Control Valve Technical Specification

Reference:

Throughout this specification, where the word “shall” is used to define a requirement, Seller must comply with the requirements. Where the word “should” is used to define a requirement, Seller may select an alternative and advise Buyer accordingly.

1 Scope

This specification prescribes the minimum mandatory requirements governing the design, sizing, and selection of control valves.

1.1 Equipment and services furnished by the Seller shall include:

1.1.1 Design, fabrication, testing and delivery of all valves, complete with actuators and accessories to meet the requirements of this specification and the control valve data sheets.

1.1.2 All interconnecting instrument tubing and fittings between the valve actuator, positioner, and filter regulator.

1.1.3 Any special tools required for assembly, disassembly and maintenance.

1.1.4 Valve drawings and calculations, including outline dimensions, weights, circuit diagrams, section drawings, part lists and materials.

1.1.5 Installation, operation, and maintenance manuals, including instructions for any sub-suppliers.

1.1.6 Recommended spare parts lists.

1.2 Equipment and services furnished by the Buyer shall include:

1.2.1 Receiving, unloading, storage, and installation of all equipment supplied by Seller.

1.2.2 Electrical wiring for power and signals for position indicating lights, solenoids, and/or control stations.

1.2.3 All external piping, tubing, valves, and fittings, except as specified to be furnished by the Seller.

2 Conflicts and Deviations

2.1 Any conflicts between this specification and other applicable industry standards, codes, and forms shall be resolved in writing by the Buyer.

2.2 Seller shall direct all requests to deviate from this specification in writing to the Buyer, who shall follow internal company procedure and forward such request to the Engineering Manager, Instrumentation and Control.
3 References

The selection of material and equipment, and the design and construction of the equipment covered by this specification shall comply with the applicable edition of the references in effect at the time of the Purchase Order and as noted throughout this specification.

3.1 The International Society for Measurement and Control

ISA Guide Control Valves, Practical Guides for Measurement and Control
ISA S20.50 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves
ISA S75.01 Flow Equations for Sizing Control Valves
ISA S75.05 Control Valve Terminology
ISA S75.11 Inherent Flow Characteristic and Rangeability of Control Valves
ISA SP75.17 Control Valve Aerodynamic Noise Prediction
ISA RP75.23 Considerations for Evaluating Control Valve Cavitation

3.2 American Society of Mechanical Engineers

ASME B1.20.1 Pipe Threads, General Purpose (inch)
ASME B16.5 Steel Pipe Flanges and Flanged Fittings
ASME B16.10 Face-to-Face and End-to-End Dimensions of Valves
ASME B16.20 Ring-Joint Gaskets and Grooves for Steel Pipe Flanges
ASME B16.34 Valves – Flanged, Threaded, and Welding End
ASME B31.1 Power Piping
ASME B31.3 Chemical Plant and Petroleum Refinery Piping
ASME VIII Rules for Construction of Pressure Vessels – Division 1

3.3 Fluid Control Institute

FCI 70-2 Control Valve Seat Leakage

3.4 National Association for Corrosion Control (where applicable)

NACE MR0175 Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment

3.5 International Electrotechnical Commission

IEC 534-8-3 Control Valve Aerodynamic Noise Prediction Method

3.6 Manufacturer’s Standardization Society

MSS-SP-61 Pressure Testing of Steel Valves

3.7 Terminology

The terminology and nomenclature used in ISA S75.05, “Control Valve Terminology”, and other ISA standards apply to this specification.
4 Control Valve Applications

Seller shall select control valve design based on the requirements of the application, process operating conditions, and this specification.

4.1 Applications

Applications, common names and uses, and their key attributes covered under this specification are defined in Chapter 12 of the ISA Guide, “Control Valves, Practical Guides for Measurement and Control” and are summarized below:

4.1.1 Process Control/Feed Regulation

<table>
<thead>
<tr>
<th>Application</th>
<th>Common Names and Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Control</td>
<td>FCV, Throttling</td>
</tr>
<tr>
<td>Level Control</td>
<td>LCV, Deareator, Heater Drain</td>
</tr>
<tr>
<td>Pressure Control</td>
<td>PCV, Injection</td>
</tr>
<tr>
<td>Pressure Reduction</td>
<td>PRV</td>
</tr>
<tr>
<td>Flow Regulation</td>
<td>Feed Regulator, Gas Regulator</td>
</tr>
</tbody>
</table>

Key attributes for process control/feed regulation applications are accuracy of control resulting from small signal changes, and high rangeability resulting from increased pressure differentials that exist across the control valve during start-up, shutdown, and low-load process conditions. Seller shall select control valves that meet these attributes.

