International Association of Oil & Gas Producers

SPECIFICATION
S-562

JANUARY
2019

Supplementary Requirements to API Specification 6D Ball Valves

Revision history

VERSION	DATE	AMENDMENTS
3.0	January 2019	Issued for publication

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Project 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 a Joint Industry Project 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). Ten key oil and gas companies from the IOGP membership participated in developing this specification under JIP33 Phase 2 with the objective to leverage and improve industry level standardization for projects 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, based on the ten participating members’ company specifications, resulting in a common and jointly approved specification, and building on recognized industry and/or international standards.

This specification has been developed in consultation with a broad user and manufacturer base to promote the opportunity to realize benefits from standardization and achieve significant cost reductions for upstream project costs. The JIP33 work groups performed their activities in accordance with IOGP’s Competition Law Guidelines (November 2014).

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 vision from the CPC industry is to standardize specifications for global procurement for equipment and packages, facilitating improved standardization of major projects across the globe. While individual oil and gas companies have been improving standardization within their own businesses, this has limited value potential and the industry lags behind other industries and has eroded value by creating bespoke components in projects.

This specification aims to significantly reduce this waste, decrease project costs and improve schedule through pre-competitive collaboration on standardization. This document defines the supplementary requirements to recognized industry standard API Specification 6D, Twenty-Fourth Edition 2014 including Errata 9, March 2017, Addendum 1 March 2015, and Addendum 2, June 2016, Specification for Pipeline and Piping Valves, which is indispensable for the application of this specification.

Following agreement of the relevant JIP33 work group and approval by the JIP33 Steering Committee, the IOGP Management Committee has agreed to the publication of this specification by IOGP. Where adopted by the individual operating companies, this specification and associated documentation aims to supersede existing company documentation for the purpose of industry-harmonized standardization.

This supplementary specification is an update to version 2.0 which was published in December 2016 as part of the pilot phase proof of concept for JIP33. This latest version incorporates manufacturer and member feedback and includes the following key changes.

- sour service included;
- standardization around types of vent and drain connections;
- standardization around gearboxes;
- standardization around designs without a pressure balance hole;
- standardization around stem retention system;
- standardization around design options;
- implementation of latest participating companies operation feedback;
- transfer of material requirements to IOGP S-563.

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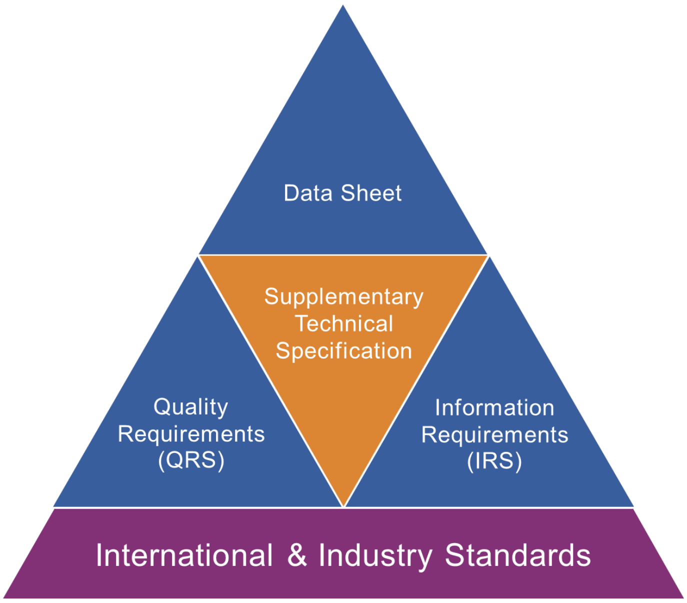
Introduction

The purpose of this specification is to define a minimum common set of supplementary requirements for the specification for procurement of trunnion mounted ball valves (only) to API Specification 6D Twenty-Fourth Edition, 2014 (including Addendum 1 March 2015, Addendum 2, June 2016 and Errata 9, March 2017), Specification for Pipeline and Piping Valves, for application in the petroleum and natural gas industries.

This JIP33 standardized procurement specification follows a common document structure comprising the three documents as described below, which together with the purchase order documentation, define the overall technical specification for procurement. It should be noted however, that this specification package for ball valves does not include a datasheet.



JIP33 Specification for Procurement Documents
Supplementary Technical Requirement

It is required to use all of these documents in conjunction with each other when applying this specification, as follows:

IOGP S-562: Supplementary requirements to API Specification 6D for Pipeline and Piping Valves

This specification is written as an overlay to API 6D, following the section structure of the parent standard, to assist in cross-referencing the requirements. Where sections from the parent standard (API 6D) are not covered in this specification, there are no supplementary requirements or modifications to the respective section. The terminology used within this specification follows that of the parent standard and otherwise is in accordance with ISO/IEC Directives, Part 2.

Modifications to the parent standard defined in this specification are identified as *Add* (add to section or add new section), *Replace* (part of or entire section) or *Delete*.

IOGP S-562L: Information requirements specification (IRS) for IOGP S-562 supplementary requirements to API Specification 6D for Pipeline and Piping Valves

This document defines the information requirements, including format, timing and purpose, for information to be provided by the manufacturer. It also defines the specific conditions which must be met for conditional information requirements to become mandatory. The information requirements listed in the IRS have references to the source of the requirement.

IOGP S-562Q: Quality requirements specification (QRS) for IOGP S-562 supplementary requirements to API Specification 6D for Pipeline and Piping Valves

This document includes a conformity assessment system (CAS) which specifies standardized user interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser in the purchase order.

The IRS is published as an editable document for the purchaser to specify application specific requirements. The supplementary requirements specification and QRS are fixed documents.

Unless defined otherwise in the requisition, 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 (equipment datasheets, IRS, QRS);

d) this specification;

e) the parent standard.

1 Scope

1.1 General

Replace first paragraph with

This specification defines the requirements for the design, manufacturing, assembly, testing and documentation of trunnion mounted ball valves for application in, but not limited to:

a) piping systems meeting the requirements of ASME B31.3 for facilities and process plants;

b) pipeline systems meeting the requirements of ASME B31.4 for liquid hydrocarbons and other liquids;

c) pipeline systems meeting the requirements of ASME B31.8 for gas transmission and distribution piping systems;

d) pipeline systems meeting the requirements of ISO 13623 for the petroleum and natural gas industries.

This specification covers:

- sizes NPS 2 (DN 50) and above;
- soft and metal seated;
- flanged and butt-welding ends;
- full bore and reduced bore;
- manually operated: lever, gearbox and bare shaft (for actuation);
- design temperature range from –50 °F (–46 °C) to 302 °F (150 °C);
- block and bleed (BB) valves;
- double block and bleed (DBB) valves;
- double isolation and bleed DIB-2 (one seat unidirectional, SPE, and one seat bidirectional, DPE) valves.

Add to third paragraph

The following items are excluded from the scope of this specification:

- check valves;
- floating ball valves;
- gate valves;
- plug valves;
- hub-end connections;
- short pattern;
- actuators (operators): electric, hydraulic or pneumatic devices;
- cryogenic service valves with a design temperature below –50 °F (–46 °C);

- high temperature valves with a design temperature above 302 °F (150 °C);
- buried valves with stem extensions;
- double isolation and bleed DIB-1 (both seats bidirectional - DPE) valves;
- lined (plastic or rubber) valves;
- internal painting/coating;
- ASME class 400 – non-standard;
- valve sizes not listed in Table 1;
- integral block and bleed valve manifold with two obturators.

1.3 Conformance with Specification

Replace section with

The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services to this specification conform to API Specification Q1, ISO 9001 or an equivalent quality management system standard agreed with the purchaser.

