SECTION 230923 - CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:
1. Section 230900 "Energy Management System and Building Automation System for HVAC and Lighting Control" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230719 “HVAC Piping Insulation” for requirements that relate to valve insulation.

C. Control valves shall not be used as manual isolation or service valves. Use appropriate full port valves for equipment and sectional header isolation.

D. Actuators for Fire Suppression Systems shall be NFPA rated for Fire Service

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Include diagrams for power, signal, and control wiring.
2. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:
1. Schedule and design calculations for control valves and actuators, including the following:
    a. Flow at project design and minimum flow conditions.
    b. Pressure differentials drop across valve at project design flow condition.
    c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
    d. Design and minimum control valve coefficient with corresponding valve position.
    e. Maximum close-off pressure.
    f. Leakage flow at maximum system pressure differential.
    g. Torque required at worst case condition for sizing actuator.
    h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional designer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Determine control valve sizes and flow coefficients by ISA 75.01.01.

F. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

G. Insulation Requirements for all valve bodies shall comply with Pipe Insulation under 230719. Insulation on all actuator valve bodies shall be constructed to be water resistant and removable for servicing and repair. The removable section shall be constructed so as not interfere with actuator or linkage operation and provided fasteners for reinstallation without the need for any additional material or tools.

H. Selection Criteria:
   1. Control valves shall be suitable for operation at following conditions:
      a. Chilled Water: 40-60 degrees F. and 50 psig.
      b. Heating Hot Water: <40-200 degrees F and 50 psig.
   2. Fail positions unless otherwise indicated:
      a. Chilled Water: Last position.
      b. Heating Hot Water: Open.
   3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
   4. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
   5. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:
      a. 50 percent of the valve inlet pressure.
      b. 50 percent of the absolute steam pressure at the valve inlet.
   6. Control valve assemblies shall be provided and delivered from a single manufacturer as a complete assembly.
   7. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:
   1. Pressure Rating for NPS 1-1/4 and Smaller: Nominal 600 psig.
   2. Pressure Rating for NPS 1-1/4 through NPS 2: Nominal 400 psig.
   3. Pressure Rating for NPS 2-1/2 through NPS 6: In accordance with ANSI 125, Class B.
   4. Close-off Pressure NPS 2 and Smaller: 200 psig .
   5. Close-off Pressure NPS 2-1/2 through NPS 6: ANSI Class 125B: 175 psid; ANSI Class 250: 310 psid.

6. Process Temperature Range: Zero to 250 deg F.
7. Body and Tail Piece NPS 2 and Smaller Nickel plated (forged) brass.
8. Body and Tail Piece NPS 2-1/2 through NPS 6: Cast iron GG25.
9. End Connections NPS 2 and Smaller: Threaded (NPT) female ends.
10. End Connections NPS 2-1/2 through NPS 6: Flanged ANSI Class 125B.
11. Ball NPS 3/4 and Smaller: Chrome-plated brass.
12. Ball NPS 1 through NPS 6:- Stainless steel.
13. Stem and Stem Extension:
    a. Material to match ball.
    b. Blowout-proof design.
14. Ball Seats: PTFE (Tefzel), (2) EPDM O-rings.
15. Stem Seal: Lubricated EPDM O-rings (2).
16. Characterizing Disc NPS 2 and Smaller: Tefzel.
17. Characterizing Disc NPS 2 through NPS 6: Stainless steel.
18. Flow Characteristic: Equal percentage.
19. Leakage: 0%.

