

SECTION 23 09 13.34 - CONTROL VALVE ACTUATORS

PART I – GENERAL

1.0 OVERVIEW [Background for PSC]

A. Control Valve/Actuator Applications

1. See Exhibit 23 09 13.33-1, Control Valve/Actuator Worksheet for approved valve/actuator combinations.

B. Preference for Pneumatic Actuators

1. It is acknowledged that the HVAC industry has embraced the use of electric/electronic valve actuators such that they are in widespread use. The University allows the use of such actuators for all applications. However, due to their superior high temperature performance, pneumatic actuators are strongly preferred over electric for steam control valve applications. Experience indicates that electric actuators “can’t take the heat” as compared to pneumatic. Given their superior torque ratings pneumatic actuators are also preferred for large hydronic valve applications.

C. Actuator Grade

1. Within these Specifications a distinction is made between HVAC Grade products and Industrial Grade products. Applications for which HVAC grade products are allowed include terminal/room level devices and unitary equipment. Those that require industrial grade products include steam and large hydronic control valves/actuators. Other applications may be identified as either HVAC or industrial based upon project by project basis. Grade shall be identified in the control valve schedule.

1.1 SECTION INCLUDES

A. HVAC Grade Actuators

1. Electric
2. Pneumatic

B. Industrial Grade Actuators

1. Electric
2. Pneumatic

1.2 RELATED SECTIONS

- A. Section 23 09 13.33 – Control Valves

1.3 COMPLIANCE

- A. Products and execution shall be in compliance with all applicable codes and standards.
- B. Installation, start-up and operation shall be in compliance with Manufacturer’s recommendations and IOM.

1.4 CONTROL VALVES

A. Valve/Actuator Combinations

1. See section entitled Control Valve/Actuator Worksheet located at end of Section 23 09 33.13 Control Valves for approved valve/actuator combinations. This section provides helpful information for preparation and interpretation of control valve schedules.

[Note to PSC: Ensure continuity between these two sections.]

B. Failure Mode

1. See Section 23 09 13.33 Control Valves for failure mode for given application.

1.5 POSITIONERS

- A. Positioners shall be provided as scheduled or otherwise indicated in project documents.
- B. Positioners are typically required on modulating control valves that serve central station equipment (e.g. AHUs, heat exchangers). If not scheduled or otherwise indicated in project documents, positioners shall be provided as a default requirement for modulating valves serving central station equipment.
- C. When multiple valves are sequenced with one another, a positioner shall be provided on each valve (e.g. parallel control valves at heat exchangers).

1.6 POSITION FEEDBACK

- A. Position feedback shall be provided as scheduled or otherwise indicated in project documents including control drawings and specifications.
- B. Position feedback shall be provided on all modulating rotary control valves larger than 2". *[Note to PSC: As repeated below, spring return electric actuators on rotary control valves larger than 2" are prohibitively expensive. Fail safe operation is achieved (to a large degree) by periodically testing proper valve function by providing control signal and confirming movement via position feedback. Thus it is necessary to have position feedback on all such valves.]*

PART 2 - PRODUCTS

2.01

2.1 VALVE ACTUATORS & ACCESSORIES

Actuator Identification Number Breakdown:

[Note to PSC: This may seem complex, but it is necessary given that there are numerous valve actuator combinations.]

HVAC = HVAC Grade
IND = Industrial Grade
E = Electronic/Electric
HP = High Pressure Pneumatic
LP = Low Pressure Pneumatic
R = Rotary
LIN = Linear
SD = Spring-Diaphragm
GV = Globe Valve Actuator Style
DMP = Damper Actuator Style
SR = Spring Return
FIP = Fail in Place
DA = Double Acting
MOD = Modulating
TP = Two Position

- A. HVAC Grade, Electronic Actuators for Modulating and Two-Position Service

(Same specifications for both services)

Note: Spring return not applicable to industrial grade electronic actuators on rotary valves larger than 2" unless otherwise indicated in project documents.