Quality plans and/or inspection and test plans developed as outputs to operational planning and control for the products and/or services shall define the specific controls to be implemented by the manufacturer and, when applicable, sub-manufacturers to ensure conformance with the specified requirements.

Controls shall address both internally and externally sourced processes, products and services.

Quality plans and/or inspection and test plans shall include provisions for:

- the quality specification level (QSL) in accordance with this specification and the contract documentation;
- the purchaser's conformity assessment system (CAS) as specified in IOGP S-562Q and in the valve enquiry or the purchase order.

2 Normative References

Replace respective references with

ASME Boiler and Pressure Vessel Code (BPVC), Section V:2017	Nondestructive Examination
ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1:2017	Rules for Construction of Pressure Vessels
ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 2:2017	Alternative Rules
ISO 17945/ NACE MR0103	Petroleum, petrochemical and natural gas industries – Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments

Add to section

API Standard 6ACRA	Age-hardened Nickel-based Alloys for Oil and Gas Drilling and Production Equipment
API Specification 6A	Specification for Wellhead and Christmas Tree Equipment
API Specification 6D	Specification for Pipeline and Piping Valves
API Specification 17D:2018	Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
ASME PCC-1	Guidelines for Pressure Boundary Bolted Flange Joint Assembly
ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing
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 and Alloy 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 A262: 2015	Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
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 A479/A479M	Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A494/494M	Standard Specification for Castings, Nickel and Nickel Alloy
ASTM A564/A564M	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A694/A694M	Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
ASTM A705/705M	Standard Specification for Age-Hardening Stainless Steel Forgings
ASTM A961/A961M	Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

ASTM A995/A995M	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM A1082/A1082M	Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications
ASTM B446	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar
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
ASTM D4894	Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials
ASTM D4895	Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced From Dispersion
ASTM F2168:2013	Standard Specification for Packing Material, Graphitic, Corrugated Ribbon or Textured Tape, and Die-Formed Ring
ASTM F2191/ F2191M:2013	Standard Specification for Packing Material, Graphitic or Carbon Braided Yarn
ASTM F788	Standard Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
ASTM F812	Standard Specification for Surface Discontinuities of Nuts, Inch and Metric Series
AWS A4.2M/A4.2	Standard Procedures for Calibrating Magnetic Instruments to Measure Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal
BS 4518	Specification for metric dimensions of toroidal sealing rings ('O'-rings) and their housings
EN 473	Non-Destructive Testing – Qualification and Certification of NDT Personnel
EN1591	Flanges and their joints – Design rules for gasketed circular flange connections
EN 1779	Non-destructive testing – Leak testing – Criteria for method and technique selection
EN 14772:2005	Flanges and their joints – Quality assurance inspection and testing of gaskets in accordance with the series of standards EN 1514 and EN 12560
EN 60529	Degrees of protection provided by enclosures
IOGP S-563	Material Data Sheets for Piping and Valves
ISO 8249	Welding – Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals
ISO 3601-2	Fluid power systems – O-rings – Part 2: Housing dimensions for general applications.
ISO 5211	Industrial Valves – Part-turn actuator attachments
ISO 9001	Quality Management Systems – Requirements
ISO 13847:2013	Petroleum and natural gas industries – Pipeline transportation systems – Welding of pipelines
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 15848-1:2015/ Amd.1:2017	Industrial valves – Measurement, test and qualification procedures for fugitive emissions – Part 1: Classification system and qualification procedures for type testing of valves, AMENDMENT 1
ISO 15848-2	Industrial valves – Measurement, test and qualification procedures for fugitive emissions – Part 2: Production acceptance test of valves
ISO 17781	Petroleum, petrochemical and natural gas industries - Test methods for quality control of microstructure of ferritic/austenitic (duplex) stainless steels
ISO 17782	Petroleum, petrochemical and natural gas industries - Scheme for conformity assessment of manufacturers of special materials
ISO 23936 (all parts)	Petroleum, petrochemical and natural gas industries - Non-metallic materials in contact with media related to oil and gas production
NORSOK M-650	Qualification of manufacturers of special materials
NORSOK M-710	Qualification of non-metallic materials and manufacturers – Polymers
SAE AS 568	Aerospace Size Standard for O-rings

3 Terms, Definitions, Acronyms, Abbreviations, Symbols, and Units

3.1 Terms and Definitions

3.1.25
on-site

Replace section with

Assembler's or manufacturer's facility where a required process activity is performed, with the activities conforming to an API Q1 or ISO 9001 quality management system (QMS).

Replace section heading with

3.1.33
pressure-containing part

Replace section with

A part whose failure to function as intended results in a release of contained fluid into the environment and as a minimum, includes bodies, end connections, bonnets/covers, bolting, stems, shafts and trunnions that pass through the pressure boundary.

Add new section

3.1.53
bolted valve joint
Valve joint with bolted bonnet, cover or body as defined in ASME B16.34, 6.4.

Add new section

3.1.54
component batch
Quantity of components of the same design, material, size and rating, from a single production lot, manufactured in one location.

Add new section

3.1.55
corrosion allowance
Additional thickness to be added to the minimum required thickness given by the selected standard to account for loss of material due to corrosion.

Add new section

3.1.56
pressure balance hole
A hole in the ball which provides pressure balance between the valve bore and valve cavity only when in the open position, to avoid the cavity pressure ever being lower than the flow bore. This is to avoid both piston seats being simultaneously energized onto the ball producing a high operating torque. The hole does not provide relief of cavity over-pressure.

Add new section

3.1.57
purchaser
An associate, subsidiary or other organization acting as owner, company, principal or customer as designated in the purchase order. It is the one who initiates the purchase order, ultimately pays for its design and construction, and will generally specify the technical requirements.

Add new section

3.1.58
soft seat insert
Non-metallic cylindrical ring insert which is the primary seat sealing element.

Add new section

3.1.59
valve batch
Quantity of valves of the same design, material, size and rating, from a single purchase order, manufactured in one location.

3.2 Acronyms and Abbreviations

Add to section

Ac	acceptance number
ACCP	ASNT Central Certification Program
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society of Testing and Materials
AWS	American Welding Society
BS	British Standard
CAD	computer aided design
CAS	conformity assessment system
CPC	capital project complexity

CRA	corrosion resistant alloy
CS	carbon steel
DIB-1	double isolation and bleed (both seats bidirectional - DPE) valves
DIB-2	double isolation and bleed (one seat unidirectional and one seat bidirectional) valves
DPE	double piston effect
DSS	duplex stainless steel
EDS	element datasheet
EN	European Norm
ENP	electroless nickel plating
FAT	factory acceptance testing
FE	fugitive emissions
FEA	finite element analysis
FEPM	tetrafluoroethylene/propylene dipolymers
FFKM	perfluoroelastomer
FKM	fluorocarbon terpolymer
HNBR	hydrogenated nitrile butadiene rubber
HSE	health, safety and environment
HVOF	high velocity oxygen fuel
ID	inner diameter
IEC	International Electrotechnical Commission
IOGP	International Association of Oil & Gas Producers
IRS	information requirements specification
ISO	International Organization for Standardization
JIP33	Joint Industry Project 33
LT	low temperature
LTCS	low temperature carbon steel
MDR	manufacturer’s valve data report
MDS	material datasheet
NACE	National Association of Corrosion Engineers
NDT	nondestructive testing
NORSOK	Norsk Sokkels Konkuranseposisjon (Norwegian industry standard)
NPT	national pipe taper
NTCS	normal temperature carbon steel
OD	outer diameter
OEM	original equipment manufacturer
PC	pressure-containing parts (as defined by 3.1.33)
PCD	pitch circle diameter
PCTFE	polychlorotrifluoroethylene
PED	Pressure Equipment Directive

PEEK	polyetheretherketone
ppm	parts per million
PR	pressure-controlling parts (as defined by 3.1.34)
PTFE	polytetrafluoroethylene
PW	process-wetted parts (as defined by 3.1.35 excluding PC and PR)
QMS	quality management system
QRS	quality requirements specification
RF	raised face
RGD	rapid gas decompression
RPTFE	reinforced polytetrafluoroethylene
RTJ	ring type joint
SAE	Society of Automotive Engineers
SDSS	super duplex stainless steel
SPE	single piston effect
SS	stainless steel
SWG	spiral wound gasket
SWL	safe working load
TCC	tungsten carbide coating
TGA	thermogravimetric analyzer
UNS	unified numbering system (alloys)
US	United States (of America)
WEF	World Economic Forum

3.3 Symbols and Units

Add to section

D	diameter
L	length
ppm	part per million (mass)
Ra	roughness average

4 Valve Types and Configurations

4.1 Valve Types

4.1.3 Ball Valves

Add to section

The valve obturator shall:

– be a one-piece casting or a forging;

– have a cylindrical port; and

– not have a hollow construction.

