft
   b. Trerice
   c. Reotemp
   d. Wika
   e. Wexler

2.3 PRESSURE GAUGES FOR HVAC APPLICATIONS

[Note to PSC – Commercial grade “contractor gauges” are typically specified for HVAC applications. It has been the experience of the University that these gauges rarely maintain proper calibration and typically fail prematurely. This false information can cause challenges in operation and maintenance. Thus, the University requires that higher quality gauges be specified. These come at a higher price. To offset this cost, the University recommends that gauges be installed only where they are truly needed. For example, pressure gauges may be provided at major systems, equipment, and where project requirements may dictate, but typically not at small unitary and terminal units such as terminal reheat coils, finned tube units, fan coil units and cabinet unit heaters. P/T plugs are typically adequate to serve these smaller units.]

A. Pressure Gauge for Hydronic and Steam Applications
   1. ANSI Grade 1A (±1% of span)
   2. 4-1/2” dial
   3. 1/4” NPT lower connection
   4. Weather-proof stainless steel or polypropylene case
   5. Stainless steel or polypropylene ring
   6. Laminated safety glass or acrylic window
   7. Stainless steel movement
8. Bronze tube and brass socket
9. Micro-adjustable knife edge pointer
10. Glycerin liquid filled
   a. Hydronic, compressed air and gas applications, 0-250-degrees-F
11. Dry type
   a. Applications above or below this temperature range
   b. Steam applications
12. Pressure range: Selected for reading near center of scale, for example:
   a. Chilled water, central: 0-160-PSIG
   b. Chilled water, dedicated: 0-100-PSIG
   c. Condenser water: 0-100-PSIG
   d. Heating hot water: 0-100-PSIG
   e. Steam, high pressure: 0-300-PSIG
   f. Steam, medium pressure: 0-100-PSIG
   g. Steam, low pressure: 0-30-PSIG
   h. Steam pumped condensate: 0-100-PSIG
13. Manufacturers
   a. Ashcroft
   b. Trerice
   c. Reotemp
   d. Wika
   e. Wexler

B. Pressure Gauge for Air Applications
1. Die cast aluminum case and bezel with acrylic cover
2. 4” dial face
3. Accuracy: ±2% full scale
4. 1/8” female NPT duplicate high and low pressure taps
5. Adjustable signal pointer
6. Pressure range: Selected for reading near center of scale
7. Stand-off mounting bracket as required to accommodate insulation
8. Duct connector and tubing kit
9. Basis of Design
   a. Dwyer / Series 2000 Magnehelic

2.4 PRESSURE/TEMPERATURE TEST PLUGS
A. P/T Test Plug
1. 1/4” or 1/2” brass body and cap
2. Body length:
   a. 1-1/2” for uninsulated piping applications
2.5 VENTURI FLOW ELEMENT

[Note to PSC: As stated elsewhere within these Standards, Proportional balancing of constant flow hydronic systems is required. Balancing of any constant-flow sub-system within a variable flow system is also required. Manual balancing of variable flow systems with two-way control valves is typically not required and thus is discouraged. Variable flow systems are essentially “self-balancing”. Optimal control is maintained as flow rate is governed by modulating control valves rather than static system components. Exceptions exist, such as stacked coils within an AHU or multiple heat exchangers. In some cases, although flow balancing is not required, flow rate measurement is still desired. In such cases a simple venturi flow element shall be provided in lieu of a balancing valve to address this need. Using a static flow measuring device of this type yields improved accuracy while reducing system pressure drop as well as installed cost. Refer to section “Hydronic Heating, Cooling Systems” for additional design requirements.]

A. 2” and Smaller
1. Forged brass body
2. NPT connections
3. 400-PSIG / 250-degrees-F rating
4. 250-degrees-F temperature rating
5. Venturi inner flow nozzle
6. Temperature Rating: 250-degrees-F
7. Pressure test ports with Nordel cores (per Paragraph 2.3 P/T Test Plug specification above
8. Accuracy: 1%
9. Straight-run pipe requirement shall not exceed 5-diameters upstream and 2-1/2 diameters downstream.
10. Manufacturers:
   a. Griswold
   b. Macon
   c. Presso
   d. Badger

B. 2-1/2” and Large
1. Carbon steel body
2. Flanged connections
3. 240-PSIG / 250-degrees-F rating
4. Venturi internal flow nozzle
5. Piezo ring dual chamber design for signal averaging
6. Pressure test ports with Nordel cores (per P/T test plug specification found elsewhere in documents)
7. Accuracy: 1%
8. Straight-run pipe requirement shall not exceed 5-diameters upstream and 2-1/2 diameters downstream.

9. Manufacturers:
   a. Griswold
   b. Macon
   c. Presso
   d. IMI Flow Design

PART 3 - EXECUTION
3.1 INSTALLATION

A. Thermometers
   1. Provide thermometers as shown on drawings. Selection of thermometer type may be based upon location or application.
   2. Locate and position thermometer for ease of viewing.
   3. Specific orientation requirements:
      a. Large pipe applications (10” diameter and larger): Orient stem 45-degrees from bottom of pipe.
      b. Small pipe applications: Install thermometer at 90-degree elbow location. Orient stem collinear with centerline of pipe.
   4. Provide separable thermowell unless otherwise indicated in project documents.
   5. Coat last two inches of stem with non-hardening heat-conducting compound suitable for measured temperature range.
   6. Trim and seal surrounding insulation. Ensure vapor barrier integrity. Apply approved mastic as required to maintain vapor barrier.

B. Pressure Gauges
   1. Provide pressure gauges as shown on drawings.
   2. Position gauge for ease of viewing.
   3. Provide pulsation dampener (aka “snubber”) at pump discharge locations. Avoid dampeners at other locations (they are prone to stopping up).
   4. Provide siphon (aka “pigtail”) at each steam pressure indicating gauge.
   5. Provide shut-off valve for each gauge. Use ball valve for hydronic or steam service as specified in 23 21 13 - Hydronic Piping or 23 22 13 - Steam and Condensate Piping. Valve may be standard port or full port design. Locate valve as near system main as practical.
   6. Use 1/2” schedule 80 steel pipe nipple from pipe connection to valve.
   7. Where gauge piping is connected to equipment (e.g. pump, suction diffuser, etc.) use “connection size” schedule 80 steel pipe from equipment connection to valve. Use 1/2” copper or stainless steel tubing from valve(s) to gauge.

C. Pressure Temperature Test Ports (P/T Plugs)
   1. Provide P/T plug in supply and return piping at each terminal unit throughout hydronic system in addition to P/T plugs shown on drawings.
      a. “Terminal unit” shall include but not be limited to reheat coil, finned tube element, unit heater, convector, fan coil unit, water cooled condenser, laboratory and process equipment, etc.
2. Additionally, provide P/T plugs at all other locations shown on drawings.
3. Locate and orient P/T plug for ease of access.
4. Avoid orienting P/T plug downward (to prevent fouling with sediment).

D. Venturi Flow Elements
   1. Provide flow elements as shown on drawings.
   2. Locate and orient flow element for ease of access.
   3. Provide manufacturer's required straight-run piping at a minimum.

END OF SECTION 23 05 19

This section of the U of I Facilities Standards establishes minimum requirements only. It should not be used as a complete specification.