- 1. Rotary Actuator, Spring Return (Fail-open or fail-closed)

HVAC-E-R-SR

- a. Brushless DC motor. Stepper motor not allowed
- b. NEMA 1 or NEMA 2, as appropriate

- c. Approved for air plenum application, as required
 - d. 24 VAC or 24 VDC power supply
 - e. 0-10, 2-10 VDC or 4-20 mA control input
 - f. Signal inverter switch
 - g. Proportional, floating point or two position as determined by application
 - h. Spring return for fail-safe operation
 - i. 60,000 cycle rated
 - j. 50% duty cycle rated
 - k. Sized for 150% of break-away torque at maximum differential pressure across valve
 - l. Multiple tandem-mounted actuators not allowed
 - m. Rated for 120 degree F ambient temperature
 - n. Motor overload/stall protection throughout rotation
 - o. Visual valve position indicator
 - p. Manual mechanical override
 - q. Conduit connection. Mounting bracket shall be provided for conduit connection if available.
 - r. Manual switchable direction of rotation
 - s. Two adjustable SPDT auxiliary switches for position indication. Provide if scheduled or otherwise indicated in project documents.
 - t. Electric analog position feedback. Provide if scheduled or otherwise indicated in project documents. Position feedback shall be provided on all modulating rotary valves larger than 2".
 - u. Adequate mounting height to accommodate 1" thick pipe insulation around valve body
 - v. 5 year unconditional warranty
 - w. Basis of Design: Belimo LR Series
 - (a) Also approved: Siemens
 - x. Not approved
 - (a) Schneider Duradrive
 - (b) Belimo TR Series
2. Rotary Actuator, Non-Spring Return (Fail in place)
HVAC-E-R-FIP
- a. Same specifications as HVAC-E-R-SR Rotary Actuator, Spring Return except without spring return feature.
3. Linear Actuator, Spring Return (Fail open or fail closed)
 For sliding stem globe valve
HVAC-E-LIN-SR
- a. Metal housing
 - b. Rack and pinion drive

- c. NEMA 1 or NEMA 2, as appropriate
 - d. 24 VAC power supply
 - e. 0-10 VDC or 4-20 mA control input
 - f. Spring return for fail-safe operation
 - g. 50% duty cycle rated
 - h. Sized for 150% of maximum differential pressure across valve
 - i. Rated for 300+ degree F media (steam) temperature
 - j. Rated for 130 degree F ambient temperature
 - k. Motor overload/stall protection
 - l. Visual valve position indicator
 - m. Manual mechanical override
 - n. Dual 1/2" conduit connections for power and control wiring
 - o. Two adjustable SPDT auxiliary switches for position indication available for external control system use. Provide if scheduled or otherwise indicated in project documents.
 - p. Position feedback potentiometer. Provide if scheduled or otherwise indicated in project documents.
 - q. Mounting bracket with adequate standoff and isolation to prevent overheating
 - r. 5 year unconditional warranty
 - s. Basis of Design: Belimo #UGLK
4. Linear Actuator, Non-Spring Return (Fail in place)
- HVAC-E-LIN-FIP
- a. Same specifications as *HVAC-E-LIN-SR Linear Actuator, Spring Return* except without spring return feature.
- B. HVAC Grade, Pneumatic Actuators and Accessories for Modulating and Two-Position Service
1. Linear Actuator, Spring-Diaphragm Type (for globe valves)
- HVAC-LP-LIN-SD-GV
- a. Aluminum or steel housing
 - b. Spring-loaded replaceable rolling molded synthetic rubber diaphragm
 - c. Rated for 25 PSIG control air pressure
 - d. Rated for -20 to 150 degree F ambient temperature
2. Rotary Actuator, Spring-Diaphragm Type (Damper actuator with linkage for rotary valves)
- HVAC-LP-R-SD-DMP
- a. Aluminum or steel housing
 - b. Spring-loaded replaceable rolling molded synthetic rubber diaphragm
 - c. Rated for 25 PSIG control air pressure
 - d. Rated for -20 to 150 degree F ambient temperature

3. Positioner, relay type (provide if scheduled or otherwise indicated in project documents)
 - a. Provided by valve manufacturer
4. Analog position feedback. Provide if scheduled or otherwise indicated in project documents. Position feedback shall be provided on all rotary valves larger than 2".