4.2 Valve Configurations

4.2.2 Reduced-opening Valves

Add to list after first paragraph

– valves with bore size above NPS 24 (DN 600): up to three sizes below nominal size of the valve with bore according to Table 1.

Add to section

Beyond the limits of Table 1, the minimum valve bore is defined by agreement with the purchaser. In this case, the minimum and maximum internal bore dimensions shall be stated in the contract documentation.

Add new section

4.3 General

When applicable, lagging requirements are indicated in Annex W.

Valves shall be designed for bidirectional sealing.

Unidirectional self-relieving type seats (single piston effect) shall be supplied unless specified otherwise by the purchaser in the contract documentation.

The valve design shall be able to operate with pressure from both ends of the valve simultaneously (no pressure into the body cavity) without damage (e.g. no plastic deformation of ball, seats, stem, trunnion, bearings and sealing components).

Valves shall be designed so that all parts can function properly, independent of the installed valve orientation defined as follows and in Figure 6:

– horizontal position (horizontal flow bore, with vertical valve stem);

– horizontal position (horizontal flow bore, with horizontal valve stem);

– vertical position (vertical flow bore, with horizontal stem); or

– any inclined position with stem orientation between horizontal and vertical up.

Horizontal orientation

Vertical orientation

Figure 6 – Valve Orientation

A bolted body valve design shall be able to be fully dismantled without any dedicated specific tools.

For valve designs requiring special tools for disassembly or maintenance (for top-entry type, etc.), such tools shall be supplied with valves and defined in agreement with the purchaser.

For metal seated design, the gap between the body and seat ring should have an anti-debris lip or similar type design to minimize debris accumulation that could impair seat dynamics and seal performance.

5 Design

5.1 Design Standards and Calculations

Replace second paragraph (including note) with

Design and calculations for pressure-containing elements, including bolted joints and bolt sizing, shall be in accordance with ASME B16.34 or ASME BPVC Sec VIII Div 1 or Div 2 and shall meet the minimum requirements of Table S.1.

When designing valves to conform to ASME VIII Div.1 or Div.2, the valve body design shall include, as a minimum, the load cases for bending moment and axial force as provided in Tables P.1 and P.2, with the coincident maximum rated pressure given according to ASME B16.34 material group at maximum design temperature. Consideration shall be given to allowable design stresses, deformations and integrity of sealing areas.

The external load for valves shall consider the following:

- pressure rating to ASME B16.34 material group at ambient temperature;
- pressure rating to ASME B16.34 material group at maximum design temperature.

Where more than one seal is used to form the pressure-containing joint, the gasket or seal diameter used in the bolting calculation and closure flange stress verification shall be the outer seal diameter of the largest seal, or in the case of spiral wound gaskets, the median diameter shall be used.

Pressure-containing bolted valve joints shall be secured by stud and nut bolting, except that the bonnet cover or gland plate may be secured by cap screws; not less than four bolts shall be used in any flange and no bolting shall be less than ⅜ in. (10 mm) in diameter.

Bolting preload torques shall be calculated using API 6A, ASME PCC-1 or EN 1591, taking into consideration accurate values for coefficient of friction based on bolting material, bolting coating and the type of lubricant applied. Bolting lubricant considered for bolting preload torque calculations shall be identical to the one used by the manufacturer on thread and nut faces.

For valve body gaskets, except ring type joint or self-energizing gaskets, the bolting preload shall generate the value required to achieve the fugitive emission performance, based on the allowable bolt stress at design temperature to achieve a 20 ksi (138 MPa) gasket seating stress.

The bolting preload shall exceed the calculated bolt load required to seal under hydrostatic test conditions, without overstressing the bolting.

To address variability in bolt stress by torqueing, the bolt stress due to preload shall not exceed 70 % of yield at design temperature.

NOTE When the applied bolting preload is less than the load applied to the bolting under hydrostatic test conditions, bolting may stretch which could lead to a loss of pressure containment during test, or a relaxation in preload, with subsequent loss of pressure containment in service. Flanged joints that may be subject to thermal gradients may likewise be subject to a decrease in bolt loads. The manufacturer may elect to reapply bolting preload after successful completion of body pressure testing.

5.5 Valve Operation

Replace first paragraph with

Valve levers or gearboxes shall be designed and sized to operate against the maximum rated pressure determined in accordance with 5.2 for material at 100 °F (38 °C).

5.6 Pigging

Add to section

Full bore valves installed in a piggable line shall have the same bore through the entire valve, including the transition piece and the pup piece, and shall be capable of being pigged, sphered and scraped regularly without damage to the seats.

The bore shall match the internal pipeline diameter and shall present as smooth a profile as possible, ensuring uninterrupted free passage.

The valve full bore diameter, transition piece and pup piece shall be measured to verify cylindricity (roundness, straightness) over the full length of the flow passage axis.

The measured dimensions shall be documented and shall meet the following tolerance acceptance criteria; diameter shall be equal to the minimum inside diameter tolerance of the governing line pipe specification.

Where the manufacturer's standard bore is close to the specified internal pipeline diameter bore, the manufacturer may propose the standard bore with smooth transition at the valve end, for the purchaser's approval. This is to avoid purchasing a bespoke valve where a standard valve can be used.

5.7 Valve Ends

5.7.1 Flanged Ends

5.7.1.1 General

Add to section

The back faces of flanges shall be machined flat, either as spot facings at the nut positions or machined over the entire back flange area.

The nut seating area shall not present an "as cast" or "as forged" surface for the nuts. Additionally, the valve end connections shall be designed to allow heavy series nuts (ASME B18.2.2) to be used for the piping connections, allowing for at least two threads to protrude above the nut without contacting other valve body parts or bolting.

The valve flanged ends shall be integral with the valve body or end closure forging or casting. Weld on flanges shall not be permitted.

5.7.1.2 Offset of Aligned Flange Centerlines – Lateral Alignment

Replace section with

For valves of NPS 2 (DN 50), the maximum lateral misalignment shall be 0.06 in. (1.5 mm).

For valves larger than NPS 2 (DN 50), the maximum lateral misalignment shall be 0.08 in. (2 mm).

5.7.1.3 Parallelism of Aligned Flange Faces – Angular Alignment

Add to section

For valves larger than NPS 24 (DN 600), the maximum parallelism misalignment shall be 0.02 in./ft (1.75 mm/m).

5.7.2 Welding Ends

Add to section

Butt-welded end valves shall be provided with extension (pup) pieces in accordance with Table 9.

Extension (pup) pieces shall be considered an integral part of the valve.

Valves requiring welded ends shall be supplied complete from the manufacturer or their designated sub-contractor to ensure welding compatibility and body or seal performance.