B. Ball Valves with Two Ports and Characterized Disk:
1. Pressure Rating for NPS 1-1/4 and Smaller: Nominal 600 psig.
2. Pressure Rating for NPS 1-1/4 through NPS 2: Nominal 400 psig.
3. Close-off Pressure: 200 psig (1379 kPa).
4. Process Temperature Range: Zero to 250 deg F.
5. Body and Tail Piece: Nickel plated (forged) brass.
6. End Connections: Threaded (NPT) female ends.
7. Ball NPS 3/4 and Smaller: Chrome-plated brass.
8. Ball: NPS 1 through NPS 6:- Stainless steel.
9. Stem and Stem Extension:
    a. Material to match ball.
    b. Blowout-proof design.
10. Ball Seats: PTFE (Tefzel), EPDM O-rings.
11. Stem Seal: Lubricated EPDM O-rings.
12. Flow Characteristics for A-Port: Equal percentage.
13. Flow Characteristics for B-Port: Modified for constant common port flow.
14. Leakage (control port): 0%.

C. Pressure-Independent Ball Valves NPS 2 and Smaller:
1. Performance:
    a. Pressure Rating for NPS 3/4 and Smaller:360 psig
    b. Pressure Rating for NPS 1 through NPS 6: In accordance with ANSI 125, Class B.
    c. Close-off pressure for NPS 3/4 and Smaller: 75 psig
    d. Close-off Pressure NPS 2 and Smaller: 200 psig.
    e. Close-off Pressure NPS 2-1/2 through NPS 6: ANSI Class 125B: 175 psid; ANSI Class 250: 310 psid.
    f. Process Temperature Range for NPS 3/4 and Smaller: Between 36 to 212 deg F.
    g. Process Temperature Range for NPS 6 and Smaller: Between 14 to 250 deg F.
    h. End Connections NPS 2 and Smaller: Threaded (NPT) female ends.
    i. End Connections NPS 2-1/2 through NPS 6: Flanged ANSI Class 125B.
2.
3. Body for NPS 2 and Smaller: Forged brass, nickel plated, and with threaded ends.
4. Body for NPS 2-1/2 through NPS 6: Cast iron GG25.
5. Ball: Stainless steel.
6. Stem and Stem Extension: Stainless steel, blowout-proof design.
7. Ball Seats: PTFE (Tefzel), EPDM O-rings.
8. Stem Seal: Lubricated EPDM O-rings.
9. NPS 3/4 and Smaller: An integral pressure regulator located upstream of characterized ball to regulate pressure, to maintain a constant pressure differential over the operating pressure

differential range of 5 to 50 psig maintaining the flow with an accuracy of +/- 5% due to system pressure fluctuations. Two internal P/T ports shall be incorporated for differential pressure verification. Replaceable cartridges are not permitted.

10. NPS 6 and Smaller: An ultrasonic flow meter (accuracy +/- 2%) shall be integrated with a characterized control valve providing analog flow feedback. The valve shall reposition to maintain the required flow with a +/- 5% accuracy over a pressure differential range of 1 to 50 psig (7 to 350 kPa). The flow meter shall incorporate an algorithm to automatically compensate for the glycol compensation.
11. Control valve shall be equal percentage flow characteristic, other than where noted as a linear flow characteristic. Flow settings shall be field-modifiable and may be modified inline.
12. Coil Optimization: Two immersion temperature sensors for supply and return coil water temperatures shall be incorporated into the valve assembly. Software shall control the valve to avoid the coil differential temperature from falling below a programmed setpoint. Real-time data and configuration of valve] operating parameters shall be available by BTL listed BACnet MS/TP, BACnet/IP, MODBUS or HTTP. Monitored points shall include inlet and outlet coil water temperatures, absolute flow, absolute valve position, absolute coil power and total heating/cooling energy in BTU/hr. Configuration points shall include valve, flow and power settings. Historical trend data shall be stored for up to 13 months and be retrievable in a standard date-time stamped format.]
13.
14.

