

SECTION 230923.11

CONTROL VALVES

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section includes Ball-style control valves.
- B. Related Requirements: Section 230923 "Direct Digital Control (DDC) System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

- A. Cv: Valve coefficient.
- B. DDC: Direct digital control.
- C. EPT: Ethylene-propylene terpolymer rubber.
- D. HNBR: Hydrogenated nitrile butadiene rubber.
- E. NBR: Nitrile butadiene rubber.
- F. PEEK: Polyether Ether Ketone rubber.
- G. PTFE: Polytetrafluoroethylene.
- H. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- I. RTFE: Glass-fiber-reinforced PTFE.
- J. TFM: A chemically modified PTFE.

1.4 SUBMITTALS

- A. Product Data for Ball-style control valves.
- B. Product Data Submittals

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 3. Product description with complete technical data, performance curves, and product specification sheets.
 4. Installation, operation, and maintenance instructions, including factors affecting performance.
- C. Shop Drawings:
1. Include plans, elevations, sections, and mounting details.
 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
 4. Include diagrams for pneumatic signal and main air tubing.
- D. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are indicated and coordinated with each other, using input from installers of the items involved:
1. Size and location of wall access panels for control valves installed behind walls.
 2. Size and location of ceiling access panels for control valves installed above inaccessible ceilings.
- E. Operation and Maintenance Data for control valves.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- D. Code Compliance: Comply with governing energy code.
- E. Ground Fault: Properly ground products to prevent failing due to ground fault conditions.
- F. Environmental Conditions: For actuators not available with integral enclosures complying with requirements indicated, house in protective secondary enclosures complying with requirements.
- G. Selection Criteria:

1. Control Valve Leakage: FCI 70-2, Class IV or less leakage, unless otherwise indicated.
2. Control Valve Pattern: Straight-through, as indicated on Drawings.
3. Control Valve Flow Characteristics, Unless Otherwise Indicated: Modulating, Two-Way Pattern: Equal percentage.
4. Fail-Safe Positions, Unless Otherwise Indicated: Heating Hot Water: Close.
5. Stable Operation: Select control valves and actuators for stable operation throughout full range of operation, from design Cv at design flow to minimum Cv.
6. Control Valve Styles:
 - a. Hydronic Systems: Pipe Sizes NPS 2 (DN 50) and Smaller: Ball- or globe-style control valves.

H. Sizing Criteria: Unless otherwise indicated, select control valve size using the following:

1. ISA Standards:
 - a. Control Valve Sizes and Flow Coefficients: ISA 75.01.01.
 - b. Control Valve Characteristics and Rangeability: ISA 75.11.01.
2. Correction Factors: Consider viscosity, flashing, and cavitation corrections when selecting control valves.
3. Ball-Style Control Valves: Select valve size with design Cv at design flow between 65 and 75 degrees of valve fully open position and minimum Cv between 15 and 25 percent of open position.
4. Globe-Style Control Valves: Select valve size to pass the design Cv at design flow with not more than 95 percent of stem travel.
5. Modulating Control Valves in Hydronic Systems: Select modulating control valve sizes at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Threaded Ends, Two Way:

1. Source Limitations: Obtain threaded end two-way ball valves from single manufacturer.
2. Performance:
 - a. Stem Action: Rotary, 0 to 90 degrees.
 - b. Controllable Flow Range: 75 percent open.
 - c. Flow Characteristic: Modified equal percentage.
 - d. Leakage: FCI 70-2, Class IV or less.
 - e. Hydronic Pressure:
 - 1) Rating for Sizes NPS 1-1/4 (DN 32) and Smaller: Nominal 600 psig.
 - 2) Close-off Pressure: 200 psig.
 - 3) Pressure Differential (Maximum): 50 psig.
 - f. Hydronic Process Temperature Range: 0 to 250 deg F.
3. Construction for Ball Valves with Threaded Ends, Two Way:
 - a. Size Range: NPS 1/2 to NPS 2.
 - b. Body: Cast bronze.
 - c. End Connections: Female threaded (NPT) ends.
 - d. Ball: Stainless steel.

- e. Ball Seats: Reinforced PTFE.
- f. Stem and Stem Extension:
 - 1) Material to match ball.
 - 2) Blowout-proof design.
 - 3) For valves installed in insulated piping systems, provide stem extension extending beyond OD of insulation.
 - 4) Provide sleeve or other approved means to allow valve to be opened and closed without damaging the insulation and the insulation vapor barrier seal.
- g. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.

2.3 GLOBE-STYLE CONTROL VALVES

A. General Requirements:

- 1. Body Dimensions: Comply with ISA 75.08.01.
- 2. Field Service: Construct the valves to be serviceable from the top with replaceable seats and plugs.
- 3. Field-Interchangeable Trim:
 - a. Cage Guided Valves: Available with field-interchangeable trim for different valve flow characteristics, such as equal percentage, linear, and quick opening.
 - b. Industrial Valves NPS 1 and Larger: Available with reduced trim one nominal size smaller.
- 4. Nameplate: Corrosion-resistant, indicating the following:
 - a. Manufacturer's name, model number, and serial number.
 - b. Body and trim size.
 - c. Arrow indicating direction of flow.

