International Association of Oil & Gas Producers

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S-729

October
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Specification for Control Valves

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	October 2021	Issued for Public Review

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of control valves for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-729: Specification for Control Valves

This specification defines the technical requirements for the supply of the equipment.

IOGP S-729D: Procurement Data Sheet for Control Valves

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-729L: Information Requirements for Control Valves

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-729Q: Quality Requirements for Control Valves

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS is in accordance with ISO/IEC Directives, Part 2.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (procurement data sheet, IRS, QRS);

d) this specification.

1 Scope

1.1

This specification defines the requirements for the design, sizing and selection, materials, inspection and testing, marking, preparation for shipment and preservation for general, severe and special service control valves using a pneumatic actuator, i.e. diaphragm, piston, single and double-acting, with accessories:

— sliding stem control valves;

— rotary control valves.

1.2

This specification shall be applied to control valves:

— in throttling (modulating) applications;

— in on-off or gap control applications;

— used as a final element of a safety instrumented function where the function of the valve is not considered to provide primary isolation (e.g. emergency shutdown or process shutdown, or a blowdown function).

1.3

This specification covers the physical boundary for the use of control valves in production facilities, transportation, refining, petrochemical, distribution and storage, with the following exclusions.

a) List of valves excluded:

   — subsea choke valves designed in accordance with API Specification 17D;

   — topside production choke valves (API Specification 6A and non-API) and valves designed in accordance with API Specification 6A;

   — subsea control valves designed in accordance with API Specification 6DSS.

b) List of special service valves excluded:

   — control valves within the process equipment licensor scope where the specific make and model is prescribed by the licensor;

   — process gas-actuated control valves;

   — control valves with special requirements that are part of a proprietary OEM package (e.g. fuel control valves);

   — de-superheater control valves;

   — process applications such as oxygen, chlorine, caustic and acids;

   — pressure-independent chemical injection valves.

1.4

This specification may be used for the procurement of some of the excluded valves/applications in 1.3. Supplementary requirements are required for the extended use of this specification.

2 Normative references

The following publications are referred to in this document, the procurement data sheet (S-729D) or the IRS (S-729L) in such a way that some or all of their content constitutes requirements of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the references document (including any amendments) applies.

ANSI/FCI 70-2, *Control Valve Seat Leakage*

ANSI/ISA 75.01.01, *Industrial-Process Control Valves - Part 2-1: Flow capacity - Sizing equations for fluid flow under installed conditions*

ANSI/ISA 75.02.01, *Control Valve Capacity Test Procedures*

ANSI/ISA 75.05.01, *Control Valve Terminology*

ANSI/ISA 75.08.01, *Face-to-Face Dimensions for Integral Flanged Globe-style Control Valve Bodies (Classes 125, 150, 250, 300, and 600)*

ANSI/ISA 75.08.02, *Face-to-Face Dimensions for Flanged and Flangeless Rotary Control Valves (Classes 150, 300, and 600, and PN 10, PN 16, PN 25, PN 40, PN 63 and PN 100)*

ANSI/ISA 75.08.04, *Face-to-Face Dimensions for Buttweld-End Globe-Style Control Valves (Class 4500)*

ANSI/ISA 75.08.05, *Face-to-Face Dimensions for Buttweld-End Globe-Style Control Valves (Class 150, 300, 600, 900, 1500, and 2500)*

ANSI/ISA 75.08.06, *Face-to-Face Dimensions for Flanged Globe-style Control Valve Bodies (Classes 900, 1500, and 2500)*

ANSI/ISA 75.08.08, *Face-to-Centerline Dimensions for Flanged Globe-Style Angle Control Valve Bodies (Classes 150, 300, and 600)*

ANSI/ISA 75.11.01, *Inherent Flow Characteristic and Rangeability of Control Valves*

ANSI/ISA 75.17, *Control Valve Aerodynamic Noise Prediction*

ANSI/ISA 75.19.01, *Hydrostatic Testing of Control Valves*

ANSI/ISA 75.25.01, *Test Procedure for Control Valve Response Measurement from Step Inputs*

ANSI/FCI 91-1, *Standard for Qualification of Control Valve Stem Seals*

ANSI/NACE MR0103/ISO 17945, *Petroleum, petrochemical and natural gas industries — Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments*

ANSI/NACE MR0175/ISO 15156-1, *Petroleum, petrochemical, and natural gas industries — Materials for use in H_2S-containing environments in oil and gas production — Part 1: General principles for selection of cracking-resistant materials*

ANSI/NACE MR0175/ISO 15156-2, *Petroleum, petrochemical, and natural gas industries — Materials for use in H_2S-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low-alloy steels, and the use of cast irons*

ANSI/NACE MR0175/ISO 15156-3, *Petroleum, petrochemical, and natural gas industries — Materials for use in H_2S-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

API Standard 609, *Butterfly Valves: Double-flanged, Lug- and Wafer-type, and Butt-welding Ends*

API Standard 6ACRA, *Age-hardened Nickel-based Alloys for Oil and Gas Drilling and Production Equipment*

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard*

ASME B16.10, *Face-to-Face and End-to-End Dimensions of Valves*

ASME B16.34, *Valves — Flanged, Threaded, and Welding End*

ASME B16.47, *Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard*

ASME BPVC, Section VIII, Division 1, *Rules for Construction of Pressure Vessels*

ASTM A105/A105M, *Standard Specification for Carbon Steel Forgings for Piping Applications*

ASTM A182/A182M, *Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*

ASTM A193/A193M, *Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications*

ASTM A194/A194M, *Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

ASTM A216/A216M, *Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service*

ASTM A217/A217M, *Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service*

ASTM A276/A276M, *Standard Specification for Stainless Steel Bars and Shapes*

ASTM A320/A320M, *Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service*

ASTM A350/A350M, *Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components*

ASTM A351/A351M, *Standard Specification for Castings, Austenitic, for Pressure-Containing Parts*

ASTM A352/A352M, *Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service*

ASTM A453/A453M, *Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels*

ASTM A479/A479M, *Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels*

ASTM A564/A564M, *Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes*

ASTM A705/705M, *Standard Specification for Age-Hardening Stainless Steel Forgings*

ASTM A739, *Standard Specification for Steel Bars, Alloy, Hot-Wrought, for Elevated Temperature or Pressure-Containing Parts, or Both*

ASTM A995/A995M, *Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts*

ASTM A1014/A1014M, *Standard Specification for Precipitation-Hardening Bolting (UNS N07718) for High Temperature Service*