If a pup piece is to be attached to a valve by the manufacturer's sub-contractor, the manufacturer shall take the following actions:

– Advise the party responsible for welding the pup pieces on to the valve body, the maximum allowable body temperature during welding and any subsequent post weld heat treatment required.

– Approve the qualified welding procedure and procedure qualification record.

– Unless the pipe for the pup piece is issued by the purchaser, the manufacturer shall provide the pup pieces as forgings equal to the highest material grade specified, that being the valve body or the associated piping/pipeline. Pup piece material shall comply with the requirements in the applicable MDS in IOGP S-563.

Add new table

Table 9 – Pup Lengths

Valve Size	Pup Length
NPS 2 to NPS 8 (DN 50 to DN 200)	8 in. (200 mm)
NPS 10 to NPS 20 (DN 250 to DN 500)	Minimum 1*D* or Maximum 20 in. (500 mm)
NPS 22 (DN 550) and above	32 in. (800 mm)
NOTE 'D' being NPS (DN).	

Outside diameter, wall thickness, material grade and composition of the pup pieces shall be as specified in the purchase order.

The pup pieces shall be welded (and the weld heat-treated, if applicable) before the valve internals are installed.

When the test pressure is limited by pup pieces, the manufacturer shall highlight it to the purchaser in order to establish adequate testing procedures and manufacturing sequence.

Transition tapers shall not be steeper than 1:4 and shall comply with ASME B31.3:2016, Figure 328.4.3 (ASME B31.8:2016, Figure I 5 or ISO 13847, 7.7).

The ratio of the valve body thickness to the pipe wall thickness shall not exceed 1.5:1.

The ratio of the specified minimum yield strength of the transition piece or pup material to the valve body material or transition piece to the pup shall not exceed 1.5:1.

Heat-treatment delivery conditions shall be clearly marked on the pup piece using a low-stress die stamp.

If the reduced wall thickness due to embossing is less than the required minimum thickness for a pup piece, alternative marking and traceability method shall be defined in agreement with the purchaser.

If the pup pieces are supplied in forged execution by the manufacturer, the manufacturer is to confirm with the purchaser whether an additional forged piece (test ring) in the same material is required for site welding qualification.

5.8 Valve Cavity Pressure Relief

Replace third paragraph with

Valve cavity pressure relief shall be achieved by self-relieving seat rings that internally relieve excess pressure from the valve cavity to prevent over-pressurization. No other cavity pressure relieving systems are permitted. Correct functioning of the self-relieving seat rings shall be verified by the tests specified in Table J.3. Acceptance criteria shall be in accordance with H.8.2.4.

Replace section heading with

5.9 Drains and Vents

Add new section heading before first paragraph

5.9.1 Drain and Vent Standard Connections

Add after first paragraph of 5.9

Drain and vent standard connections shall be specified by the purchaser and be in accordance with one of the following:

- For all sizes, and classes 150 to 600, and for classes 900 to 2500, sizes NPS 8 (DN 200) and below:
  - NPT threaded fitting;
  - NPT threaded fitting suitable for seal welding;
  - Double seal (axial outboard and radial inboard) parallel threads with locking ring. During loosening of the fitting, the design configuration shall ensure pressure is relieved from the inboard seal without thread disengagement.
- For NPS 10 (DN 250) and above, classes 900 to 2500, a studded flange connection shall be used.

Drains and vents shall be designed to ensure the following conditions are met:

- The drain connection shall be at the lowest possible position on the valve body cavity and the vent connection at the highest practical position on the valve body cavity, both with respect to the purchaser's specified installation orientation. If the installation orientation is not specified, the standard valve orientation is horizontal flow bore and stem vertical up.
- Valves with a bore of NPS 3 (DN 80) and smaller may have a single drain and vent connection, at the lowest possible position on the valve body cavity.

- Plugs, fittings and blinds shall have a design pressure not less than the valve rated pressure and shall be capable of withstanding the valve hydrostatic shell test pressure (150 % of valve rated pressure).
- Plugs, fittings and blinds shall be designed in accordance with a recognized industry design code.
- Minimum wall thickness of connection areas shall be in accordance with ASME B16.34 unless otherwise specified.
- On a corrosion resistant alloy (CRA) clad valve where drain ports breach the CRA layer, the drain and vent ports shall be fitted with a welded nickel based alloy insert that has an integral shoulder on the valve cavity side to prevent blowout in case of attachment weld failure. Welds of the nickel based alloy insert shall be full pressure containing welds in accordance with ASME VIII Div1 or 2.

Typical configurations of the specified drain and vent connections are shown, for illustration purposes only and do not imply design, in Figures 7 to 10, as applicable.

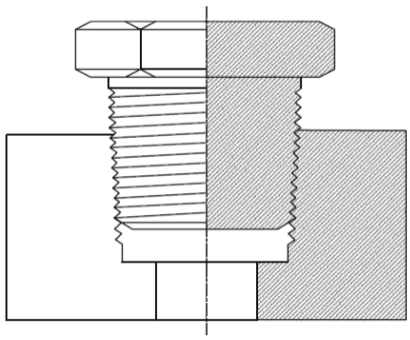


Figure 7 – NPT Fitting with Additional Tolerance Requirements

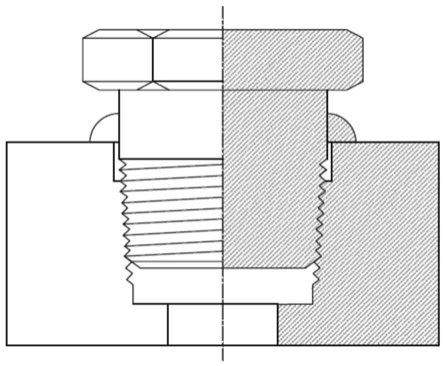


Figure 8 – Seal Welded NPT Fitting with Additional Tolerance Requirements

Requirements for welded plugs:

- Welding on to threaded areas is not permitted.
- The thread form shall protrude above the bottom of the recess to enable additional tolerance requirements per 5.9.2.
- The shoulder shall extend below the surface of the valve body so that the seal weld does not come into contact with the threads of the NPT fitting.

- Parallel areas should be machined first and allow adequate tolerance to permit fitment and welding as per the manufacturer's approved procedure.
- Minimum body wall thicknesses shall not be affected by the recess.

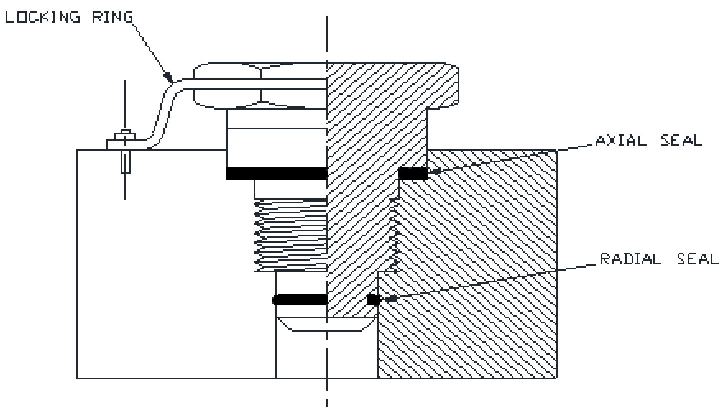


Figure 9 – Double Seal (Axial Outboard and Radial Inboard) Parallel Threads with Locking Ring

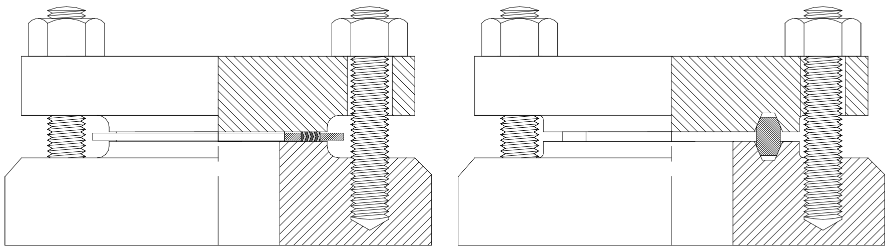


Figure 10 – Studded Flange Connection

Add new section after Table 2

5.9.2 NPT Tolerance and Torque Control

PTFE tape shall not be used on threaded connections.

