

Section 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 – GENERAL

The following addition should be made to 1.2.B.

1.2 SUMMARY

- B. Related Sections include the following:
 - 3. Division 23 Section "Hydronic Piping" for requirements for piping packages for control valves.

The following replaces the noted specification sections, except as noted.

2.15 ACTUATORS

- A. Electronic Actuators:
 - 1. Manufactured, brand labeled or distributed by BELIMO.
 - 2. Size for torque required for damper seal at load conditions.
 - 3. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
 - 4. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
 - 5. Overload protected electronically throughout rotation.
 - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. **[Electronic fail safe shall incorporate a visual indication of the fail safe status on the face of the actuator. The power fail position shall be field adjustable between 0 to 100% in 10° increments. The electronic fail safe shall have a 2 sec [0-10 sec] <Insert Timing between 0-10 sec> operational delay.]**
Choose electronic fail safe option when specifying pressure independent valves (2-1/2" through 6").
 - 7. Power Requirements: 24 [120] [230] V ac, maximum 10 VA [22 VA] at 24-V ac or 8 W at 24-V dc.
Choose 22 VA is selecting electronic fail safe option in 2.15.A.6. (above).
 - 8. Proportional Actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches
 - 9. Temperature Rating: **-22 to +122°F -30 to +50°C [-58 to +122°F -50 to +50°C]**
 - 10. Housing: Minimum requirement NEMA type 2 (4/4X) / IP54 (IP67) mounted in any orientation.
 - 11. Agency Listings: ISO 9001, cULus, CE or CSA
 - 12. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.
- B. Industrial Actuators (ONLY TO BE USED WITH 2.16.I Butterfly Valves – Resilient Seat and 2.16.J Butterfly Valves – High Performance.)
 - 1. Manufactured, brand labeled or distributed by BELIMO.
 - 2. The combination of valve and actuator shall meet the close-off requirements as specified in Section 2.16.H – Butterfly Valves.
 - 3. Coupling: ISO 5211 mounting standards.
 - 4. Overload Protection: A self resetting thermal switch embedded in the motor.
 - 5. Manual Override: Actuator shall be equipped with a hand wheel or shaft for manual override to permit operation of the actuator in the event of an electrical power failure
 - 6. Power Requirements: 24VAC [120VAC] [230VAC] 1 pH.
 - 7. Auxiliary Switches: 2 SPDT rated 3A at 250 VAC.
 - 8. Temperature Rating: **-22 to +150°F -30 to +65°C.**
 - 9. Housing: Minimum requirement NEMA type 4X/ IP67 with an industrial quality coating. Actuator shall have an internal heater to prevent condensation within the housing. A visual indication beacon shall indicate position status of the device.
 - 10. Agency Listing: ISO, CE, CSA
 - 11. The manufacturer shall warrant for 2 years from the date of production.

2.16 CONTROL VALVES

- A. Manufacturer:
 - 1. Manufactured, brand labeled or distributed by BELIMO.
- B. Control Valve Actuators:
 - 1. Size for valve close off at 100 percent of total system (head) pressure for two-way valves and three-way diverting valves; and 100 percent of total system (pump) head differential pressure for three-way mixing valves. **[Combination of actuator and trim shall provide minimum close-off pressure rating of [100 psid] [200 psid] <Insert Close-Off Rating>.]**
Choose optional close-off pressure rating statement for higher (greater than 100psid) requirements.
 - 2. Coupling: directly couple and mount to valve stem, shaft ISO-style direct-coupled mounting pad.
 - 3. Shall meet all the requirements of 2.15.A. Electronic Actuators.
Specifier must include section 2.15.A Electronic Actuators when using this section.
- C. Control Valves:
 - 1. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
 - 2. Sizing:
 - a. Two-Position: Line size or size using a pressure differential of 1 psi.
 - b. Two-Way Modulating: [3 psid] 5 psid or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than [3 psid] 5 psid.
 - [2. Sizing (steam):
 - a. Two-Position: Line size or sized using 10% of inlet gauge pressure.
 - b. Modulating: 15 PSIG or less inlet steam pressure, the pressure drop shall be 80% of inlet gauge pressure. Higher than 15 PSIG inlet steam pressure the pressure drop shall be 42% of the inlet absolute pressure.]
Choose this option when specifying steam valves.
 - 3. The control valve assembly shall be provided and delivered from a single manufacturer as a complete assembly.
 - D. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional (except as noted).
- E. Pressure Independent Control Valves
 - 1. NPS 2 and Smaller: Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc.
 - 2. NPS 2-1/2 through 6: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.
 - 3. Accuracy: The control valves shall accurately control the flow from 0 to 100% full rated flow with an operating pressure differential range of 5 to 50 PSI differential across the valve with a valve body accuracy of +/- 5% variance due to differential pressure fluctuation or +/- 10% total assembly error incorporating differential pressure fluctuation, manufacturing tolerances and valve hysteresis
 - 4. Flow Characteristics: Equal percentage characteristics.
Remember to modify 2.15.A.6 to incorporate electronic fail-safe option for 2-1/2" through 6" Pressure Independent Valves, where fail safe applications are required.

5. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow. Programming using actuator mounted switches or multi-turn actuators are not acceptable. **[Actuators for 3-wire floating (tri-state) on ½" – 1" pressure independent control valves shall fail in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow.] [Actuators for two-position ½'-1" pressure independent control valves shall fail in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow.] [Actuators shall be provided with an auxiliary switch.]**

Option for two-position or floating control actuator (non-programmable) for small, unitary (1/2" thru 1") applications.

Option for actuator with built-in auxiliary switch.

6. **[Coil optimization 2-1/2" through 6" shall be accomplished by utilizing a pressure independent control valve assembly; two temperature sensors providing feedback of coil inlet water temperature and coil outlet water temperature; and a flow meter to provide analog flow feedback. Software shall control the valve to avoid the coil differential temperature from falling below a programmed setpoint. Independent trend logs data shall be available by means of BACnet MS/TP trending data to include, but not be limited, to inlet and outlet coil water temperatures, valve position, absolute flow, absolute valve position, absolute power and heating/cooling energy in BTU/hr.]**
7. The manufacturer shall provide a published commissioning procedure following the guidelines of the National Environmental Balancing Bureau (NEBB) and the Testing Adjusting Balancing Bureau (TABB).
8. The control valve shall require no maintenance and shall not include replaceable cartridges.
9. NPS 2" and smaller pressure independent control valves for individual coil control shall be provided as part of a pipe package supplied by the valve manufacturer. The supply side of the coil shall contain an integrated isolation ball valve/manual air vent **[strainer/shut-off valve/drain]** with a P/T port. The return side shall contain a union fitting with a P/T port, pressure independent control valve, an integrated isolation ball valve/manual air vent with a P/T port. Shut-off valves as an integrated part of the pressure independent control valve are prohibited. **[A [12"] [24"] flexible hose set shall be provided for each coil supply and return connection for all pipe packages.]**

When choosing pressure independent control valves, specifier must include the revisions to 232113 for elimination of the balancing valve installation. Modify 230593 to eliminate the individual balancing of each coil/valve combination when installing pressure independent valves. 230953 is also modified for selected testing and verification of the PI Valves installed.

F. Characterized Control Valves:

1. NPS 2 and Smaller: Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc. **[NPS ¾" and Smaller for Terminal Units: Nickel plated forged brass body rated at no less than 600 psi, chrome plated brass ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-Ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc.]**
2. NPS 2-1/2 through 3: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring package design, PTFE seats, and a stainless steel flow characterizing disc.
3. **[NPS 1 and Smaller: Nickel-plated forged brass body rated at no less than 600 psi, stainless steel ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced PTFE Teflon seats, and a PTFE Teflon flow characterizing disc.]**

Choose option when specifying smaller terminal unit characterized control valves ½" and ¾" only.

a. Flow Characteristics: Equal percentage characteristics.]

Choose option when specifying for steam applications.

4. NPS 2" and smaller characterized control valves for individual coil control shall be provided as part of a pipe package supplied by the valve manufacturer. The supply side of the coil shall contain a strainer/shut-off ball valve/drain **[an integrated isolation ball valve/manual air vent]** with a P/T port. The return side of the coil shall contain a union fitting with a P/T port, characterized control valve, an integrated manual balancing valve/union/isolation ball valve/manual air vent with P/T port. Shut-off valves as an integrated part of the characterized control valve are prohibited. **[For 3-way installations, supply an integrated 100% port isolation valve/manual air vent with a P/T port for field installation in the bypass of the circuit.] . [A [12"] [24"] flexible hose set shall be provided for each coil supply and return connection for all pipe packages.]**
5. Six-way Control Valves shall have the following characteristics:
 - a. NPS ½" and ¾": Nickel plated forged brass body rated at no less than 600 psi, dual chrome plated brass ball and blowout proof stems, and female NPT end fittings. Each three-way portion of the 6-way valve body shall have EPDM O-Ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc.
 - b. The six-way control valve shall be controlled by a rotary actuator for managing two media in a switching application. The valve shall be closed to flow at mid-rotation.
6. Globe valves shall have the following characteristics:
 - a. NPS 2 and Smaller: ANSI Class 250 bronze body, stainless steel stem, brass plug, bronze seat, and a TFE packing.
 - b. NPS 2-1/2 and Larger: ANSI Class 125 [250] cast iron body, stainless steel stem, bronze plug, bronze seat, and a TFE V-ring packing.
 - c. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - d. Two- and three-way globe valves shall be used only if characterized control valves do not fit the sizing criteria or application.