2.3 BUTTERFLY-STYLE CONTROL VALVES

A. Commercial-Grade, Two-Way Butterfly Valves:
   1. Performance:
      a. Bi-directional bubble tight shutoff at 250 psig.
      b. Comply with MSS SP-67 or MSS SP-68.
      c. Rotation: Zero to 90 degrees.
      d. Linear or modified equal percentage flow characteristic.
   2. Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216/A216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
   3. Disc: 316 stainless steel.
   4. Shaft: 316 or 17-4 PH stainless steel.
   5. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.
   6. Shaft Bushings: Reinforced PTFE or stainless steel.
   7. Replaceable seat, disc, and shaft bushings.
   8. Corrosion-resistant nameplate indicating:
      a. Manufacturer's name, model number, and serial number.
      b. Body size.
      c. Body and trim materials.
      d. Flow arrow.

B. Commercial-Grade, Three-Way Butterfly Valves:
   1. Arrangement: Two valves mated to a fabricated tee with interconnecting mechanical linkage.
   2. Performance:
      a. Bi-directional bubble tight shutoff at 250 psig.
      b. Comply with MSS SP-67 or MSS SP-68.
      c. Rotation: Zero to 90 degrees.
      d. Linear or modified equal percentage flow characteristic.
   3. Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216/A216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
   4. Disc: 316 stainless steel.
   5. Shaft: 316 or 17-4 PH stainless steel.
   6. Seat: Reinforced EPDM or reinforced PTFE seat with retaining ring.

7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:
    a. Manufacturer's name, model number, and serial number.
    b. Body size.
    c. Body and trim materials.
    d. Flow arrow.

2.4 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:
1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
2. Construct the valves to be serviceable from the top.
3. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 (DN 25) and larger.
4. Replaceable seats and plugs.
5. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
    a. Manufacturer's name, model number, and serial number.
    b. Body and trim size.
    c. Arrow indicating direction of flow.
6. Control valve assemblies shall be provided and delivered from a single manufacturer as a complete assembly.
7. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.

B. Two-Way Globe Valves NPS 2 and Smaller:
1. Globe Style: Single port.
2. Body: Bronze with ANSI Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: EPDM O-ring.
6. Plug, Seat, and Stem: Brass.
7. Process Temperature Range: 20 to 280 deg F.
8. Ambient Operating Temperature: Minus 22 to 122 deg F.
9. Leakage: ANSI Class VI.
10. Equal percentage flow characteristic.

C. Three-Way Globe Valves NPS 2 and Smaller:
1. Globe Style: Mix flow pattern.
2. Body: Bronze with ANSI Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: EPDM O-ring.
6. Plug, Seat, and Stem: Brass.
7. Process Temperature Range: 20 to 280 deg F.
8. Ambient Operating Temperature: Minus 22 to 122 deg F.
9. Leakage: ANSI Class VI.
10. Modified equal percentage flow characteristic.

D. Two-Way Globe Valves NPS 2-1/2 to NPS 6:
1. Globe Style: Single port.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.

6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

E. Industrial-Grade Straight-Through Globe Valves NPS 1 and Larger:
1. Globe Style: Single port.
2. Body: Cast iron or cast steel.
3. End Connections for NPS 2: Threaded.
4. End Connections for NPS 2-1/2 and Larger: Raised face flanged.
5. Bonnet: Bolted.
6. Packing: PTFE V-ring.
7. Plug: Cage guided and unbalanced.
8. Plug, Seat, and Stem: 416 stainless-steel plug and seat, 17-4 PH stainless-steel cage and 316 stainless-steel stem.
9. Valve Stem: Thread and pin stem to plug.
10. Valve Stem Finish: Polished to 5 microinches rms or less.
11. Plug and Seat Surfaces: Hardened facing.
12. Process Temperature Range: Zero to 450 deg F.
13. Ambient Operating Temperature: Minus 20 to plus 150 deg F.
14. Leakage: FCI 70-2, Class IV.
15. Flow Characteristic: Equal percentage.

2.5 SOLENOID VALVES

A. Description:
1. Action: Either normally open or normally closed in the event of electrical power failure as required by the application.
2. Size to close against the system pressure.
3. Manual override capable.
4. Heavy-duty assembly.
5. Body: Brass.
6. Seats and Discs: NBR or PTFE.
7. Solenoid Enclosure: NEMA 250, Type 4.