NPT connections shall be in accordance with ASME B1.20.1 with additional thread tolerance requirements, ensuring that a hand-tight joint assembly achieves four to five full turns of engagement per ASME B1.20.1:2013, Table 2 prior to application of sealant.

The manufacturer shall further tighten the threaded fitting with a sealant to achieve the make-up number of turns (three full turns for up to 1 in. diameter NPT plugs per ASME B1.20.1:2013, Table 2). Final torques shall meet the manufacturer's documented torques with a calibrated torque wrench to verify that the correct required torque value has been achieved and that the connection is leak tight at the rated pressure.

The thread sealant shall be compatible with the plug and housing materials and consideration made to prevent galling.

The internal thread length and port geometry shall be sufficient to avoid the plug bottoming out on the valve body.

Add new section

5.9.3 Seal Welds

All sealant shall be fully removed prior to seal welding.

Seal welding of threads shall comply with the requirements of ASME B31.3 and consist of two passes with rotating starts and stops.

Seal welds shall meet the following:

– a minimum welding dimension C_x in ASME B31.3:2016, Figure 328.5.2C;

– all the welding qualification requirements in ASME B31.3 for an equally sized socket weld.

Seal welding of threaded connections shall not be permitted if PWHT is required on the seal weld. Seal welding of threaded connections shall not be performed when heat treatment of body is required.

Seal welds shall be examined by NDE in accordance with Table J.1.

Parallel threaded plugs shall have an external shoulder suitably profiled to accept a seal weld, where the size of the shoulder:

– allows a seal weld ⅓ times the nominal size of the plug;

– is not less than 0.12 in. (3 mm); and

– is not greater than 0.5 in. (13 mm).

Add new section

5.9.4 Locking Ring

The locking ring shall be designed such that it:

– locks the plug to prevent loosening;

– is secured to the valve body; and

– can be removed without loosening the plug in order to facilitate seal welding after site testing.

Add new section

5.9.5 Studded Connections

Studded flange connections shall be supplied complete with a blind flange, gasket and bolting installed.

Studded flange, gasket and bolting connection design pressure-temperature rating shall be the same as for the valve.

For studded flange connections, engagement of the threaded part shall comply with recognized industry code or standard requirements, and not be less than one stud diameter.

The length of engagement of the threaded connection shall be defined by the valve manufacturer.

Gaskets shall meet the requirements of ASME B16.20.

5.10 Injection Points

Add to section

Injection fittings shall only be provided when specified by the purchaser. The injection fitting to the valve body/bonnet connection shall be a threaded design as specified for vent and drain connections in 5.9.1.

Minimum wall thickness of connection areas shall be in accordance with ASME B16.34 unless otherwise agreed with the purchaser.

Injection fittings shall have a design pressure not less than the greater of the valve design pressure and the maximum sealant injection pressure.

Injection facilities shall be capable of withstanding the valve hydrostatic shell test pressure (150 % of the valve rated pressure).

Stem injection point shall be located above the primary sealing barrier. Graphite fire safe seal shall not be considered as a primary sealing barrier. For valves supplied with stem sealing PTFE lip seal, the seal shall be of anti-collapse design so that the injection of fluid does not compromise the integrity of the PTFE lip seal.

Seat and stem sealant injection points shall have two non-return valves, each with a tungsten carbide ball and UNS N06625 spring, where one of the non-return valves shall be placed in a separate fitting inside the valve body. The non-return valve in the body wall shall be secured independent of the injection fitting.

The sealant injection fittings shall incorporate a giant button head connection which is protected by a threaded cap. The protective cap shall:

- seal-off the button head connection by plugging the sealant port;
- allow any entrapped pressure to be released by the provision of a vent hole.

Injection devices shall be designed in accordance with ASME VIII Div 2 or a similar recognized industry design code.

Sealant or lubricant fitting connections to the valve body shall be in accordance with Figure 11.

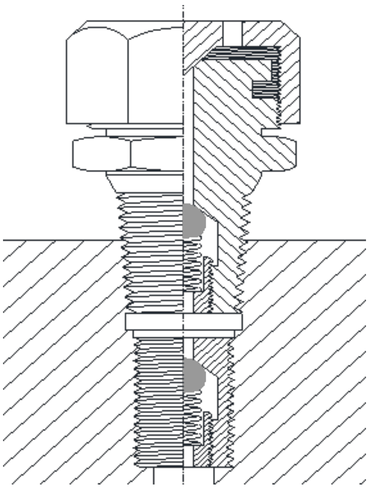


Figure 11 – Injection Fitting with a Double Check Valve

Design of the seat injection points to the seat shall enable cleaning and injection of sealant, to the ball and seat sealing surfaces.

The design shall incorporate a sufficient number of injection fittings and canals to the seat area, to ensure good distribution of sealant or cleansing agent. A minimum of two injection fittings per seat shall be provided for valves NPS 16 (DN 400) and above. Injection fittings shall be equally spaced around the perimeter starting from the horizontal axis.

5.13 Handwheels and Wrenches – Levers

Add to section

For valves operated manually, the maximum force required under design and test conditions, when applied at the rim of the handwheel or lever, shall not exceed 80 lbf (360 N). This applies to seating, unseating and operating at maximum pressure differential at both minimum operating temperature and ambient temperatures.

The drive shall be suitable for any stem orientation of operation, horizontal to vertical up.

The lever and handwheel shall be secured by a nut or dowel pin with additional locking to provide robust double retention (for example with a second nut or retention pin to prevent dowel pin from ejecting).

Levers and handwheels directly installed on the valve shall be in grade 316 stainless steel material.

Handwheels installed on the gearbox shaft shall be in grade 316 stainless steel material.

Levers and handwheels shall be free from burrs and sharp edges and made from a solid material, suitable for the environmental conditions. Hollow components shall not be allowed.

The handwheel diameter shall not exceed the lesser of the face-to-face dimension or 32 in. (800 mm).

The lever length shall not exceed the lesser of twice the face-to-face dimension or 24 in. (600 mm).

If the force or dimensional limitations are exceeded on directly installed levers or handwheels, the valve shall be provided with a gearbox.

5.14 Locking Provision

Add to section

Manually operated isolation valves shall be supplied with brackets, locking plates or other devices to allow the valves to be locked in the open or closed position using padlocks supplied by others.

5.16 Position Indicators

Replace section with

Position indicator devices which indicate the ball position shall be supplied for the following:

- manual valves;
- wrench operated valves; and
- gear operated valves.

The ball position indicator shall not be capable of incorrect fitting to give a false indication of the valve position.

The gearbox position indicator shall be directly associated with the actual stem or port position and shall be visible at all times under normal operation.

After removing the gearbox, it shall be possible to re-fit the gearbox back to the exact same position indicated by the position indicator.

5.17 Travel Stops

Replace section with

All ball valves shall be fitted with travel stops. Refer to Annex D.

For a valve operated with a gearbox, the open and closed stops shall be set on the gearbox and shall be located according to the position of the obturator in the fully open and closed positions.

The travel stops shall not affect any of the drive train components or the sealing capability of the valve.