ASTM A1082/A1082M, *Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications*

ASTM B564, *Standard Specification for Nickel Alloy Forgings*

ASTM B637, *Standard Specification for Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High Temperature Service*

EN 10204, *Metallic products – Types of inspection documents*

EN 13445, *Unfired pressure vessels*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60534-1, *Industrial-process control valves – Part 1: Control valve terminology and general considerations*

IEC 60534-2-1, *Industrial-process control valves – Part 2-1: Flow capacity – Sizing equations for fluid flow under installed conditions*

IEC 60534-2-3, *Industrial-process control valves – Part 2-3: Flow capacity – Test procedures*

IEC 60534-2-4, *Industrial-process control valves – Part 2-4: Flow capacity – Inherent flow characteristics and rangeability*

IEC 60534-3-1, *Industrial-process control valves – Part 3-1: Dimensions – Face-to-face dimensions for flanged, two-way, globe-type, straight pattern and centre-to-face dimensions for flanged, two-way, globe-type, angle pattern control valves*

IEC 60534-3-2, *Industrial-process control valves – Part 3-2: Dimensions – Face-to-face dimensions for rotary control valves except butterfly valves*

IEC 60534-3-3, *Industrial-process control valves – Part 3-3: Dimensions – End-to-end dimensions for buttweld, two-way, globe-type, straight pattern control valves*

IEC 60534-4, *Industrial-process control valves – Part 4: Inspection and routine testing*

IEC 60534-5:2004, *Industrial-process control valves – Part 5: Marking*

IEC 60534-8-3, *Industrial-process control valves – Part 8-3: Noise considerations – Control valve aerodynamic noise prediction method*

IEC 60534-8-4, *Industrial-process control valves – Part 8-4: Noise considerations – Prediction of noise generated by hydrodynamic flow*

IEC 60534-9, *Industrial-process control valves – Part 9: Test procedure for response measurements from step inputs*

IEC 60721-2-1, *Classification of environmental conditions – Part 2-1: Environmental conditions appearing in nature – Temperature and humidity*

IEC 60721-3-0, *Classification of environmental conditions – Part 3-0: Classification of groups of environmental parameters and their severities – Introduction*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEEE 1, *IEEE Recommended Practice — General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation*

IOGP S-563:2018, *Material Data Sheets for Piping and Valve Components*

IOGP S-705, *Supplementary Specification to API Recommended Practice 582 Welding Guidelines for Welding of Pressure Containing Equipment and Piping*

IOGP S-715, *Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine, Coastal and Subsea Environments*

IOGP S-716, *Specification for Small Bore Tubing and Fittings*

ISO 8573-1, *Compressed air — Part 1: Contaminant and purity classes*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 12944-1, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

ISO 12944-5, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems*

ISO 12944-6, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods*

ISO 15848-1:2015, *Industrial valves — Measurement, test and qualification procedures for fugitive emissions — Part 1: Classification system and qualification procedures for type testing of valves*

ISO 15848-2, *Industrial valves — Measurement, test and qualification procedures for fugitive emissions — Part 2: Production acceptance test of valves*

MSS SP 61, *Pressure Testing of Valves*

NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*

NFPA 70, *National Electrical Code*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60534-1, ISA 75.05.01 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org.obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
severe service
application where one or more of the following criteria is met for the specified operating conditions:
— cavitation potential: $(P_1-P_2)/(P_1-P_V)$ is greater than 0,5 for water and aqueous solutions
— cavitation potential: $(P_1-P_2)/(P_1-Pv)$ is greater than 0,7 for single-phase fluids other than water and aqueous solutions
— flashing in liquids: P_2 is less than P_V
— choked flow: where the pressure drop ratio $(P_1-P_2)/P_1$ is greater than 0,7
where
P_1 is the upstream pressure
P_2 is the downstream pressure
P_V is the vapour pressure of the fluid at flowing temperature

3.2
special service
application where one or more of the following apply:
— aerodynamic compressor anti-surge control valves
— low-temperature and cryogenic conditions where the service temperature ranges between -47 °C (-51 °F) and -196 °C (-320 °F)
— release of gases from pressurized liquids or outgassing
— erosive conditions (e.g. applications with entrained solids or particles)
— trim blockage may occur due to potential scaling or wax formation
— supercritical fluids are present

3.3
general service
criteria or applications not defined as severe or special

3.4
pressure-containing part
part whose failure to function as intended results in a release of contained fluid into the environment

Note 1 to entry: Includes as a minimum the body, bonnet, stem, gland flange, bolting and body/bonnet gasket that pass through the pressure boundary.

3.5
pressure-controlling part
part intended to control the flow of fluids

Note 1 to entry: Includes as a minimum the plug and seat.

4 General

4.1

Valves and actuator control equipment shall be designed to operate for the specified:

— environmental conditions; or

— environmental classification in accordance with IEC 60721-3-0 and climatic classification in accordance with IEC 60721-2-1.

4.2

Valve design and pressure-temperature ratings shall be in accordance with ASME B16.34 for the specified pressure class.

5 Valve body style

5.1 General

Separable flanges shall not be used with globe or rotary valves.

5.2 Sliding stem control valves

5.2.1

Globe valves shall be a single-piece casting or forged body with a bolted bonnet design.

5.2.2

Globe valves shall be a single-port design.

5.3 Rotary control valves

5.3.1

Butterfly valves shall be designed in accordance with API Standard 609.

5.3.2

Wafer type butterfly valves shall not be selected for:

— flammable products;

— toxic applications.

5.3.3

For lug and wafer type butterfly valves, the body material shall have the same nominal coefficient of thermal expansion as the connected pipe material.

5.3.4

Lug type butterfly valves with a body size DN 200 (NPS 8) or above, installed between pipe sections, shall have drilled-out threads.

6 Valve body design

6.1

The pressure rating of the valve body shall be greater than or equal to the pressure rating of the connected piping.

6.2 Connection size

6.2.1

The valve body size shall be at least DN 25 (NPS 1) except for depressurization applications.

6.2.2

Valves in depressurization applications shall have a minimum body size of DN 50 (NPS 2) rated for at least ASME Class 300.

6.2.3

The valve size shall not be smaller than two sizes from the pipe size.

NOTE Typical line sizes and their corresponding minimum valve sizes are indicated in Table 1.