4.1.2 Continuous Letdown

<table>
<thead>
<tr>
<th>Application</th>
<th>Common Names and Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attemperation</td>
<td>Spray</td>
</tr>
<tr>
<td>Blowdown</td>
<td>BDV</td>
</tr>
<tr>
<td>Flow Control</td>
<td>FCV, Mixing, Steam Supply</td>
</tr>
<tr>
<td>Choke</td>
<td>Injection, Withdrawal, Re-Injection</td>
</tr>
<tr>
<td>Letdown</td>
<td>Rich Amine, Drum, Drain</td>
</tr>
<tr>
<td>Level Control</td>
<td>LCV, Flash Tank, Separator LCV</td>
</tr>
<tr>
<td>Pressure Control</td>
<td>PCV, Sootblower, Steam, Reducing</td>
</tr>
<tr>
<td>Pressure Regulation</td>
<td>PRV, Steam Supply</td>
</tr>
</tbody>
</table>

The key attribute for continuous letdown applications is accuracy of control. Seller shall select control valves that meet this attribute.

4.1.3 Intermittent Letdown

<table>
<thead>
<tr>
<th>Application</th>
<th>Common Names and Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti Surge Load Reject</td>
<td></td>
</tr>
<tr>
<td>Auxiliary</td>
<td>Aux. Steam</td>
</tr>
<tr>
<td>Extraction</td>
<td>Gas Withdrawal, Cavern Withdrawal</td>
</tr>
<tr>
<td>Relief</td>
<td>PRV</td>
</tr>
<tr>
<td>Blowdown</td>
<td>BDV, Steam Vent, Gas Vent</td>
</tr>
<tr>
<td>Flare</td>
<td>Gas to Flare</td>
</tr>
<tr>
<td>Start-Up</td>
<td>Bypass</td>
</tr>
<tr>
<td>Turbine Bypass</td>
<td>PRDS</td>
</tr>
<tr>
<td>Injection</td>
<td>Gas Injection, Steam Injection</td>
</tr>
<tr>
<td>Letdown</td>
<td>Depressurizing</td>
</tr>
</tbody>
</table>

pp. 417-419

REFERENCE ISA GUIDE pp. 416-417

REFERENCE ISA GUIDE pp. 412-415
Key attributes for intermittent letdown applications are tight shut-off and fast stroke speeds. Seller shall select control valves that meet these attributes.

4.1.4 Recirculation

<table>
<thead>
<tr>
<th>Application</th>
<th>Common Names and Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti Surge</td>
<td>Compressor Recycle, Spillback, Kickback, Surge Control</td>
</tr>
<tr>
<td>Bypass</td>
<td>Start-up, Vent, Turbine Bypass</td>
</tr>
<tr>
<td>Recirculation</td>
<td>Mini-flow, Leak-off, BFP Recirculation</td>
</tr>
<tr>
<td>Dump</td>
<td>Overboard Dump</td>
</tr>
<tr>
<td>Return</td>
<td></td>
</tr>
<tr>
<td>Letdown</td>
<td></td>
</tr>
</tbody>
</table>

Key attributes for recirculation applications are tight shut-off, anti-cavitation and/or low noise trim, and pipe vibration elimination. Seller shall select control valves that meet these attributes.

4.2 Process Operating Conditions

4.2.1 Process Data

For each control valve, Buyer shall specify the process data for the following three flow conditions as a minimum: Normal Flow Rate, Maximum Flow Rate, and Minimum Flow Rate.

4.2.1.1 Normal Flow Rate

This flow condition is generally referred to as the design flow or material balance flow.

4.2.1.2 Maximum Flow Rate

This flow condition shall be consistent with the plant or equipment operational maximum flow condition. The maximum flow condition is generally the governing case for required maximum Cv capacity.

4.2.1.3 Minimum Flow Rate

This flow condition shall be consistent with the plant turndown requirement or equipment turndown capability. The minimum flow condition generally subjects the control valve to the highest differential pressure condition. The minimum flow conditions are generally the governing case for the required trim performance.