Replace section heading with

5.18 Operators, Gearboxes and Stem Extensions

5.18.1 General

Replace first paragraph with

The maximum output of the gearbox, at an input torque given by a force equal to 1.5 times 80 lbf (360 N) and applied at the rim of the handwheel, shall not produce stresses that exceed the stress limits of the drive train specified in 5.20.2.

Add to section

The gearbox output torque rating shall be at least 1.5 times the maximum required operating torque of the valve. The gearbox is selected based on the valve maximum operating torque and not on the drive train/stem strength safety factor.

Gearbox flange dimensions shall be in accordance with ISO 5211.

Body/bonnet closure bolting shall not be used to directly mount a gearbox to the valve.

5.18.4 Overpressure Protection

Add to section

Relief devices shall be designed to meet all environmental conditions which could be detrimental to the gearbox relief function e.g. corrosion and/or debris.

Add new section

5.18.6 Gearbox Requirements

Gearboxes shall be provided with continuous seals and shall have, as a minimum, EN 60529 IP67 protection class. The gearbox shall be of dust-proof and weatherproof construction.

Gearboxes shall be equipped with one or more easily accessible injection fittings and a weatherproof vent connection, permitting easy packing in situ and lubrication of rotating shafts penetrating the gearbox.

External shafts shall be manufactured from a material that resists corrosion caused by environmental conditions and rated for maximum design torque and thrust strength e.g. 13Cr material or austenitic grade of stainless steel.

All gearboxes shall be filled with grease or heavy-duty gear oil to ensure that all moving parts are submerged and sufficiently lubricated.

Gearboxes shall be suitable for operation between -40 °F to 176 °F (-40 °C and 80 °C).

Gearboxes shall allow orientation at 180° increments.

Gearboxes shall be self-locking, e.g. worm and wheel designs which maintain the position.

Valves with ball bore sizes equal to or greater than those specified in Table 10 shall have gearboxes fitted.

The connection between the valve body and the gearbox shall be vented so that any product leakage from the stem cannot penetrate the gearbox housing.

The dimensions of the gearbox shall not exceed the limitations specified for handwheels (refer to 5.13).

If the number of handwheel turns exceeds 100 from the fully open position to the fully closed position, the manufacturer shall specify the number of handwheel turns on the quotation

Table 10 – Minimum Bore Sizes at which Gearbox is Required

Class	Ball Bore Size
150	≥ NPS 6 (DN 150)
300	≥ NPS 6 (DN 150)
600	≥ NPS 6 (DN 150)
900	≥ NPS 4 (DN 100)
1500	≥ NPS 3 (DN 80)
2500	≥ NPS 2 (DN 50)

5.19 Lifting

Add to section

The manufacturer shall provide lifting sketches and handling instructions for safe lifting operation for valves and valve assemblies weighing between 55 lbs. (25 kg) and 550 lbs. (250 kg).

Permanent lifting points shall be provided for:

– valves of NPS 8 (DN 200) and above;

– valves over 550 lbs. (250 kg) weight including accessories.

Acceptable designs of lifting points are:

– forged lifting lug welded to valve body/bonnet;

– integral forged/cast lifting lug;

– single piece plate lifting lug connected to at least two pressure retaining bolts;

– lifting eye bolt threaded into valve body/bonnet.

Lifting points are regarded as part of the valve and not a lifting apparatus. Lifting points shall be calculated according to API SPEC 17D, Annex K.

The design of lugs shall incorporate the additional weight of operators. Lifting points on the gearbox shall never be used for lifting the valve.

Lifting lug positions shall be designed for the valve orientation specified in the purchasing documentation. If the installation orientation is not specified, the standard valve orientation is horizontal flow bore and stem vertical up. Additional lifting lugs may be required when valves are installed with the stem in the horizontal position.

Lifting lugs shall be of the same material type as the valve body, except that stainless steel grade 316 may be used on valves constructed of duplex stainless steel.

Valves shall be marked to indicate the mandatory safe lifting points and each lifting lug SWL. The SWL shall be specified on the general arrangement drawings.

5.20 Drive Trains

5.20.1 Design Thrust or Torque

Add to section

At the maximum specified operator output torque, drive train design shall comply with the maximum torque limits defined by Annex R and 5.18.1 for the complete range of design temperature.

5.20.2 Allowable Stresses

Add to section

Stress limits shall apply to both the drive train (including couplings and connections) and to the torque or force reaction path back to the gearbox.

If a load is shared (e.g. between dowels and flange face friction), the assumptions that are made shall be clearly stated in the calculation (friction coefficient, etc.).

5.21 Stem Retention

Add to section

Stem retention shall be achieved by:

- an integral stem shoulder on the internal body diameter; or
- an integral stem shoulder on the internal body bonnet/cover, where the bonnet/cover is attached to the body by means of a bolted joint.

5.22 Fire Type-testing

Add to section

Valves shall be of a fire safe and fire type-tested certified design, in accordance with ISO 10497.

Pre-existing designs already qualified in accordance with API Spec 6FA or API 607 are acceptable, with the exception of API 607 4th edition. When requested by the purchaser, the manufacturer shall provide complete fire testing reports and records compliant with the relevant standard.

Requalification of a fire type-tested valve will be required, if any of the following substitutions, removals or changes of non-metallic materials are made:

- elastomeric seals with thermoplastic seals (e.g. elastomeric O-rings substituted for PTFE lip seals), and vice versa;

- PTFE seat to closure member seal with PEEK, and vice versa;
- removal of graphite based fire seals which form part of the original qualified design;
- significant design change to the seat, e.g. substitution of one seat for a DIB-2 configuration.

Substitution of a soft seat for a metal seat of the same soft sealing configuration may not require requalification.

Gearbox requirements of API 607 or ISO 10497 shall apply to all fire type-tested valves.

Fire type-tests shall be witnessed by an independent agency.

A graphite sealing barrier shall be installed on each external leakage path, in addition to a non-metallic primary sealing barrier.

Graphite seals are not acceptable as primary pressure containment seals.

Graphite seals are only acceptable as back-up seals for fire resistance properties.

Graphite back-up seals shall be constructed from a single piece, solid graphite compound. Braided graphite fire seals may be used if they pass the fire type-test requirements.

If by design, higher integrity graphite or metallic seals satisfy the emission and fire type-test requirements for static seals, the elastomeric or thermoplastic primary seal may be excluded.

5.23 Antistatic Device

Add to section

Graphite seals shall not be considered to offer electrical continuity.

Add new section

5.24 Stem Design

Stem design shall prevent galling potential between similar corrosion resistant materials, specifically grade 316 stainless steel, DSS and SDSS, by use of metal-polymer self-lube bearings.

The stem shall be designed such that in the event of failure, the failure shall occur outside the valve pressure boundary.

The stem shall be constructed from one piece of wrought material. Welded fabrication or threaded stem assembly are not allowed.

Stem sections shall be cylindrical, within a tolerance of 0.002 in. (0.05 mm).

The stem shall be straight over its end-to-end length, within a tolerance of 0.012 in./ft (1 mm/m).

The stem sealing area shall have a maximum surface roughness, *Ra*, of 32 µin. (0.8 µm) and be free from any defects.

The stem surface area in contact with polymer or elastomer materials shall have a surface finish, *Ra*, less than or equal to 16 µin. (0.40 µm).

The stem surface area in contact with lip seals shall have a surface finish, *Ra*, of 4 µin. to 8 µin. (0.10 µm to 0.20 µm).

The stem surface area in contact with graphite packing shall have a surface finish, *Ra*, of 16 µin. to 32 µin. (0.40 µm to 0.80 µm).