2.6 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Agency Listings: ISO 9001, UL 873 or UL 60730, CE and CSA.

B. The valve assembly (control valve and actuator) shall be provided and delivered froma single manufacturer.

C. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.

D. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

E. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.

F. Position indicator and graduated scale on each actuator.

G. Type: Motor operated, with or without gears, electric and electronic.

H. Voltage: Voltage selection delegated to professional designing control system.

I. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

J. Function properly within a range of 85 to 120 percent of nameplate voltage.

K. Field Adjustment:
   1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
   2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

L. Two-Position Actuators: Single direction, spring return or reversing type.

M. Modulating Actuators:
   1. Operation: 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 proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-V signals. (EMS Prefer to remove this range to standardize range.)
      b. Programmable Multi-Function: (EMS Prefers this option. It will be better data for future AI data analytics for energy savings)
         1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
         2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
         3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

N. Position Feedback:
   1. Where indicated, equip modulating actuators with position feedback through voltage signal for remote monitoring. (e.g., VAV damper, hydronic valve position, non-safety related indication only applications where other feedback sensors are available.)
   2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

O. Fail-Safe:
   1. Where indicated, provide actuator to fail to an end position.
   2. Mechanical spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
   3. Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the Super Capacitors. The power fail position shall be proportionally adjustable between 0 to 100% in 10-degree increments with a 2 second operational delay.

P. Integral Overload Protection:
   1. Provide against overload throughout the entire operating range in both directions.
   2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

Q. Valve Attachment:

1. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
2. Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
3. V-bolt dual nut clamp with a V-shaped toothed cradle; directly couple and amount to the valve bonnet stem, or ISO-style direct-coupled mounting pad.

R. 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 shall be from 5 to 95 percent relative humidity, non-condensing.

S. Enclosure:
1. Suitable for ambient conditions encountered by application.
2. NEMA Type 1 for indoor installation in an equipment enclosure.
3. NEMA Type 2 for indoor and protected applications.
4. NEMA Type 4 or Type 4X for outdoor and unprotected applications.
5. Provide actuator enclosure with heater and control where required by application.

T. Stroke Time:
1. Select operating speed to be compatible with equipment and system operation.

PART 3 - EXECUTION

3.1 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. Unless otherwise noted, select valves as follows,
   a. Pressure-independent ball valves for systems controlled with VFDs.
   b. Ball valves with single port and characterized disks for all NPS 2” and smaller.
   c. Globe valves for all NPS 2-1/2” and larger applications.
   d. Butterfly valves, as required, for sizes larger than NPS 6” or outdoor chiller plant operation.

3.2 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 instruments, 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 force.

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. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:
1. Pipe wrenches, pliers, and other grooved tools that will cause injury to or mar surfaces of rods, nuts, and other pa 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. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:
   a. Laboratory exhaust airstreams.
   b. Process exhaust airstreams.
3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. 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.
5. 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.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 4.

E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.

F. Valve Orientation:
1. Install valves with actuators per manufactures recommendations for the specific application.
2. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
3. Install valves in a position to allow full stem movement.
4. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

G. 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.
3. Assure actuator indicators are visible.

H. 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.

I. Flanged Valves:
1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

J. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

K. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same cable designation at each end for operators to determine continuity ~~at~~ and also the unique wire designations to match points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

L. Install engraved phenolic nameplate with valve identification on valve.

3.5 CHECKOUT PROCEDURES

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. (Retrofit applications only)

5. For pneumatic valves, verify that pressure gauges are provided in each airline to valve actuator and positioner. (Retrofit applications only)
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.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING

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

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent open, 50 percent, and zero percent open at proper air pressures. (Retrofit applications only)

C. Check and document open and close cycle times for applications with a cycle time of less than 30 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