Table 1 — Minimum valve size

Upstream line size — DN (NPS)	25 (1)	40 (1½)	50 (2)	80 (3)	100 (4)	150 (6)	200 (8)	250 (10)	300 (12)	350 (14)	400 (16)	450 (18)	500 (20)	600 (24)	700 (28)	750 (30)	800 (32)	900 (36)
Minimum valve size — DN (NPS)	25 (1)	25 (1)	25 (1)	40 (1½)	50 (2)	80 (3)	100 (4)	150 (6)	200 (8)	250 (10)	300 (12)	350 (14)	400 (16)	450 (18)	500 (20)	600 (24)	700 (28)	750 (30)

6.2.4

Body flange dimensions of valve sizes between DN 25 (NPS 1) and DN 600 (NPS 24) shall be in accordance with ASME B16.5.

6.2.5

The body flange dimensions of valve sizes between DN 650 (NPS 26) and DN 1500 (NPS 60) shall be in accordance with ASME B16.47.

6.3 Connection type

Valves with welded end connections shall have a facility to perform in-situ seat and stem leakage tests.

6.4 Flow direction

6.4.1

The normal flow direction of sliding stem valves shall be marked with an arrow as follows:

— permanently cast on the valve body;

— engraved on the valve body; or

— on a stainless steel plate riveted to the valve body.

6.4.2

The normal flow direction of rotary valves shall be marked with an arrow:

— engraved on the valve body;

— on a stainless steel plate riveted to the valve body or bonnet; or

— stamped on the flange rim.

6.4.3

Valves in bidirectional applications shall be marked with an arrow indicating the specified flow direction.

6.5 Valve dimensions

6.5.1

The valve body face-to-face, centre-to-face and end-to-end dimensions shall be in accordance with Table 2.

Table 2 — Body face-to-face, centre-to-face and end-to-end dimensions

Body style	IEC/API standards	ISA standards
Globe style with integral flanges	IEC 60534-3-1 (up to ASME class 1500)	ISA 75.08.01 (up to ASME class 600) ISA 75.08.06 (for ASME class 900 to class 2500)
Globe style angle with integral flanges	IEC 60534-3-1 (up to ASME class 1500)	ISA 75.08.08 (up to ASME class 600)
Flanged and flangeless rotary control valves	API Standard 609 (butterfly valves up to ASME class 600) IEC 60534-3-2 (except butterfly valves up to ASME class 600)	ISA 75.08.02 (up to ASME class 600)
Buttweld end globe style	IEC 60534-3-3 (for ASME class 150 to class 2500)	ISA 75.08.04 (for ASME class 4500) ISA 75.08.05 (for ASME class 150 to class 2500)

6.5.2

When the selected valve pressure classification and sizes are outside the limits of the standards indicated in Table 2, ASME B16.10 dimensions shall apply.

6.6 Body/bonnet gasket and seals

6.6.1

Fluorocarbon-based FKM elastomers shall not be used for CO_2 service where the CO_2 content exceeds 15 % by volume.

6.6.2

Elastomers shall not be used when the H_2S concentration is greater than 5 % by volume.

6.7 Packing

6.7.1

Valve stem flanges shall have a live-loaded packing arrangement or an adjustable bolted gland packing.

6.7.2

The packing system shall be lubricant free.

6.7.3

Packing for process design temperatures less than or equal to 200 °C (392 °F) shall be polytetrafluoroethylene based.

6.7.4

Packing for process design temperatures greater than 200 °C (392 °F) shall be graphite based.

6.8 Fugitive emission or low emission packing

6.8.1

Fugitive emission packing shall be type tested and certified in accordance with ISO 15848-1 or ANSI/FCI 91-1.

NOTE Fugitive emission packing is also referred to as low-emission packing.

6.8.2

Type test qualification shall be performed in accordance with the specified endurance class.

6.8.3

Bellows seal bonnets shall not be used.

6.9 Bonnet design

6.9.1 General

6.9.1.1

Bonnets shall be integral or bolted type with fully retained gaskets.

6.9.1.2

Bonnet bolts shall not be used for mounting brackets or actuator control equipment.

6.9.2 Extension bonnet

When standard bonnet packing cannot meet the process design temperature limits, extension bonnet design may be used.

6.10 Lifting

6.10.1

Lifting points or a method for lifting shall be provided for valve assemblies weighing between 25 kg (55 lb) and 200 kg (440 lb).

6.10.2

Valve assemblies weighing more than 200 kg (440 lb) shall have lifting lugs.

6.10.3

Lifting fixtures or hooks shall have a minimum design safety factor of 2.

7 Valve trim design

7.1 General

7.1.1

The seat ring shall not be pinned, spot-welded or threaded.

7.1.2

Seat rings and cages shall be removable.

7.1.3

The cage and plug shall have the same nominal coefficient of thermal expansion.

7.2 Stem

7.2.1

The valve stem attached to the plug shall be threaded and pinned, threaded, pinned and welded or a single-piece design from bar stock.

7.2.2

Rotary valves shall have a splined or keyed shaft.

7.3 Seat leakage

7.3.1

Valve seat leakage shall conform to IEC 60534-4 or ANSI/FCI 70-2.

7.3.2

Soft seating may be used in applications with a design temperature less than 200 °C (392 °F).

7.4 Severe service trims

7.4.1 Cage hole sizing

Cage holes shall be sized to prevent clogging by fluid particulates.

7.4.2 Erosive service

Cage-guided, multi-stage trim used in erosive service shall have a protected seat design.

7.4.3 Cavitation service

7.4.3.1

For cavitation service, trims shall be hardened according to 10.5 or have an anti-cavitation design.

7.4.3.2

Anti-cavitation trims shall be multi-stage, multi-turn or multi-slot design.

7.4.4 Flashing

Angle valves used in flashing services shall have replaceable outlet liners.

8 Valve sizing and selection

8.1 General

8.1.1

Valve sizing shall be calculated in accordance with IEC 60534-2-1 or ISA RP75.01.01.

8.1.2

When pipe reducers or pipe fittings are used at the valve inlet and outlet, capacity correction shall be included in the sizing calculation.

8.1.3

For three-way globe valves, each flow path shall be sized separately.

8.1.4

For outgassing, supercritical fluids and multi-phase fluid applications, the sizing method, equations and correction factor used to calculate the C_V shall be provided.

8.2 Operating range

8.2.1

The travel of sliding stem valves shall be between 10 % and 90 % for the specified minimum and maximum flow conditions.