Buyer shall also specify the minimum and normal flow conditions for control valve services identified with “normally no flow” as well as the required flow conditions during non-normal plant operating conditions such as start-up, venting, depressurizing, etc.

Seller shall provide sizing calculations for all specified flow conditions.

4.2.2 Data Sheets

Individual control valve specification requirements shall be specified by Buyer and/or Seller on ISA Form S20.50 data sheet (see Appendix A) or Seller’s equivalent.
4.2.3 Seat Leakage

Seat leakage classification shall be in accordance with FCI 70-2 or MSS-SP-61. The leakage class shall be determined by the service application. Soft-seated valves shall not be applied in services with design temperature conditions over 230°C (450°F) or in flashing liquid services.

Leakage problems are commonly related to insufficient seat loading. While a control valve with insufficient seat loading may pass a specified leakage test after it is manufactured, the same valve will not meet the specified leakage rate after it has been subjected to thermal distortion, flashing, or erosive service.

The following minimum seat load requirements (after hydraulic loads, spring loads and friction loads are considered) shall apply:

- **Class I – III**: Per Seller’s Recommendation
- **Class IV**: $5.4 \text{ kgf/mm} (300 \text{ lbf/in})$ of seat ring circumference
- **Class V**: $8.9 \text{ kgf/mm} (500 \text{ lbf/in})$ of seat ring circumference
- **Class VI**: Per Seller’s Recommendation
- **MSS-SP-61**: $17.9 \text{ kgf/mm} (1000 \text{ lbf/in})$ of seat ring circumference

Seat ring circumference is defined as the line of contact between the plug and the seat when the valve is in the fully closed position.

The maximum shut-off differential pressure shall always be calculated and specified for the selected control valve. For all metal-to-metal shut-off applications equal to or exceeding FCI 70-2 Class IV requirements, actuator load calculations shall be provided. Calculations are required to show the minimum load to be applied to the plug-seat arrangement for meeting the required shut-off specifications.

5 Control Valve Selection

5.1 Control Valve Sizing

Each control valve shall be sized and selected to provide reliable operation and control at the specified operating and design conditions. Control valve sizing shall generally be based on ISA S75.01, “Flow Equations for Sizing Control Valves”. Seller may deviate from the ISA formulas provided that the reason is detailed in the technical quotation.

Seller shall select and size the control valve and actuator assembly and accurately evaluate the minimum trim performance requirements.

Capacity calculations for all operating conditions shall be provided. The calculation basis and results shall be shown for manual or computer calculations.

5.1.1 $C_v$ Capacity ($C_v$ Required)

The selected control valve trim capacity ($C_v$ selected) should meet the following:

5.1.1.1 An equal percentage trim shall operate below 95% travel at maximum flow.
5.1.1.2 A linear trim and quick opening trim shall operate below 90% travel at maximum flow.

The \( C_v \) capacity required to meet above criteria is referred to as “\( C_v \) required”. The actual \( C_v \) capacity of the valve is referred to as the “\( C_v \) selected”. Specific applications may require an over-sized \( C_v \) capacity, which shall be specified by the buyer.

5.1.2 Piping Geometry Factor, FP

For valves mounted between pipe reducers or other pipe fittings, the calculated valve capacity shall be corrected for a decrease in valve capacity conforming to ISA S75.01. The piping geometry factors FP, control valve correction factor, calculated \( F_{LP} \) and/or \( X_{TP} \) factors shall be specified by the Seller.

5.1.3 Body Size

Control valve bodies with reduced trims shall be considered for applications with the following conditions:

- Pressure drop in excess of 5170 kPa (750 psi)
- Gas/vapor outlet velocities in excess of 0.3 Mach
- High noise exceeding 85 dBA
- Choked flow
- Flashing exceeding 5% weight of liquid being vaporized
- Erosive fluids
- Future capacity increase is anticipated

In all cases, the control valve nominal body size shall not exceed the nominal line size.

5.1.4 Minimum Rangeability

The installed rangeability (actual available rangeability) of each control valve in the process system shall meet all flow conditions specified. The specified minimum flow condition shall be fully controllable.

5.2 Control Valve Design

5.2.1 Minimum Rating

The valve shall be rated to meet the design pressure and design temperature of the application according to an internationally recognized standard.

For flanged valves, the valve body rating shall never be lower than the flange rating. The flange rating for valve bodies smaller than 16-inch nominal size shall be minimum ASME Class 300. Flange rating for valve bodies 16-inch nominal size and larger shall be minimum ASME Class 150.