The stem shall be suitably supported and have clearances sufficient such that with all anticipated side loads, it does not make rubbing contact with the adjacent static metallic components (e.g. bonnet, gland ring). This is to avoid the potential for galling.

Stems and shafts shall be corrosion resistant to the specified service fluids and external environmental corrosion, and shall be as specified in the contract documentation.

Add new section

5.25 Securing

Separate removable valve parts shall be positively secured against loosening.

Spring tension pins shall not be used for locking of internal valve components.

Add new section

5.26 Soft Seat Insert Design

Soft seated valves shall have a thermoplastic seat insert as specified in the contract documentation.

The soft seat materials used shall be in accordance with Table 11.

Table 11 – Soft Seats

Class	Type
150	RPTFE / PCTFE
300	RPTFE / PCTFE
600	RPTFE / PEEK / PCTFE
900	PEEK / PCTFE
1500	PEEK / PCTFE
2500	PEEK

Soft seat materials listed in Table 11 shall be limited to 302 °F (150 °C).

Elastomeric O-ring seat inserts shall not be permitted.

The manufacturer shall ensure suitability that soft seat material complies with the temperature and pressure range.

Add new section heading

5.27 Sealing Rings

Add new section

5.27.1 Elastomers

Elastomer O-rings shall be fully operable at valve design rated pressure and their use limited to temperatures including and above –20 °F (–29 °C).

Refer to 6.3 for elastomer qualification requirements.

Elastomers shall be in accordance with Table 12.

Rapid gas decompression resistant grades shall be used for all classes.

For seals at risk from rapid gas decompression in Class 300 and above, the O-ring section shall be limited to 0.275 in. (6.99 mm), unless specified otherwise by the purchaser.

Seal rings shall be fully contained to minimize extrusion.

Table 12 – Elastomer Types

Class	Type				
	$H_2S \leq 0.01$ % ($\leq$ 100 ppm)		0.01 % (100 ppm) < $H_2S \leq$ 20 % (200000 ppm)		20 % (200000 ppm) < H_2S
	Temperature				
	< 250 °F (< 120 °C)	< 300 °F (< 150 °C)	< 210 °F (< 100 °C)	< 300 °F (< 150 °C)	< 300 °F (< 150 °C)
150	HNBR	LT FKM	HNBR	LT FKM	FEPM FFKM
300	HNBR	LT FKM	HNBR	LT FKM	FEPM FFKM
600	HNBR	LT FKM	HNBR	LT FKM	FEPM FFKM
900	HNBR +BU	LT FKM +BU	HNBR +BU	LT FKM +BU	FEPM +BU FFKM +BU
1500	HNBR +BU	LT FKM +BU	[a]	[a]	[a]
2500	HNBR +BU	LT FKM +BU	[a]	[a]	[a]

[a] Sealing materials in sour service above 250 °F (120 °C) in pressure classes 1500 and 2500 is difficult. The manufacturer shall confirm seal suitability after consultation with seal OEM. The manufacturer shall confirm qualification and certification testing of elastomers at these pressure classes.

NOTE 1 In sour service peroxide cured FKMs are required.

NOTE 2 Low Temperature - LT grades is standard for FKM. LT grades are available in HNBR.

NOTE 3 +BU means complete with back-up rings.

NOTE 4 HNBRs have limited suitability with aromatic hydrocarbons and steam.

NOTE 5 FKMs have limited suitability with methanol, amines, strong alkalis and some Freons.

NOTE 6 The information given in this table is for guidance only. It is the manufacturer's responsibility to confirm seal suitability against specified service conditions with seal OEM.

Add new section

5.27.2 Lip seals and V-packing seals

Lip seals or V-packing (chevron) seals shall be used in lieu of elastomeric seals (O-rings) for design rated pressures and temperatures below –20 °F (–29 °C).

The minimum and maximum design temperatures shall be specified on the general arrangement drawing.

Lip seals and V-packing (chevron) seals shall only be used on metallic surfaces of corrosion resistant material or with a corrosion resistant overlay.

The polymers used in lip seals shall be reinforced PTFE as specified in the contract documentation.

Lip seals shall have an anti-collapse design incorporating RPTFE (limited to a maximum of class 600), PEEK or metal support ring, to prevent crushing against backpressure in the reverse direction. The jacket and spring design of lip seals shall be capable of accommodating these requirements.

Springs used in lip seals shall be constructed from UNS R30003 or R30035.

Metallic surface areas in contact with lip seals shall have a surface finish, *Ra*, of 4 µin. to 8 µin. (0.10 µm to 0.20 µm).

Arrangements involving two face-to-face lip seals with the open ends facing each other (as per Figure 12) shall be avoided.

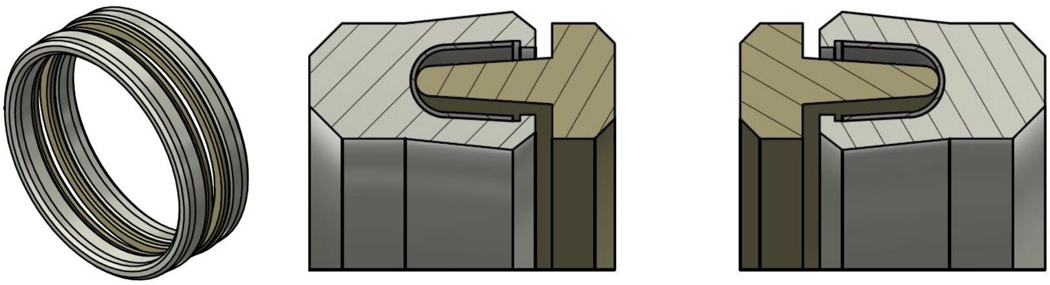


Figure 12 – Lip Seals, Face to Face Configuration

Designs using lip seals with open ends away from each other (as per Figure 13) may be used, provided the design is fully proven. As a minimum, a validation test to demonstrate the seals are not crushed, for example where utilized on DIB-2 design on completion of the seat test H.11, repeat test 9.4 or H.4.3. as applicable.

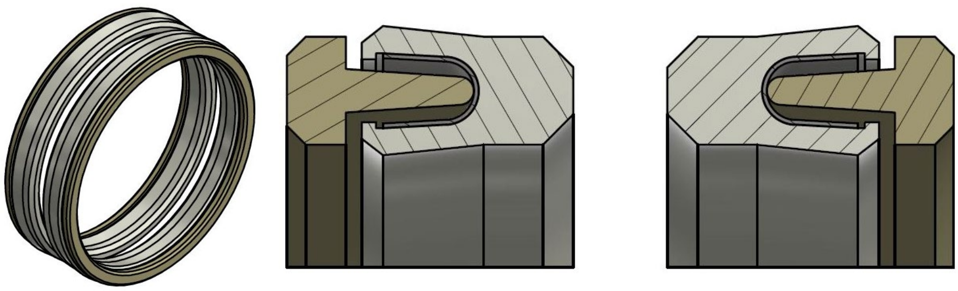


Figure 13 – Lip Seals, Back to Back Configuration

In cases where a closed gland design for lip seals cannot be avoided, the manufacturer shall use the applicable seal OEM procedures, expanding mandrel, pusher and resizing tools.

Add new section

5.27.3 Seals in Vacuum Conditions

Valves with non-metallic (soft) seals shall be suitable for withstanding:

– manufacturer's vacuum drying at pressures of 0.07 psia (500 Pa); and

– vacuum drying during maintenance at pressures down to 0.001 psia (10 Pa).

The OEM of asymmetric unidirectional seals shall certify that the seal design can seal against atmospheric pressure in the reverse direction towards the vacuum side.

Add new section

5.28 Stem Seals, Stuffing Box and Gland

All sealing surfaces shall have a surface finish conforming to the seal OEM recommendations.