8.2.2

The travel of eccentric rotary valves and butterfly valves shall be between 15° and 60° for the specified minimum and maximum flow conditions.

8.2.3

The travel of high performance butterfly valves shall be between 15° and 70° for the specified minimum and maximum flow conditions.

8.3 Characteristics

8.3.1

Inherent valve characteristics shall not be achieved by characterizing the positioner cams.

8.3.2

When the inherent flow characteristics or Cv are different to the manufacturer's published values, plots of travel versus flow shall be provided for 5 %, 10 % and every subsequent 10 % increment up to 100 % of rated travel.

8.4 Velocity limitation

The valve body outlet velocity shall be limited to:

— 0,2 Mach for gas, vapor, and steam services, with any particulates including black powder;

— 0,3 Mach for wet gas, wet vapor and saturated steam services;

— 0,4 Mach for dry gas, dry vapor and superheated steam services;

— 0,5 Mach for gas in infrequent services or services such as venting and depressurization;

— 10 m/s (33 ft/s) for liquid services including water;

— 6 m/s (20 ft/s) for fluids containing erosive particles.

8.5 Noise requirements

8.5.1

Aerodynamic noise calculations for gas, steam or vapour shall be performed in accordance with IEC 60534-8-3 or ISA 75.17.

8.5.2

Hydrodynamic noise calculations for liquids shall be performed in accordance with IEC 60534-8-4.

9 Valves used in safety instrumented systems

9.1

A dedicated solenoid valve shall be configured to achieve the specified fail-safe function.

9.2

On a solenoid valve trip, valves shall switch to the fail-safe state, irrespective of the positioner control signal.

9.3

The valve and components used to achieve the fail-safe state shall be compliant with IEC 61508.

10 Material selection

10.1 General

10.1.1

Material selection shall be based on the specified service and pressure-temperature envelope.

10.1.2

Materials for pressure-containing parts including valve body and bonnet, gasket and bolting shall meet or exceed the piping specification of the connected piping.

10.1.3

Pressure-containing and pressure-controlling part materials shall be selected from Table 3 through Table 11, according to the material selection of the control valve.

10.1.4

Materials shall comply with the standards and IOGP S-563 material data sheets referenced in Table 3 through Table 11 for the listed components and any applicable additional requirements in this specification.

10.1.5

Free machining steel shall not be used.

10.1.6

Lifting lugs, supports, plugs and fittings welded directly to the valve body shall be of the same material grade as the body.

10.1.7

Metallic gaskets shall be minimum 316 stainless steel.

10.1.8

Asbestos and asbestos-containing materials shall not be used.

10.1.9

Cadmium plating shall not be used.

10.1.10

Mating surfaces of sliding elements and threaded components shall have different hardness values or an anti-galling coating.

10.2 Materials

10.2.1

Valves with the following basic materials shall have the materials of their components selected in accordance with Table 3 through Table 11:

— normal temperature carbon steel (NTCS);

— low temperature carbon steel (LTCS);

— austenitic stainless steel type 316 stainless steel;

— ferritic-austenitic stainless steel, type 22Cr duplex and 25Cr super duplex;

— ferritic low alloy Cr-Mo steels type 1¼Cr ½Mo and 2¼Cr 1Mo.

10.2.2

If Table 3 through Table 11 do not list an MDS for a particular material grade, the materials shall be supplied in accordance with the material standard without additional requirements.

10.2.3

Materials for pneumatic actuator components shall conform to the requirements specified in Table 12.

Table 3 — Normal temperature carbon steel – Sweet service, -29 °C (-20 °F) to 425 °C (800 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A105	IC004	A [d]				
ASTM A216 WCB	IC006	A [d]				
ASTM A216 WCC	IC006	A [d]				
ASTM A182 F6A	IM104		A		A	A
ASTM A182 FXM-19	IS404		A			
ASTM A479 UNS S20910 XM-19	IS107		A			
ASTM A479 UNS S41000	IM107		A		A	A
ASTM A276 T410 / ASTM A276 T420	IM107/IM127		A		A	A
ASTM A217 CA 15	IM106				A	A
ASTM A564 Gr. 630 UNS S17400	IU607		A			
ASTM A705 Gr. 630 UNS S17400	IU604		A			
ASTM A182 F316/316L	IS104		A			
ASTM A276 316/316L	IS107		A			
ASTM A479 316/316L	IS107		A			
ASTM A193 B7 / ASTM A194 2H	IX110/IX120			A		
ASTM A193 B7M / ASTM A194 2HM	IX110/IX120			A		
ASTM A320 L7 / ASTM A194 7	IX100/IX109			A		
ASTM A320 L7M / ASTM A194 7M	IX100/IX109			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.
[d] Corrosion allowance 3 mm.

Table 4 — Normal temperature carbon steel – Sour service, -29 °C (-20 °F) to 425 °C (800 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A105	IC004S	A [d]			A	
ASTM A216 WCB	IC006S	A [d]			A	
ASTM A216 WCC	IC006S	A [d]			A	
ASTM A182 FXM-19	IS404SS		A			
ASTM A479 UNS S20910 XM-19	IS107S		A		A	A
ASTM A564 Gr. 630 UNS S17400	IU607S		A		A	A
ASTM A705 Gr. 630 UNS S17400	IU604S		A		A	A
ASTM A182 F316/316L	IS104S		A		A	A
ASTM A276 316/316L	IS107S		A		A	A
ASTM A479 316/316L	IS107S		A		A	A
ASTM A351 CF3M/CF8M	IS106S					A
ASTM A193 B7M / A194 2HM	IX110S / IX120S			A		
ASTM A320 L7M / A194 7M	IX100S / IX109S			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.
[d] Corrosion allowance 3 mm.

Table 5 — Low temperature carbon steel – Sour service, -46 °C (-50 °F) to 345 °C (650 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A350 LF2 Class 1	IC104S	A [d]			A	
ASTM A352 LCC	IC106S	A [d]			A	
ASTM A182 FXM-19	IS404SS		A			
ASTM A479 UNS S20910 XM-19	IS107S		A		A	A
ASTM A182 F316/316L	IS104S		A		A	A
ASTM A276 316/316L	IS107S		A		A	A
ASTM A479 316/316L	IS107S		A		A	A
ASTM A351 CF3M/CF8M	IS106S					A
ASTM A182 F51	ID144S		A			A
ASTM A276 UNS S31803	ID147S		A			A
ASTM A995 Gr. 4A	ID146S					A
ASTM B564 UNS N06625	IN104S		A			
ASTM B637 UNS N07718	- [e]		A			
ASTM A320 L7M / A194 7M	IX100S / IX109S			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.
[d] Corrosion allowance 3 mm.
[e] UNS N07718 compliant with API Standard 6ACRA.