5.2.2 Materials

Control valve body materials shall meet, or exceed, the requirements of the application. Body and trim materials shall meet the temperature requirements. NACE MR0175, “Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment” shall be applied for all materials in sour fluid services.
Trim materials shall be selected to withstand corrosion, erosion and wear under severe service conditions. Material combinations shall be selected for maximum galling resistance. AISI 300- and 400-series stainless steel, or equivalent, shall be used as a minimum.

Hard facing or heat treating shall be applied to trim seating surfaces of valves as per Seller's recommendations, but as a minimum, they shall include erosive applications, steam applications with pressure drop conditions exceeding 350 kPa (50 psi) and applications with pressure drop conditions exceeding 4000 kPa (580 psi).

5.2.3 Flow Direction

Flow direction for liquid service applications shall be flow-to-close. Flow direction for gas service applications should be flow-to-open.

5.2.4 Trim Design

Valve trim shall be of the quick-change type for ease of maintenance. No internal components shall be screwed or welded into the valve bodies or bonnets. Trim shall be designed to provide equal pressurization around the plug in order to minimize vibration and prevent any potential for binding. Seller shall select control valve trim design that meets the requirements of this specification.

Seller shall provide a minimum of five years experience with any proposed control valve trim design.

5.2.5 End Connections

End connections shall be specified by the Buyer.

5.2.5.1 Flanged Connections

Flanged connections shall comply with ASME B16.5. Dimensions of flanges larger than 24" size shall comply with industry standard and shall be specified by the Buyer. Raised face (RF) flanges shall be used for lines rated up to and including ASME Class 600 and up to a design temperature of 480°C (900°F). The gasket contact surface of raised face flanged valves up to and including ASME Class 600 ratings shall be smooth machine-finished.

Ring joint (RTJ) flanges shall be used for lines rated ASME Class 900 and above, and for design temperature conditions exceeding 480°C (900°F). Ring grooves shall comply with ASME B16.20.

Unless otherwise noted, face-to-face dimensions of flanged valves should comply with ASME B16.10. Seller to advise face-to-face dimensions proposed.

5.2.5.2 Butt-Weld Connections

Dimensions of butt-weld connections shall comply with Buyer's specification.
5.2.6 Gaskets, Packing and Bonnet

Body gaskets for temperatures below 230°C (450°F) shall be PTFE or equal. Over 230°C (450°F), a spiral-wound gasket, grafoil-type gasket, or equal, shall be used. In all cases, valve gaskets for body/bonnet joints or bottom flange joints shall be metal seal or spiral wound stainless steel with a non-asbestos or Teflon filler suitable for the operating and design conditions.

PTFE V-ring packing shall be used for services up to 230°C (450°F). Above 230°C (450°F), graphite or Seller’s recommended packing shall be used.

A standard bonnet shall be specified for temperatures of 0°C to 230°C (-32°F to 450°F). Above 230°C (450°F) and below 0°C (-32°F), an extended bonnet and/or special packing shall be considered. Seller’s recommendation shall be evaluated and followed when feasible.

5.3 Control Valve Performance

5.3.1 Noise

The maximum noise level emission from a control valve manifold installation, including contributions from piping elbows and reducers, shall not exceed the following limits for any specified operating condition.

- 85 dBA for process control/feed regulation, continuous letdown, intermittent letdown daily service and recirculation daily service applications.

- 90 dBA for infrequent letdown and recirculation applications.

Noise shall be calculated in accordance with methodology outlined in ISA SP75.17 and IEC 534-8-3 guidelines. The maximum noise levels are specified in terms of equivalent continuous A-weighted Sound Pressure Levels (SPL) with an upper tolerance of +0 dBA. Seller shall be required to include inaccuracies of their quoted noise levels and shall guarantee that the noise emission from control valves, including upper tolerance, shall not exceed the above stated limits for any specified operating condition.

Control valve noise shall be treated at the source except as noted below. The provision of low-noise multipath multi-stage trim designs is generally most cost-effective. Diffusers, baffle plates and silencers, either inside the valve body or downstream of the valve, shall not be permitted for the following applications:

- Process control/feed regulation
- Continuous letdown
- Intermittent letdown in daily service
- Recirculation in daily service

For other applications, special attention shall be given to the limited flow rangeability of these devices (i.e., noise reduction from these devices is generally reduced at low flow conditions). Noise generated by diffusers or orifice plates shall be calculated by ISA SP75.17 or IEC 534-8-3 as a separate system from the valve trim and included in the overall noise source.