C. Industrial Grade, Electric Actuators for Modulating and Two-Position Service

(Same specifications for both services)

Note: Spring return not applicable to electric actuators on rotary valves larger than 2" unless indicated otherwise in project documents. Exception: Utility plant applications

1. Rotary Actuator, Spring Return (Fail-open or fail-closed)

IND-E-R-SR

[Note to PSC: As stated above, spring return actuators for rotary control valves larger than 2" are prohibitively expensive. Fail safe operation is achieved (to a large degree) by periodically testing proper valve function by providing control signal and confirming movement via position feedback. Thus it is necessary to have position feedback on all such valves.]

- a. NEMA 4 aluminum housing
- b. 24 VAC, 24 VDC or 120 VAC power
- c. True 50% duty cycle rated
- d. Sized for 150% of break-away torque at maximum differential pressure across valve
- e. Rated for 400 degree F media (steam) temperature
- f. Rated for 150 degree F ambient temperature
- g. Motor overload/stall protection
- h. Torque limiting feature
- i. Positioner with 4-20 mA or 0-10 VDC control input (for modulating applications only)
- j. Analog position feedback potentiometer or transmitter as scheduled or otherwise indicated in project documents. Position feedback shall be provided for all rotary valves larger than 2".
- k. Two SPDT auxiliary switches for position indication available for external control system use. Provide if scheduled or otherwise indicated in project documents.
- l. Internal heater for outdoor and/or high humidity applications
- m. Prewired terminal strip
- n. Dual 1/2" conduit connections for power and control wiring
- o. Visual valve position indicator
- p. Brake or worm gear drive
- q. Manual mechanical override if scheduled or otherwise indicated in project documents.
- r. Mounting bracket with adequate standoff and isolation to prevent overheating.
- s. Approved manufacturers
 - (1) Building applications:

- i. RCS
 - ii. Remote Control Inc.
 - (2) Utility plant applications:
 - i. Limitorque
 - ii. Rotork
 - 2. Rotary Actuator, Non-Spring Return (Fail in place)
 - IND-E-R-FIP
 - a. Same specifications as IND-E-R-SR Rotary Actuator, Spring Return except without spring return feature
- D. Industrial Grade, Pneumatic Actuators and Accessories for Modulating Service
- Assembly shall include Actuator 1, 2 or 3 along with items 4 through 11.
- All components shall be rated for -20 to 150 degree F ambient temperature.
1. High Pressure Rotary Actuator, Spring-Return (Fail-open or fail-closed)
 - IND-HP-R-SR-MOD
 - a. Rack and pinion type for lower torque applications - Approved manufacturers: Hytork Series XL, Habonim Compact
 - b. Scotch yoke type for higher torque applications - Approved manufacturers: Rotork P Series, Bettis G Series
 - c. Sized for 60 PSIG supply air pressure when used in conjunction with an existing air compressor, 80 PSIG in conjunction with a new compressor, 80 PSIG within a central utility plant.
 - d. Sized for 125% of break-away torque at maximum design pressure differential across valve.
 - e. ISO valve mounting flange. NAMUR and VDI/VDE mounting pads for top works..
 2. High Pressure Rotary Actuator, Double-Acting (Fail in place)
 - IND-HP-R-DA-MOD
 - a. Rack and pinion type for lower torque applications - Approved manufacturers: Hytork Series XL, Habonim Compact
 - b. Scotch yoke type for higher torque applications - Approved manufacturers: Rotork P Series, Bettis G Series
 - c. Sized for 60 PSIG supply air pressure when used in conjunction with existing air compressor, 80 PSIG in conjunction with new compressor, 80 PSIG within a central utility plant
 - d. Sized for 125% of break-away torque at maximum design pressure differential across valve.
 - e. ISO valve mounting flange. NAMUR and VDI/VDE mounting pads for top works..
 3. Low Pressure Rotary Actuator, Spring-Diaphragm (Fail-open or fail-closed)
 - For use with eccentric plug valves only
 - IND-LP-R-SD-MOD
 - a. Industrial grade spring-diaphragm type
 - b. Rated for 35 PSIG supply air pressure minimum
 - c. Sized for 20 PSIG supply air pressure