Table 6 — Low temperature carbon steel – Sweet service, -46 °C (-50 °F) to 345 °C (650 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A350 LF2 Class 1	IC104	A [d]				
ASTM A352 LCC	IC106	A [d]				
ASTM A182 FXM-19	IS404		A			
ASTM A479 UNS S20910 XM-19	IS107		A		A	A
ASTM A182 F316/316L	IS104		A		A	A
ASTM A276 316/316L	IS107		A		A	A
ASTM A479 316/316L	IS107		A		A	A
ASTM A351 CF3M/CF8M	IS106					A
ASTM A182 F51	ID144		A			A
ASTM A276 UNS S31803	ID147		A			A
ASTM A995 Gr. 4A	ID146					A
ASTM B564 UNS N06625	IN104		A			
ASTM B637 UNS N07718	- [e]		A			
ASTM A320 L43 / A194 7	IX100 / IX109			A		
ASTM A320 L7 / A194 7	IX100 / IX109			A		
ASTM A320 L7M / A194 7M	IX100 / IX109			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.
[d] Corrosion allowance 3 mm.
[e] UNS N07718 compliant with API Standard 6ACRA.

Table 7 — Austenitic stainless steel type 316, -198 °C (-325 °F) to 540 °C (1 000 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A182 FXM-19	IS404		A			
ASTM A479 UNS S20910 XM-19	IS107		A			
ASTM A182 F316/316L	IS104	A	A		A	A
ASTM A276 316/316L	IS107		A		A	A
ASTM A479 316/316L	IS107		A		A	A
ASTM A351 CF3M/CF8M	IS106	A				A
ASTM A193 B8M/B8MA / ASTM A194 8M/8MA	IS109			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.

Table 8 — 22Cr DSS, -46 °C (-50 °F) to +260 °C (+500 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A182 F51	ID144	A	A		A	A
ASTM A995 Gr. 4A	ID146	A			A	A
ASTM A276 UNS S32750 / UNS32760	ID257		A		A	A
ASTM A193 B8MLCuNA / ASTM A194 GRADE 8MLCuNA	-			A		
ASTM A193 B8MLCuN-CLASS 1B / ASTM A194 GR 9CA	-			A		
ASTM A453 GR 660 Class D	IU100			A		
ASTM A1014 UNS N07718 / API Std 6ACRA (120K)	IN120S			A		
ASTM A1082 UNS S32750, S32760	ID260			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.

Table 9 — 25Cr DSS, -46 °C (-50 °F) to +300 °C (+570 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A182 F53/F55	ID254	A	A		A	A
ASTM A276 UNS S32750 / UNS32760	ID257		A			
ASTM A995 Gr. 6A	ID256	A			A	A
ASTM A193 B8MLCuNA / ASTM A194 GRADE 8MLCuNA	-			A		
ASTM A193 B8MLCuN-CLASS 1B / ASTM A194 GR 9CA	-			A		
ASTM A453 GR 660 Class D	IU100			A		
ASTM A1014 UNS N07718 / API Std 6ACRA (120K)	IN120S			A		
ASTM A1082 UNS S32750, S32760	ID260			A		

Key

A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.

[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.

[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.

Table 10 — 1¼Cr ½Mo Low Alloy Steel, -18°C (0 °F) to 440 °C (825 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/ bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A182 F316/316L	IS104				A	A
ASTM A182 F6A	IM104		A		A	A
ASTM A479 UNS S41000	IM107		A		A	A
ASTM A276 T410/ ASTM A276 T420	IM107/IM127		A		A	A
ASTM A217 CA 15	IM106				A	A
ASTM A276 316/316L	IS107				A	A
ASTM A479 316/316L	IS107				A	A
ASTM A351 CF3M/CF8M	IS106				A	A
ASTM A182 F11 Cl. 2	IV104	A [d]	A			
ASTM A217 WC6	IV106	A [d]			A	
ASTM A739 B11	IV107		A		A	
ASTM A193 B16 / ASTM A194 7	- /IX109			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.
[d] Corrosion allowance 3 mm.

Table 11 — 2¼Cr ½Mo low alloy steel, -29°C (-20 °F) to 540 °C (1 000 °F)

Material selection	MDS/EDS [a]	Pressure-containing parts			Pressure-controlling parts	
		Body/bonnet	Stem	Bolting	Seat ring [b]	Plug, ball, disk, cage [c]
ASTM A182 F316/316L	IS104				A	A
ASTM A276 316/316L	IS107				A	A
ASTM A479 316/316L	IS107				A	A
ASTM A351 CF3M/CF8M	IS106				A	A
ASTM A182 F22 Cl. 3	IV204	A [d]	A			A
ASTM A217 WC9	IV206	A [d]			A	A
ASTM A739 B22	IV207		A		A	
ASTM A193 B16 / ASTM A194 7	- /IX109			A		

Key
A Acceptable alternative

[a] MDS or EDS requirements in IOGP S-563 apply.
[b] Seat hardfacing in accordance with IOGP S-563, EDS IH001.
[c] Trim material for severe service shall be hardfaced or solid hard material in accordance with 10.5.
[d] Corrosion allowance 3 mm.

Table 12 — Material requirements for pneumatic actuator components

Item	Material
Actuator cylinder/covers/spring housing	Onshore: carbon steel with coating [a] (Note: ductile iron can be specified for cylinder flanges) Offshore and marine coastal: carbon steel [a] or 316 stainless steel
Actuator diaphragm material	Nylon reinforced neoprene or nitrile rubber (also called Buna N rubber)
Stroke adjustment components, piston rods and shafts exposed to external environment	Onshore: manufacturer to specify Offshore and marine coastal: 316 stainless steel or better
Yoke	High tensile cast or ductile iron [a]
Mounting kit (connection between valve and actuator)	carbon steel with coating [a] or 316 stainless steel
Tie-rods/bolts/nuts/washers	316 stainless steel or low alloy steel with coating [a]
Actuator/valve connection bolts, nuts, washers, keys	316 stainless steel
Brackets for mounting accessories like limit switch box, junction box, positioner	Onshore: carbon steel with coating [a] Offshore and marine coastal: 316 stainless steel
Hand-wheel	Onshore: carbon steel with coating [a] Offshore and marine coastal: 316 stainless steel
Buffer vessel or volume tank	Onshore: carbon steel with coating [a] Offshore and marine coastal: 316 stainless steel
[a] The coating systems in accordance with Clause 15 shall be followed.	