A maximum of 5 dBA credit may be used for the application of insulation for noise reduction.
Seller shall submit detailed noise calculations with the proposal in accordance with methodology outlined in ISA SP75.17 and IEC 534-8-3 guidelines. The calculation basis and results shall be shown for manual or computer calculations. Seller shall guarantee control valves supplied meet the above requirements.

5.3.2 Vibration and Erosion Limits

Proper control valve selection shall ensure that the required energy can be dissipated without exceeding the maximum vibration levels in the piping system and without exceeding the wear properties of the trim material. Seller shall select control valve trim design that facilitates maximum reduction of control valve induced vibration and trim wear.

Control valve vibration and trim erosion can be reduced by multi-stage multipath trim designs. In order to minimize vibration, Seller shall select control valves based on Table 12.3 of the ISA Guide, “Control Valves, Practical Guides for Measurement and Control” summarized below:

5.3.2.1 Liquid Service Applications

The design shall provide a sufficient number of discrete pressure drop stages to maintain the trim exit velocity below 30 m/sec (100 ft/sec) for single-phase liquids and 23 m/sec (75 ft/sec) for cavitating, flashing, and/or erosive services. Seller shall specify number of discreet pressure drop stages required and provide body and trim exit velocity calculations with proposal. The calculation basis and results shall be shown for manual or computer calculations.

5.3.2.2 Gas Service Applications

The design shall provide a sufficient number of discrete pressure drop stages to maintain the trim exit fluid velocity head \( V_h \) below 480 kPa (70 psia) for continuous or intermittent duty and 1030 kPa (150 psia) for infrequent duty. Valve trim exit fluid velocity head shall be calculated based on ISA Guide, “Control Valves, Practical Guides for Measurement and Control” as follows:

\[
V_h = \text{Kinetic Energy} = \rho_o V_o^2 / (2 g_c)
\]

Where:

- \( \rho_o \) = valve trim exit fluid density
- \( V_o \) = valve trim exit fluid velocity
- \( g_c \) = gravitational constant in unit of measurement

Seller shall specify number of discreet pressure drop stages required and provide body and trim exit fluid velocity head calculations with proposal. The calculation basis and results shall be shown for manual or computer calculations.
5.3.3 Cavitation, Choked Flow and Flashing

ISA S75.01, the ISA Guide “Control Valves, Practical Guides for Measurement and Control”, and the Seller’s valve cavitation index data shall be used for determining the severity of cavitation, choked flow, or flashing conditions in the control valves. Seller shall provide a control valve that eliminates cavitation damage.

The design of valves in cavitation and flashing service shall be based on Chapter 7 of the ISA Guide, “Control Valves, Practical Guides for Measurement and Control” and include the following techniques for Cavitation-Resistant Valves:

– Reduce the pressure in multiple stages
– Direct flow away from the valve body and pipe walls
– Break the flow into many small streams
– Force the flow through multiple turns or tortuous paths

The design shall provide a sufficient number of discrete pressure drop stages to maintain the trim exit velocity below 23 m/sec (75 ft/sec) for cavitating and flashing service. Seller shall specify number of discreet pressure drop stages required and provide body and trim exit velocity calculations with Seller’s proposal. For multi-constituent fluids, special consideration shall be given to the potential for cavitation of the minor components in the fluid.

Contingencies on the minimum required control valve cavitation index shall be applied to compensate for inaccuracies in process data and inaccuracies in Seller’s control valve cavitation index data. Buyer shall carefully evaluate Seller’s selection of a control valve that eliminates cavitation.

5.3.4 Flow Characteristic

Seller shall select the control valve flow characteristic to meet the rangeability requirements as defined in Section 5.1.4, Minimum Rangeability, and to provide stable control over the required range of operating conditions. Seller should select the control valve flow characteristic specified in the control valve data sheets.

6 Actuator Selection

6.1 Actuator Systems

Seller shall be responsible for correctly sizing the actuators based on the process operating conditions and this technical specification. Actuator systems should be pneumatic type, either diaphragm or double-acting piston. For applications with valve bodies greater than 2-inch nominal size and pressure drop in excess of 4000 kPa (580 psi), diaphragm actuators shall not be applied. Air supply system design pressure conditions are generally 930 kPag (135 psig) or less.