- d. Sized for 125% of break-away torque at maximum design pressure differential across valve
 - e. Approved manufacturers: Cashco, Fisher, Masoneilan, Warren
4. Positioner
 - a. Pneumatic, 3-15 PSIG input, 60-80 PSIG supply
 - b. 0.25 SCFM maximum steady state air consumption at 60 PSIG, 0.35 SCFM at 80 PSIG
 - c. Instrument, supply and output pressure gauges
 - d. Approved manufacturers: PMV model P5N low bleed, BLX model V100P low bleed
 5. Filter-Regulator
 - a. ¼" NPT connections minimum, larger as appropriate
 - b. Approved manufacturers: ASCO, Bellofram, Control-Air, Fisher, Parker
 6. Isolation Valve
 - a. Line-size full-port ball valve, ¼" NPT minimum
 - b. Piped to filter-regulator inlet connection with union fitting (or equivalent) to allow convenient removal of filter-regulator / positioner without shutting down supply air source.
 - c. Back-bleed feature to vent downstream air pressure when valve is closed.
 7. Limit Switch Assembly – Provide if scheduled or otherwise indicated in project documents.
 - a. Two end-of-travel SPDT limit switches.
 - b. NEMA 4 metal enclosure. Plastic enclosure not acceptable.
 - c. Approved manufacturer: Stonel
 8. Analog position feedback module as scheduled or otherwise indicated in project documents. Position feedback shall be provided for all modulating rotary valves larger than 2".
 9. Visual position indicator
 - a. High visibility dome type or equivalent.
 10. Hand wheel manual override - Provide if scheduled or otherwise indicated in project documents.
 11. Assembly
 - a. Actuator and accessories shall be pre-assembled, pre-piped, pre-wired and mounted on valve
 - b. Any required brackets and hardware shall be included
 - c. Drive pinion adapters shall be standard products designed for specific valve/actuator combination rather than custom fabricated components. Pinned adapters not allowed. Any "free-play" that results from standard manufacturing tolerances shall be eliminated by permanent means requiring no consideration when actuator is removed and reinstalled in field.
 - d. Hand wheel manual override shall be provided if indicated on valve schedule.

- e. Assembly work shall be accomplished at valve manufacturer's or supplier's facility and warranted as a complete unit. (Allowable exception: Isolation valve may be field installed to prevent damage during shipment).
- E. Industrial Grade, Pneumatic, Rotary Actuators and Accessories for Two-Position (On-Off) Service

Assembly shall include Actuator 1, 2 or 3 along with items 4 through 10.

All components shall be rated for -20 to 150 degree F ambient temperature.

Full stroke time shall not exceed 20 seconds.

1. High Pressure Rotary Actuator, Spring-Return (Fail-open or fail-closed)
IND-HP-R-SR-TP
 - a. Same specifications as IND-HP-R-SR-MOD High Pressure Rotary Actuator, Spring-Return
2. High Pressure Rotary Actuator, Double-Acting (Fail in place)
IND-HP-R-DA-TP
 - a. Same specifications as IND-HP-R-DA-MOD High Pressure Rotary Actuator, Double-Acting
3. Low Pressure Rotary Actuator, Spring-Diaphragm (Fail-open or fail-closed)
For use with eccentric plug valves only
IND-LP-R-SD-TP
 - a. Same specifications as IND-LP-R-SD-MOD Low Pressure Rotary Actuator, Spring-Diaphragm
4. Solenoid Valve
 - a. 1/4" NPT connections, minimum
 - b. Dual coil type (not spring return) for true fail-in-last-position operation
 - c. 24 VAC or 24 VDC
 - d. Manual override
 - e. Pre-mounted to switch box and pre-wired to terminal strip
 - f. Approved manufacturers: ASCO, Burkert, Honeywell, Parker/Skinner, TopWorx
5. Filter-Regulator
 - a. 1/4" NPT connections minimum, larger as appropriate
 - b. Approved manufacturers: ASCO, Bellofram, Control-Air, Fisher, Parker
6. Isolation Valve
 - a. Line-size full-port ball valve, 1/4" NPT minimum
 - b. Piped to solenoid valve inlet connection with union fitting (or equivalent) to allow convenient removal of solenoid valve without shutting down supply air source.
 - c. Back-bleed feature to vent downstream air pressure when valve is closed.
7. Bi-directional Speed (Flow) Control
 - a. Heavy duty brass or stainless steel body, drilled and tapped
 - b. Adjustable control air supply and exhaust bleed rates