10.3 Welding and NDE

10.3.1

Welding and post weld heat treatment of pressure-containing parts and attachment welding to pressure-containing parts shall be performed in accordance with IOGP S-705.

10.3.2

Weld overlay and hardfacing shall comply with IOGP S-563:2018, IO001 and IH001.

10.4 Sour service

When sour service is specified, materials and fabrication shall comply with ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103 and the additional metallurgical, manufacturing, testing and certification requirements stated in the applicable material data sheet and element data sheet in IOGP S-563.

10.5 Severe and erosive services

10.5.1

Closure member and seat materials for severe service shall be hardfaced.

10.5.2

Closure member and seat materials for erosive service shall be hardfaced, solid tungsten carbide or ceramic.

10.5.3

Hardfacing or solid hard material shall be compatible with the process fluid.

10.5.4

Solid tungsten carbide shall be in accordance with IOGP S-563, EDS IH005.

11 Actuators

11.1 General

11.1.1

Sliding stem actuators shall have a valve travel indicator.

11.1.2

Rotary valve position shall be indicated using a travel indicator marked in degrees.

11.1.3

Open, close and intermediate position indications shall be marked on a 316 stainless steel scale.

11.1.4

Pneumatic actuators and actuator control equipment shall be operable for the compressed air quality specified below, in accordance with ISO 8573-1:

— class 6 for particle size;

— class 3 for pressure dew point; and

— class 3 for oil concentration.

11.2 Actuator sizing

11.2.1

Actuators shall be sized for:

— maximum shut-off differential pressure; and

— minimum network air supply pressure.

11.2.2

The sum of forces required by the actuator shall be calculated using:

— unbalanced forces arising based on the chosen body style;

— frictional forces due to valve drive train, trim and packing; and

— seating forces to attain the required seat leakage class.

11.2.3

For applications involving bi-directional flow, actuator sizing shall take account of the reverse flow maximum shut-off differential pressure.

11.2.4

The selected actuator torque/thrust shall be greater than or equal to 110 % of the calculated torque/thrust.

NOTE The valve should operate under the specified process conditions at 91 % of minimum network air supply pressure and the extra 10 % margin is only to account for any increase in friction due to usage.

11.3 Pneumatic actuators

11.3.1

Pneumatic actuators shall be:

— single-acting diaphragm type with spring return;

— piston type with spring return; or

— double-acting piston type.

11.3.2

Double-acting actuators shall be used only if valve travel is greater than 100 mm (4 in).

11.3.3

Double-acting actuators used in fail-safe applications shall be supplied with an air receiver.

NOTE Air receivers are also be referred to as buffer vessels or volume tanks.

11.3.4

When the maximum allowable actuator casing pressure is less than the network maximum air supply pressure, tubing relief valves shall be installed in the pneumatic circuit.

11.3.5

The tubing relief valve set pressure with overpressure at full lift shall be less than the maximum actuator casing pressure.

NOTE Typically, the minimum relief valve set pressure is 110 % of the air filter regulator set pressure.

11.3.6

Exhaust, vent and breathing ports of actuators and control equipment shall not allow formation of ice or ingress of bugs.

11.4 Travel stops

11.4.1

Travel stops shall be achieved by a mechanical device fitted to the valve or actuator.

11.4.2

Travel stop functionality shall be achieved independently from the handwheel.

11.4.3

Adjustable travel stops shall be provided with a mechanism that prevents inadvertent operation.

11.4.4

The travel stop position shall be set at a position equal to the specified limiting C_V flow or at the specified position in terms of percentage or degrees.

11.5 Handwheel

11.5.1

The force required at the handwheel to apply the breakaway torque or thrust shall not exceed 360 N (80 lb).

11.5.2

The handwheel diameter shall not exceed 800 mm (32 in).

11.5.3

The handwheel shall close the valve in the clockwise direction.

11.5.4

The handwheel shall have a clutch mechanism for manual use.

12 Actuator control equipment

12.1 General

12.1.1

Actuator control equipment, air receivers and pneumatic components shall be designed for the specified maximum network air supply pressure.

12.1.2

Electronic devices and termination boxes shall be provided with an earth boss outside the housing or enclosure.

12.1.3

Accessories shall be accessible for repair or replacement without removing any part of the actuator.

12.1.4

Electronic equipment and termination boxes shall have a minimum ingress protection of IP66 in accordance with IEC 60529 or NEMA 4X in accordance with NEMA 250.

12.2 Air filter regulators

12.2.1

Air filter regulators shall be installed in the supply line to the control valve.

12.2.2

Air filter regulators shall be internal relief type with an integral filter and manual drain.

12.2.3

Adjustment of the air filter regulator setpoint shall prevent unintentional operation.

12.3 Digital positioners and controllers

12.3.1 Mounting hardware

For offshore and marine coastal applications, the digital positioner or controller mounting bracket, mounting bolts and nuts material shall be 316 stainless steel.

12.3.2 Diagnostics

12.3.2.1

The digital positioner or controller shall have a diagnostic feature to detect if the valve does not move in accordance with the commanded position within the set time.

12.3.2.2

The digital positioner or controller shall have a diagnostic feature to detect if the valve has moved away from the commanded position.

12.3.2.3

The digital positioner or controller shall have a diagnostic feature to detect loss of power or air.

12.3.2.4

The digital positioner or controller shall have a feature to capture valve profiling.

NOTE Valve profiling is also referred to as valve signature or footprint.

12.3.2.5

The digital positioner or controller shall have a predictive diagnostics feature to alert performance degradation that may lead to malfunction.

12.3.3 Cyber security

12.3.3.1

Device type manager and device description files shall be obtained directly from the equipment manufacturer or downloaded from the equipment manufacturer's authorized secure website.

12.3.3.2

Device type manager and device description files shall be signed by the equipment manufacturer using a trusted certificate authority.

12.3.3.3

The digital positioner or controller shall be protected against inadvertent changes with the use of a physical switch, jumper or password.