Control valve actuator systems other than pneumatic shall be applied on an exception basis only. For actuator systems other than pneumatic type, Seller shall submit a request to deviate in writing to the Buyer.
6.2 Materials

6.2.1 Actuator Cylinders

Materials of the pneumatic actuators shall be suitable for the application and the operating environment.

6.2.2 Pneumatic Tubing, Valves, and Fittings

Materials of the pneumatic tubing, valves, and fittings, which are to be supplied by the control valve Seller, shall be a minimum of AISI 316 stainless steel. Carbon steel, copper, bronze, brass, and AISI 304 stainless steel materials shall not be used on a control valve and actuator assembly. Air tubing, fitting or connection nipple sizes shall not be less than ¼" NPT.

6.3 Performance

6.3.1 Valve Travel Position Accuracy

The total maximum inaccuracy of the valve travel position due to any limitation (i.e., repeatability, deadband, resolution, hysteresis, etc.) shall be less than 2.0%.

6.3.2 Stability

In modulation, no more than one overshoot greater than 2.0% shall be observed during shop performance and field-testing. Seller shall submit test reports with proposal showing performance curve of previous experience with the same specification.

6.3.3 Fail Position

Air failure position shall be accomplished without the aid of process pressure conditions. Air failure position shall be testable during inspection and during plant commissioning when piping systems are de-pressurized.

When an internal spring return feature can not achieve the failure mode of a piston actuator, piston actuators shall be equipped with a fail-safe trip system. Boosters may be applied, as required, to meet actuator stroke response requirements on large or fast control signal changes.

6.3.4 Stroke Speed Requirements

Seller shall select control valve and actuator assembly to achieve the stroke speed requirements specified on the process data sheets.

All applications need to be verified for the actual stroke speed requirements. Stroke times shall be tested on a 100% control signal step change without the aid of process pressure conditions. Stroke times shall be tested during Seller’s inspection. Seller shall document the test criteria and results of the functional tests performed during Seller’s inspection to verify operability and stroke speed. Boosters may be applied to meet stroke time requirements, but stroke movements shall remain stable at 20%, 50%, and 80% control signal step changes.

Fast stroke time requirements under failure conditions shall be separately specified. Seller may use quick-exhaust valves, provided that they do not interfere with the normal control operation of the actuator system.
6.4 Actuator Yoke

Yoke assemblies shall be cast or welded. Bolted yoke assemblies shall not be applied. Yoke assemblies shall be designed such that it will accept installation of all accessories needed to meet the requirements of the specified application.

7 Accessories

7.1 Positioners and Electro-Pneumatic (I/P) Transducers

7.1.1 Valve positioners shall be provided with gauges to indicate supply pressure, control air signal, and positioner output pressure.

7.1.2 Electro-pneumatic valve positioners and pneumatic valve positioners with integral electro-pneumatic transducers shall not be used in potentially vibrating service conditions. The I/P transducer shall then be mounted separately from the valve and actuator assembly.

7.1.3 The total maximum inaccuracy of the signal conversion in I/Ps, or electro-pneumatic valve positioners, due to any limitation (i.e., repeatability, deadband, resolution, hysteresis, etc.), shall be less than 2.0%.

7.2 Handwheels

When handwheels are specified, handwheel installations shall meet the following requirements:

– Neutral position shall be clearly indicated.
– Handwheel mechanism shall not add friction to the actuator.
– Maximum rim pull should be a maximum of 23 kgf (50 lbf).

7.3 Limit Switches

Limit switches shall be actuated by a mechanical switch or proximity sensor. Limit switch enclosures shall be hermetically sealed. Switch contact outputs shall be at minimum, Single-Pole, Double-Throw (SPDT).

7.4 Volume Tanks

7.4.1 Minimum Rating

Volume tanks shall be mechanically designed to withstand a minimum pressure of 930 kPag (135 psig). Volume tanks shall be manufactured in accordance with ASME VIII. Div. 1 (stamped UM) requirements, or equivalent.

7.4.2 Sizing

Volume tanks shall have a minimum capacity for two complete stroke operations of the control valve at the minimum available instrument air pressure of 415 kPag (60 psig). The I/P transducer shall also be supplied from this volume tank.
7.5 Position Indication

7.5.1 Valve Position Indicator

Each control valve shall be provided with a valve position indicator. The indication pointer shall be directly connected to the stem or shaft. The valve position shall be indicated on a reversible scale with clearly graduated markings at 25% valve opening position intervals and the words OPEN and CLOSED at the valve travel limits.