[Steam system globe valves shall have the following characteristics:

- e. NPS 2 and Smaller: ANSI Class 250 bronze body; stainless steel seat, stem and plug; and a TFE packing.
- f. NPS 2-1/2 and Larger: ANSI Class 125 [250] cast iron body; stainless steel seat, stem and plug; and a TFE V-ring packing.

SPECIFYING PRESSURE INDEPENDENT CONTROL VALVES REQUIRE THE FOLLOWING ADDITIONS TO SECTIONS 232113 AND 230593.

To be inserted into Section 232113 – HYDRONIC PIPING

2.6 CONTROL VALVES

- K. Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be used on equipment where pressure independent control valves are installed.

To be inserted into Section 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

3.11 PROCEDURE FOR HYDRONIC SYSTEMS

- H. Systems installed with pressure independent control valves shall not require terminal level hydronic system balancing. **[Total system flow shall be verified to be within +/-10% of system design.] [[10%] [20%] [25%] <Insert Percentage> of the total installed product shall be randomly checked for individual conformance. Exact locations of tested product to be coordinated with the design engineer. Any individual adjustments for the pressure independent valve assembly (valve and actuator combination) for field conditions shall be performed using the pressure independent control valve manufacturer's documented procedure following the guidelines of the National Environmental Balancing Bureau (NEBB) and the Testing Adjusting Balancing Bureau (TABB)]**

g. Flow Characteristics: Linear or equal percentage characteristics.]

Choose option when specifying globe valves in a steam system application.

G. Butterfly Valves – Resilient Seat:

1. NPS 2 to 12: Valve body shall be full lugged cast iron 200 psig body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize an internal spline. The shaft shall be supported at four locations by RPTFE bushings.
2. NPS 14 and Larger: Valve body shall be full lugged cast iron 150 psig body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize a dual-pin method to prevent the disc from settling onto the liner. The shaft shall be supported at four locations by RPTFE bushings.
3. Sizing:
 - a. Two-Position: Line size or size using a pressure differential of 1 psi.
 - b. Modulating: [3 psig] 5 psig or twice the load pressure drop, whichever is more. Size for the design flow with the disc in a 60-degree-open-position and a design velocity not to exceed 12 feet per second.
4. Close-Off Pressure Rating: NPS 2-12" 200 psi bubble tight shut-off. NPS 14 and larger, 150 psi bubble tight shut-off.

H. Butterfly Valves – High Performance:

1. Valve body shall be full lugged carbon steel ANSI Class 150 [300] body with a 316 stainless steel disc without a nylon coating, RTFE seat, and be ANSI Class 150300 flange standards. Blowout-proof shaft shall be 17-4ph stainless steel and shall be supported at four locations by glass-backed TFE bushings. Valve packing shall be Chevron TFE and shall include fully adjustable packing flange and separable packing gland. Valve body shall have long stem design to allow for 2" insulation (minimum). Valve face-to-face dimensions shall comply with API 609 and MSS-SP-68. Valve assembly shall be completely assembled and tested, ready for installation.
2. Sizing:
 - a. Two-Position: Line size or size using a pressure differential of 1 psi.
 - b. Modulating: [3 psig] 5 psig or twice the load pressure drop, whichever is more. Size for the design flow with the disc in a 60-degree-open-position with the design velocity less than 32 feet per second.
3. Flow Characteristics: Modified equal percentage, unidirectional.
4. Close-Off Pressure Rating: 150 [285] psi bubble tight shut-off.
5. Media Temperature Range: ANSI Class 150 [300] limitations.
6. Max Differential Pressure: 285 psi @ 100 deg F for ANSI 150 (725 psi @ 100 deg F for ANSI 300).
Select 2.16.B. Industrial Actuators when specifying 2.16.G Butterfly Valves – Resilient Seat and 2.16.H Butterfly Valves – High Performance.)