12.3.4 Electromagnetic immunity

Digital positioners or controllers shall be certified for electromagnetic immunity in accordance with IEC 61000-4-3 or IEC 61000-4-8.

12.4 Solenoid valves

12.4.1

Solenoid valves shall be direct-acting, spring return with power consumption less than 10 W.

12.4.2

The solenoid coil insulation rating shall conform to IEC 60085 or IEEE 1.

12.4.3

When solenoid valves and a positioner are specified for the same application, the solenoid valves shall be installed between the positioner signal output and the actuator.

12.5 Position indication

12.5.1

Limit switches shall be magnetic or inductive proximity type.

12.5.2

Adjustable limit switches shall be set at:

— 3° from the open and closed positions for quarter-turn actuators; or

— 3 % from the open and closed positions for linear actuators.

12.5.3

Limit switches shall be provided with a junction box.

12.6 Air lock relay (lockup valve)

An airlock relay shall be provided if a "fail lock" position is specified.

12.7 Air receiver

12.7.1

The air receiver shall be sized to operate at least three valve strokes at normal network instrument air supply pressure in the event of air supply failure to double-acting actuators:

— fail open valve: open to close, close to open and open to close;

— fail close valve: close to open, open to close and close to open.

NOTE Air receiver is also referred to as volume tank or buffer vessel.

12.7.2

On completion of three strokes, the air receiver pressure shall not be less than the minimum network instrument air supply pressure.

12.7.3

Air receivers shall be provided with a check and block valve for the supply line, a block valve for the pressure instrument connection, a drain valve and a vent valve.

12.7.4

Air receivers shall be equipped with a pressure safety valve or rupture disc.

12.8 Tubing, fittings and instruments valves

Instrument air supply tubing and fittings shall be in accordance with IOGP S-716.

13 Performance requirements

13.1 Hysteresis and dead band

The total hysteresis with dead band error for valves in severe and special services shall be less than or equal to:

— 2 % of the calibrated span for sliding stem valve sizes up to DN 400 (NPS 16) and rotary valve sizes up to DN 250 (NPS 10);

— 3 % of the calibrated span for sliding stem valve sizes greater than DN 400 (NPS 16) and rotary valve sizes greater than DN 250 (NPS 10).

13.2 Anti-surge valves

13.2.1

On initiation of a trip command to the solenoid valve, the anti-surge valve shall be fully opened from the closed position within the specified time, or in no greater than 2 seconds.

NOTE Travel time includes dead time and excludes detection and logic solver time.

13.2.2

Following a step change to the positioner or controller, the anti-surge valve shall be fully opened from the closed position within the specified time, or in no greater than 2 seconds.

NOTE Travel time includes dead time.

13.2.3

The dead band for a valve with an actuator and positioner shall be less than 0,5 % of the calibrated span.

13.2.4

If a limit is not specified, the overshoot shall not exceed 3 % of the calibrated span for a control signal step change within the 10 % to 80 % range.

14 Factory acceptance testing

14.1 Mandatory testing

14.1.1 General

14.1.1.1

Factory acceptance testing of sliding stem and rotary valves shall be performed in accordance with Table 13.

14.1.1.2

Butterfly valves designed in accordance with API Standard 609 shall be tested in accordance with this specification.

14.1.2 Visual inspection

A visual inspection shall be performed to verify the following:

— make/model number;

— cable/tube entry;

— tag plate and marking;

— flow direction;

— orientation of actuator;

— material grade for body/bonnet;

— coating and colour coding check;

— flange size, rating and surface finish;

— air filter regulator and air lock set pressure values;

— supply of accessories;

— plugs and adapters;

— positioner/controller configuration and jumper setting check.

Table 13 — Factory acceptance test — Mandatory tests

Test	Extent of testing for severe and special service for all pressure classes	Extent of testing for general service		Reference (in this specification)
		≤ 600 ASME class	≥ 900 ASME class	
Visual inspection	100 %	1 valve per model per size per pressure class per lot	20 % (minimum 1 valve per model per size per pressure class per lot)	14.1.2
Dimensional check	100 %	1 valve per model per size per pressure class per lot	20 % (minimum 1 valve per model per size per pressure class per lot)	14.1.3
Hydrostatic test	100 %	1 valve per model per size per pressure class per lot	50 % (minimum 1 valve per model per size per pressure class per lot)	14.1.4
Seat leakage test	Class V and Class VI — 100 % Class IV — 1 valve per model per size per pressure class per lot	Class V and Class VI — 100 % Class IV — 1 valve per model per size per pressure class per lot	Class V and Class VI — 100 % Class IV — 1 valve per model per size per pressure class per lot	14.1.5
Packing test	100 %	1 valve per model per size per pressure class per lot	20 % (minimum 1 valve per model per size per pressure class per lot)	14.1.6
Functional test	100 %	1 valve per model per size per pressure class per lot	20 % (minimum 1 valve per model per size per pressure class per lot)	14.1.7
Positive material identification for body/bonnet/closure member	100 %	1 valve per model per size per pressure class per lot	1 valve per model per size per pressure class per lot	14.1.8
Non destructive examination	See IOGP S-563			14.1.9

14.1.3 Dimensional check

A dimensional check shall be performed to verify the following:

— face-to-face or center-to-face dimensions;

— dimensional information for valves with an actuator;

— bolt circle diameter, number of bolts and flange thickness.

14.1.4 Hydrostatic test

14.1.4.1

A hydrostatic shell test shall be carried out for pressure-containing components in accordance with IEC 60534-4 or ISA 75.19.01.

14.1.4.2

The hydrostatic test medium shall be filtered, potable water with a chloride content not exceeding 250 mg/l.

14.1.4.3

For hydrostatic testing of austenitic and duplex stainless steels, the chloride content in the testing medium shall not exceed 50 mg/l.

14.1.4.4

On completion of hydrostatic testing, valves shall be drained of test fluids and dried.

14.1.5 Seat leakage test

14.1.5.1

Seat leakage tests shall be performed in accordance with IEC 60534-4 or ANSI/FCI 70-2.

14.1.5.2

Seat leakage tests shall be performed on assembled valves with actuators and actuator control components.

14.1.5.3

If water is used as a testing medium for seat leakage testing on austenitic and duplex stainless steel valves, the chloride content in the testing medium shall not exceed 50 mg/l.