- c. 1/4" NPT connections, minimum
- 8. Limit Switch Assembly
 - Required for automated building service entrance chilled water return isolation valve.
 - Otherwise, provide only if scheduled or otherwise indicated in project documents.
 - a. Two end-of-travel SPDT limit switches
 - b. NEMA 4 metal (not plastic) enclosure
 - c. Approved manufacturers: Accord, PMV, Stonel, Westlock, TopWorx
- 9. Visual position indicator
 - Provide with or without limit switch assembly.
 - a. High visibility dome type or equivalent
- 10. Hand wheel manual override
 - Provide if scheduled or otherwise indicated in project documents.
- 11. Assembly
 - a. Actuator and accessories shall be pre-assembled, pre-piped, pre-wired and mounted on valve.
 - b. Any required brackets and hardware shall be included.
 - c. Drive pinion adapters shall be standard products designed for specific valve/actuator combination rather than custom fabricated components. Pinned adapters are not allowed. Any "free-play" that results from standard manufacturing tolerances shall be eliminated by permanent means requiring no consideration when actuator is removed and reinstalled in field.
 - d. Hand wheel manual override shall be provided if indicated on valve schedule.
 - e. Assembly work shall be accomplished at valve manufacturer's or supplier's facility and warranted as a complete unit. (Allowable exception: Isolation valve may be field installed to prevent damage during shipment).

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Electronic Actuators

- 1. If actuator is provided with both conduit connector and prewired cable, conduit connector shall be used.
- 2. If provided with conduit connector, final connection to actuator shall be made with flexible metal conduit.
- 3. If provided with prewired cable only, cable shall be terminated within junction box or enclosure. Junction box shall be located near actuator to prevent free-air splice.
- 4. Rubber strain relief grommet shall be provided at junction box or enclosure to protect cable from damage.

3.2 ORIENTATION

A. Rotary Control Valves/Actuators

- 1. For hydronic applications, preferred valve orientation is with shaft oriented horizontally. Valve shall not be installed such that shaft is oriented vertically downward (i.e. with actuator at bottom). Exception: Small rotary valves with electronic actuators (e.g. at reheat coils and fan coil units) may be installed in any orientation.

2. For steam applications, valve/actuator shall be installed such that shaft is oriented horizontally. In no case shall shaft be oriented in vertically upward position. Vertical upward orientation results in overheating of actuator and accessories.

B. Linear (Sliding Stem) Control Valves/Actuators

1. For hydronic applications, valve/actuator shall be installed such that stem is oriented within 45 degrees of vertical upward position. If this orientation cannot be practically achieved, valve may be installed such that stem is oriented horizontally. In no case shall valve be installed such that stem is oriented vertically downward.
2. For steam applications, valve/actuator shall be installed such that stem is not oriented in vertically upward position. Vertical upward orientation results in overheating of actuator and accessories. Preferred orientation is 45 degrees from vertically upward position. If this orientation cannot be practically achieved, valve may be installed such that stem is oriented horizontally. In no case shall valve be installed such that stem is oriented vertically downward.

3.3 MOUNTING BRACKET

A. Standoff

1. As applicable, actuator mounting bracket shall have adequate standoff to accommodate insulation. In steam applications mounting bracket shall have adequate standoff to protect actuator from excessive radiant, convective and conductive heat.

B. Isolation

1. In steam applications, actuator mounting bracket and linkage shall provide adequate isolation to protect actuator from excessive conducted heat.

3.4 SPECIAL NOTE

A. Electronic Actuators

1. Electric/electronic actuators are especially vulnerable to damage by heat (radiant, convective and conductive). It is essential that they be installed in strict compliance with requirements of 3.1 and 3.2 above.

END OF SECTION **23** 09 13.34

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