I. Zone Valves (On/Off Two-Position Applications):

1. NPS 1 and Smaller: Forged brass body rated at no less than 300 psi, stainless steel stems, female, NPT union or sweat with a stainless steel stem and EPDM seals.
2. The manufacturer shall warrant all components for a period of 2 years from the date of production.
3. All zone valves for individual coil control shall be provided as part of a pipe package supplied by the valve manufacturer. The supply side of the coil shall contain a strainer/shut-off ball valve/drain [an integrated 100% port isolation valve/manual air vent] with a P/T port. The return side of the coil shall contain a union fitting with a P/T port, zone valve, an integrated manual balancing valve/union/isolation ball valve/manual air vent with P/T port. Shut-off valves as an integrated part of the zone valve are prohibited. [A [12"] [24"] flexible hose set shall be provided for each coil supply and return connection for all pipe packages.]

To be inserted into Section 233300 – AIR DUCT ACCESSORIES

2.8 SMOKE DAMPERS

I. Damper Motors:

1. Manufactured, brand labeled or distributed by BELIMO.
2. Size for torque required for damper seal at load conditions with one actuator per damper section. Mechanically paralleled or 'piggybacked' actuators are not permitted.
3. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
4. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
5. Power Requirements: 0.23A (running) and 0.09A (holding) at 24V-ac or 27 VA (running) and 10 VA (holding) at 120V-ac.
6. Actuator timing shall be 15 sec [75 sec] [local codes].
7. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 350°F [250°F].
8. **[Proportional Smoke Damper Actuators shall meet all requirements specified above and shall modulate 0-100% open in response to a 2-10vdc or 4-20mA control signal. A 2-10vdc feedback output shall provide a 2-10vdc signal for position indication.**
 - a. **Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc.**
 - b. **A manual override winder and locking mechanism shall be provided for override operation of the actuator on a loss of power.]**
9. **[Balancing Smoke Damper Actuators shall meet all requirements specified above and shall include an integral adjustable maximum opening potentiometer for airflow adjustment.**
 - a. **Power Requirements (Balancing): Maximum (running) 9.5 VA at 24-V ac or 6 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc.**
 - b. **A manual override winder and locking mechanism shall be provided for override operation of the actuator on a loss of power to the actuator.]**

The following replaces item 2.8.K.1

1. Auxiliary switches for [signaling] [fan control] [or] [position indication].

2.9 COMBINATION FIRE AND SMOKE DAMPERS

O. Damper Motors:

1. Manufactured, brand labeled or distributed by BELIMO.
2. Size for torque required for damper seal at load conditions.
3. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
4. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
5. Power Requirements: 0.23A (running) and 0.09A (holding) at 24V-ac or 27 VA (running) and 10 VA (holding) at 120V-ac.
6. Actuator timing shall be 15 sec [75 sec] [local codes].
7. Temperature Rating: Actuator shall have UL555 and UL555S listings by the damper manufacturer for 350°F [250°F].
8. **[Proportional Combination Fire and Smoke Damper Actuators shall meet all requirements specified above and shall modulate 0-100% open in response to a 2-10vdc or 4-20mA control signal. A 2-10vdc feedback output shall provide a 2-10vdc signal for position indication.**

- a. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc.
 - b. A manual override winder and locking mechanism shall be provided for override operation of the actuator on a loss of power.]
9. [Balancing Combination Fire and Smoke Damper Actuators shall meet all requirements specified above and shall include an integral adjustable maximum opening potentiometer for airflow adjustment.
- a. Power Requirements (Balancing): Maximum (running) 9.5 VA at 24-V ac or 6 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc.
 - b. A manual override winder and locking mechanism shall be provided for override operation of the actuator on a loss of power to the actuator.]

The following replaces item 2.9.Q.1

1. Auxiliary switches for [signaling] [fan control] [or] [position indication].
2. Housing: Steel housing, aluminum is unacceptable.
3. Agency Listing: ISO 9001, UL873, or UL60730.
4. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

NOTE TO SPECIFIER

Any (or all) of the following manufacturers are listed per UL555S with Belimo actuators: Air Balance, Arlan, E.H. Price, Greenheck, Leader, Lloyd Industries, Nailor, Pottorff, Prefco, Ruskin and Safe-Air.