14.1.5.4

No adjustments shall be made to the actuator, body and bonnet assembly after completion of the seat leakage test.

14.1.6 Packing test

Packing not subjected to fugitive emission testing shall be tested in accordance with IEC 60534-4.

14.1.7 Functional test

14.1.7.1

Functional tests shall be performed on assembled valves with actuator and actuator control equipment.

14.1.7.2

Functional tests shall be performed by stroking the valve from 0 % to 100 % and vice-versa at least three times under atmospheric conditions, using the positioner signal to verify:

— set pressure for the air filter regulator and air lock relay, as applicable;

— specified power supply applied to the positioner/controller, position transmitters and solenoid valve, as applicable;

— limit switch setting, if applicable;

— valve rated travel;

— actuator bench set;

— position transmitter output, if applicable;

— positioner/controller settings and firmware revisions;

— movement is smooth without any jerking.

14.1.7.3

The fail-safe position shall be checked for air supply and power supply failure.

14.1.7.4

Handwheel operation shall be checked from 0 % to 100 % open and vice versa.

14.1.8 Positive material identification

Positive material identification of pressure-containing, pressure-retaining and pressure-controlling parts shall be performed 100 % on alloy steel, stainless steel, nickel alloy and non-ferrous alloy valves.

14.1.9 Non destructive examination

14.1.9.1

Non destructive examination for pressure-containing and trim parts shall be performed in accordance with IOGP S-563.

14.1.9.2

Non destructive examination for fabrication by welding, post-weld heat treatment, and weld overlay or hardfacing shall be in accordance with 10.3.

14.2 Supplementary testing

14.2.1 Rated valve travel test

Rated valve travel tests shall be performed with positioners in accordance with IEC 60534-4.

14.2.2 Fugitive emission production test

Fugitive emission production tests shall be carried out in accordance with ISO 15848-2.

14.2.3 Flow capacity test

Flow capacity tests shall be performed in accordance with IEC 60534-2-3 or ISA 75.02.01.

14.2.4 Flow characteristic test

Flow characteristic tests shall be performed in accordance with IEC 60534-2-4 or ANSI/ISA 75.11.01.

14.2.5 Step response test

Step response tests shall be performed using positioners or controllers in accordance with IEC 60534-9 or ISA 75.25.01.

14.2.6 Travel time test

Travel time tests shall be carried out on the valve from open to close position and vice versa using:

— normal network air supply pressure to the actuator;

— atmospheric pressure across the valve body; and

— booster/speed control devices set at required set values, if supplied.

14.2.7 Low-temperature and cryogenic valves test

14.2.7.1 Seat leakage test

The seat leakage test for low-temperature and cryogenic valves shall be performed in accordance with Table 14.

Table 15 — Low-temperature/cryogenic seat leakage test

Description	Testing prerequisite and acceptance criteria
Test pressure	IEC 60534-4 or ANSI/FCI 70-2
Test temperature	Specified minimum operating temperature
Test gas	— Helium gas (97 % pure) for applications with a design temperature less than -110 °C (-166 °F) — Helium gas (3 % pure) for applications with a design temperature above -110 °C (-166 °F) or nitrogen
Holding time	1 minute after temperature and pressure stabilization
Acceptance criteria	IEC 60534-4 or ANSI/FCI 70-2

14.2.7.2 Hydrostatic shell and body/bonnet/stem seal leakage test

A single test for hydrostatic shell and body/bonnet/stem seal leakage shall be performed on low-temperature/cryogenic valves in accordance with Table 15.

Table 16 — Low temperature / cryogenic shell (external leakage) test

Description	Testing prerequisite and acceptance criteria
Test pressure	Design pressure
Test temperature	Specified minimum design temperature
Test gas	Helium gas (97 % pure) or nitrogen in accordance with specified minimum design temperature
Holding time	10 minutes after temperature and pressure stabilization
Leakage testing for stem seal, body/bonnet and body/bonnet extension gasket area	Sniffing probe with spectrometer
Acceptance criteria	MSS SP 61

14.2.7.3 Functional test

14.2.7.3.1

When low-temperature and cryogenic valve seat leakage or shell hydrostatic testing is specified, functional testing shall be performed at the specified lowest operating temperature.

14.2.7.3.2

The low-temperature and cryogenic valves functional tests shall be performed by stroking the valve from 0 % to 100 % and vice versa at least three times.

15 Surface protection

15.1

Offshore and marine coastal coating systems shall be in accordance with IOGP S-715.

15.2

Onshore and non-marine coating systems shall be selected in accordance with ISO 12944-5.

15.3

Onshore and non-marine coating systems shall be qualified to ISO 12944-6.

15.4

Coating under insulation shall be in accordance with IOGP S-715.

16 Marking, tagging and nameplate

16.1

Tag plates shall be marked with the tag numbers of the valve assemblies, air receivers, positioners, controllers, solenoid valves, limit switches and position transmitters.

16.2

Tag plates shall be 316L stainless steel.

16.3

Tag plates shall be affixed with 316L stainless steel rivets or screws.

16.4

Tag plate information shall be stamped or engraved.

16.5

Markings shall be in accordance with IEC 60534-5:2004, Table 1, with items 19 and 28 mandatory.

16.6

Three-way valves shall be marked to indicate the common inlet or common outlet port by a permanent stamp on the flange.

17 Preparation for shipment and preservation

17.1

Inside and outside surfaces of valves and threaded surfaces of accessories shall be protected from atmospheric corrosion during shipment and storage.

17.2

Open ports and connections shall be blanked off prior to packaging using covers or plugs made of hard plastic or a metal compatible with the port/flange material.

17.3

The mounting surfaces of flanges and weld ends shall be protected from damage during shipment and storage.

17.4

Packing shall prevent moisture, water or foreign matter entering the valve body and components.

17.5

Items that are not installed on the valve shall be packed separately, labelled and tied to the valve.

Bibliography

[1] API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*

[2] ASTM E415-14, *Standard Test Method for Analysis of Carbon and Low-Alloy Steel by Spark Atomic Emission Spectrometry*

[3] ASTM E1086-14, *Standard Test Method for Analysis of Austenitic Stainless Steel by Spark Atomic Emission Spectrometry*

[4] ISO 10005, *Quality management — Guidelines for quality plans*

[5] ISO 17000, *Conformity assessment — Vocabulary and general principles*

[6] ISO 17050, *Conformity assessment — Supplier's declaration of conformity — Part 1: General requirements*

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