7.5.2 Valve Position Transmitter

An electronic travel position transmitter, either separate or integral to the positioner, providing a proportional valve stem or shaft position signal, shall be specified when required for remote valve position indication.

7.6 Marking and Identification

7.6.1 Marking

The direction of flow shall be cast or steel-stamped on the valve body, or alternatively, a stainless steel arrow shall be permanently fixed to the body by rivets or screws, for all appropriate valves that have been designed or selected for a specific flow direction.

7.6.2 Identification

Stainless Steel nameplates shall be provided for all control valves. Nameplates shall be permanently fastened to the valve by rivets or screws.

8 Documentation Requirements

Documentation requirements to be submitted by the Seller are indicated throughout this specification. As a minimum, documentation submitted by the Seller shall include the following:

8.1 For Gas Service Applications

8.1.1 Capacity \( C_v \) as a function of travel; confirmation by the Seller that the required rangeability can be met with the proposed control valve.

8.1.2 Noise calculations, including calculation basis and results, for each specified flow condition; the Seller shall specify the maximum total inaccuracy (i.e., tolerance expressed in ±dBA for each noise calculation) and shall add this to his calculated noise level.

8.1.3 Body and trim exit fluid velocity head calculations, including number of discreet pressure drop stages required, for each specified flow condition; Seller to also specify body and trim exit fluid velocities expressed in sonic velocity (Mach number).
8.2 For Liquid Service Applications

8.2.1 Capacity ($C_v$) as a function of travel; confirmation by the Seller that the required rangeability can be met with the proposed control valve.

8.2.2 Noise calculations, including calculation basis and results, for each specified flow condition; the Seller shall specify the maximum total inaccuracy (i.e., tolerance expressed in ±dBA for each noise calculation) and shall add this to his calculated noise level.

8.2.3 Cavitation index data and choked flow parameter data both as a function of travel specific for the selected control valve and application. The Seller shall confirm in writing that the selected control valve eliminates cavitation damage.

8.2.4 Size Scale Effect (SSE) and Pressure Scale Effect (PSE) correction data for the cavitation index data.

8.2.5 Body and trim exit fluid velocity calculations, including number of discreet pressure drop stages required, for each specified flow condition.

8.3 For All Applications

8.3.1 Actuator load calculations for each control valve.

8.3.2 Prior test reports of actuator performance stability showing performance curve of previous experience with the same specification.

8.3.3 Seller’s hydrostatic test report for each control valve.

8.3.4 Seller’s seat leakage test report for each control valve.

8.3.5 Seller’s stroke performance test report for each control valve.

8.3.6 Certified Material Test Reports for each control valve.
## APPENDIX A

### Control Valve Technical Specification

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Flow Rate</th>
<th>Units</th>
<th>Max Flow</th>
<th>Nom Flow</th>
<th>Min Flow</th>
<th>Short-Off</th>
</tr>
</thead>
<tbody>
<tr>
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### Service Conditions

<table>
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<tr>
<th>Pipe Line Size</th>
<th>In</th>
<th>Out</th>
<th>Schedule</th>
<th>53</th>
<th>64</th>
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</table>

### Valve Body / Bonnet

<table>
<thead>
<tr>
<th>Type</th>
<th>56</th>
<th>Size</th>
<th>ANSI Class</th>
<th>57</th>
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### Actuator

<table>
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<tr>
<th>Type</th>
<th>66</th>
<th>Max Allowable Pressure</th>
<th>69</th>
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### Actuator Orientation

<table>
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<tr>
<th>Manual Type</th>
<th>63</th>
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### Air Failure Valve

<table>
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<th>Input Signal</th>
<th>64</th>
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### Trim

<table>
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<tr>
<th>Type</th>
<th>70</th>
<th>Lump Nut Material</th>
<th>71</th>
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### Air Set Switches

<table>
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<tr>
<th>Mfr. &amp; Model</th>
<th>72</th>
<th>Quantity</th>
<th>74</th>
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### Tests

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<tr>
<th>Hydro Pressure</th>
<th>75</th>
<th>ANSI/FCI Leakage Class</th>
<th>77</th>
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</table>

*Information supplied by Seller unless already specified.

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