B. Globe Valves NPS 2 (DN 50) and Smaller, Two Way:

- 1. Source Limitations: Obtain two-way globe valves, NPS 2 and smaller, from single manufacturer.
- 2. Performance:
 - a. Stem Action: Linear stem travel.
 - b. Flow Characteristic: Equal percentage.
 - c. Leakage: FCI 70-2, Class IV for brass trim.
 - d. Hydronic Pressure:
 - 1) Rating: In accordance with ASME B16.15, Class 250.
 - 2) Close-off Pressure: Equal to pressure rating at maximum temperature.
 - 3) Pressure Differential (Maximum): 30 psig for sizes through NPS 2.
 - e. Ambient Operating Temperature: 35 to 150 deg F.
 - f. Process Temperature Range:

- 1) Hydronic: 35 to 248 deg F.
- 2) Steam: Temperature at saturated steam pressure.

g. Rangeability: 100 to 1.

3. Construction:

- a. Size Range: NPS 1/2 to NPS 2.
- b. Body: Cast bronze or forged brass; ASME B16.15, Class 250.
- c. End Connections: Unions with threaded ends.
- d. Bonnet: Bronze or brass, threaded.
- e. Plug: Top guided.
- f. Brass Trim:
 - 1) Packing: Self-adjusting Ethylene Propylene Rubber (EPR) rings or PTFE V-ring.
 - 2) Plug: Brass.
 - 3) Seat: Bronze or molded elastomeric disk.
 - 4) Stem: Stainless steel.

2.4 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

- A. Furnish control valves with factory-installed actuators from control valve manufacturer. Actuators manufactured by listed control valve manufacturers are acceptable subject to compliance with requirements.
- B. Actuators for Control Valves in Hydronic Systems: Select actuators to close off against system pump shutoff head.
- C. Type: Motor operated, without gears, electronic.
- D. Voltage:
 1. Actuator to deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
 2. Actuator to function properly within a range of 85 to 120 percent of nameplate voltage.
- E. Construction:
 1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 2. 100 up to 400 W: Ground steel gears, oil immersed; shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains are to be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- F. Local Field Adjustment: Make spring-return actuators easily switchable from fail-safe open to fail-safe closed in the field without replacement.
- G. Local Manual Override: Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- H. Modulating Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
 2. Control Input Signal:
 - a. Proportional: Actuator drives proportionally to input signal, modulates throughout its angle of rotation, and is suitable for zero to 10 V dc and 4 to 20 mA signals.
- I. Valve Attachment:
1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve stem without the need for connecting linkages.
 2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
 3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- J. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
 2. Humidity: Suitable for humidity range encountered by application; minimum operating range is to be from 5 to 95 percent relative humidity, noncondensing.
- K. Enclosure:
1. Suitable for ambient conditions encountered by application.
 2. NEMA 250, Type 2 or Type 4 for indoor and protected applications.
 3. Provide actuator enclosure with a heater and controller where required by application.
- L. Stroke Time:
1. Select operating stroke time to be compatible with equipment and system operation, and as follows:
 - a. Operate valve from fully closed to fully open position within 30 seconds.
 - b. Operate valve from fully open to fully closed position within 30 seconds.
 - c. Move valve to fail-safe position within 15 seconds.
- M. Sound: Where actuators are located in tenant-occupied rooms with a room sound level criteria of NC-35 or lower, comply with the following sound levels:
1. Spring Return: 45dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL VALVE APPLICATIONS

- A. Control Valves:
 - 1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
 - 2. **<Insert system> System, <Insert unique application>, Two-Way Applications Controlled by Flow: Ball valves.**

3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support control valves and actuators, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a seismic event, wind, or others forces common to the application.
- D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Seal penetrations made in fire-rated and acoustically rated assemblies.
- F. Fastening Hardware:
 - 1. Wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
 - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- H. Corrosive Environments:
 - 1. Use products that are suitable for environment to which they will be subjected.
 - 2. Use Type 316 stainless steel tubing and fittings when in contact with a corrosive environment.
 - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.

4. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 CONTROL VALVES

- A. Install pipe reducers for control valves smaller than line size. Position reducers as close to control valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
- B. Install unions to allow drop-in and -out valve installation.
- C. Clearance:
 1. Locate valves for easy access, and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
 2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.
- D. Threaded Valves:
 1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
 2. Align threads at point of assembly.
 3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
 4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Use same designation at each end for each piece of wire, cable, and tubing for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with valve identification on valve. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

3.6 ELECTRICAL CONNECTIONS

- A. Install electrical power to field-mounted control devices requiring electrical power.
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260523 "Control-Voltage Electrical Power Cables."
- C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Furnish and install raceways. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems."

- E. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- F. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.7 CONTROL CONNECTIONS

- A. Install control signal wiring to field-mounted control devices.
- B. Connect control signal wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Furnish and install raceways. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems."

3.8 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed surfaces.

3.9 STARTUP

- A. Control Valve Checkout:
 - 1. Check installed products before continuity tests, leak tests, and calibration.
 - 2. Check valves for proper location and accessibility.
 - 3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
 - 4. For pneumatic products, verify air supply for each product is properly installed.
 - 5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
 - 6. Verify that control valves are installed correctly for flow direction.
 - 7. Verify that valve body attachment is properly secured and sealed.
 - 8. Verify that valve actuator and linkage attachment are secure.
 - 9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
 - 10. Verify that valve ball, disc, and plug travel are unobstructed.
 - 11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

- B. Stroke pneumatic control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.
- C. Check and document open and close cycle times for applications with a cycle time of less than 15 seconds.
- D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.11