Stem seals shall be self-energizing.

Stem seal arrangements consisting of only a single O-ring or lip seal shall not be permitted on Class 600 and above. It shall not be assumed that graphite “fire seals” provide an effective additional seal.

Add new section

5.29 O-ring Housing Design

For seals with toroidal sealing rings (O-rings), the groove design dimensions and surface finish shall be in accordance with one of the following:

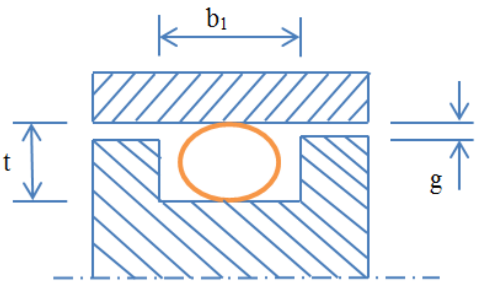
– BS 4518, ISO 3601-2, or SAE AS 568 for metric sized O-rings;

– ISO 3601-2 or SAE AS 568 for US customary sized O-rings;

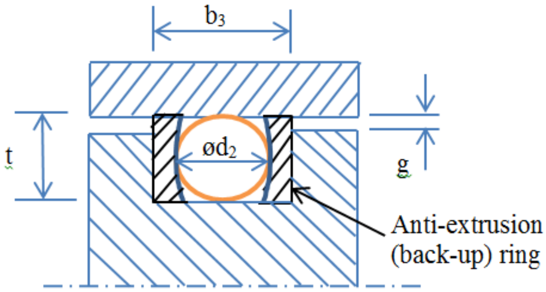
– For class 600 and above, based on either of the above with a groove filling ranging from 75 % to 85 % to allow for an effective resistance to rapid gas decompression. If required, a contoured back-up ring(s) may be used to achieve groove fill.

The housing design of elastomeric O-rings shall prevent risk of extrusion by use of thermoplastic back-up rings on both sides (PEEK or reinforced PTFE) for valves in piping class 900 and above.

O-ring housing design shall be as per Figure 14.



Option 1 - O-ring housing without anti-extrusion (back-up) ring



Option 2 - O-ring housing with two anti-extrusion (back-up) rings

Symbols (refer to ISO 3601-2)

t - total radial housing depth

b1 - width of the O-ring housing without an anti-extrusion (back-up) ring

b3 - width of the O-ring housing with two anti-extrusion (back-up) rings

ød2 - O-ring cross-section diameter

g - extrusion gap

Figure 14 – O-ring Housing Design

Add new section

5.30 Finite Element Analysis (FEA)

For the following metal seated valves, an FEA of the ball to seat interface and seat to body interface with full differential pressure applied shall be performed to demonstrate that the required seat to ball contact is maintained with the material remaining within the elastic limit and freedom of movement is preserved:

- valves equal to or greater than NPS 20 (DN 500) Class 150, 300, 600 and 900 rating;
- valves equal to or greater than NPS 16 (DN 400) in Class 1500; and
- valves equal to or greater than NPS 12 (DN 300) in class 2500.

FEA shall be carried out using an elastic-plastic analysis to satisfy the service criteria described in ASME VIII Div.2, 5.2.4.3 (b). Acceptance criteria for the FEA shall be defined by the manufacturer.

FEA results shall show code compliance and identify areas of deformation.

NOTE Linear elastic analysis and subsequent stress linearization on the complex geometries involved are not covered in the classification list from ASME VIII Div 2 and as such, this method can only be applied after agreement and approval from the purchaser.

Add new section

5.31 Pressure Balance Hole

The manufacturer shall provide valves without a balance hole as standard.

The purchaser may elect to specify in the contract documentation or in the purchase order that valves are to be provided with a pressure balance hole.

When a balance hole is specified, the minimum diameter of the hole shall be 0.25 in. (6 mm) up to and including NPS 8 (DN 200) and 0.31 in. (8 mm) for sizes above NPS 8 (DN 200).

The ratio between the length of the hole and the hole diameter shall be less than 10 (L/D < 10).

The hole shall be positioned adjacent to the stem and top trunnion of the ball to reduce the risk of blockage.

The sizing of the valve operator shall not take advantage of the reduced breakaway torque at start of the closing stroke due to the presence of a balance hole, to ensure operability in the event that the hole is blocked. The manufacturer shall size the operator/actuator assuming there is no balance hole present and provide sufficient output torque, including specified factor of safety to operate the valve with design pressure in the bore and atmospheric pressure in the valve cavity.

6 Materials

6.1 Material Specification

Add to section

A table of acceptable and optional materials for ball valve components is provided in Annex Q.

Additional requirements for these materials shall be in accordance with the applicable MDS in IOGP S-563, as referenced in Annex Q.

Stem and sliding elements, including threaded components particularly in stainless steel, should have a minimum 50 HBW hardness difference between contacting surfaces and an appropriate surface finish to prevent galling. When a minimum differential hardness cannot be obtained, the use of surface treatment, coating or dissimilar material combinations shall be applied.

Valves shall be supplied with graphite materials in accordance with Annexes T and U.

6.3 Service Compatibility

Add to section

The manufacturer shall verify that the materials selected by the purchaser using Annex Q are compatible with the service conditions specified in the purchase order.

Qualification and production testing of elastomers and thermoplastics shall be performed in accordance with NORSOK M-710 or ISO 23936 Parts 1 and 2, qualifying the materials for sour service for the temperature range specified in Annex Q or any purchaser specified requirements.

6.5 Composition Limits

Replace first paragraph with

The chemical composition of carbon steel valves and valve parts shall comply with the applicable MDS in IOGP S-563, as referenced in Annex Q.

Replace second sentence with

Where Table Q.1 does not reference an MDS, the material shall comply with the applicable material standard, except for welding end valves which shall also fulfil the following additional requirements.

Replace last paragraph with

The chemical composition of corrosion resistant alloys shall meet the requirements of the applicable MDS in IOGP S-563 as referenced in Annex Q. Where Table Q.1 does not reference an MDS, the material shall comply with the applicable material standard.

6.6 Toughness Test Requirements

Replace fourth and fifth paragraphs with

Impact testing shall comply with the requirements of the applicable MDS in IOGP S-563, as referenced in Table Q.1.

Where Table Q.1 does not reference an MDS, impact test results for full-size specimens shall meet the requirements of Table 3.

Where the material specification for the pipeline and/or piping design standard requires impact values to be higher and/or test temperature to be lower than those shown in the MDS or Table 3, the most stringent values shall apply.

Delete seventh and eight paragraphs

6.7 Bolting

Add to section

Bolting materials shall be as specified in Annex Q and the applicable MDS in IOGP S-563, as referenced in Table Q.1.

Coating requirements for carbon and low alloy steel bolting shall be hot dip spun galvanized in accordance with the MDS in IOGP S-563.

Thread tolerances shall be Class 2A for bolts and 2B for nuts when hot dip spun galvanized.

For bolting size 10 mm and below, where hot dip spun galvanized process cannot be applied, CRA bolting shall be used.

6.8 Sour Service

Add to section

Materials for sour service shall also comply with the additional metallurgical, manufacturing, testing and certification requirements stated in the applicable MDS in IOGP S-563, as referenced in Table Q.1.

The purchaser shall specify materials from Table Q.1 that are suitable for the specific sour environments defined in the contract documentation.

Materials for sour service shall be marked in accordance with ISO 15156-2:2015/NACE MR0175-2:2015, Section 9 or ISO 15156-3:2015/NACE MR0175-3:2015, 7.2, as specified by the purchaser.

Replace section heading with

6.9 Drain, Vent and Injection Connections

Add to section

Material requirements for drain, vent, injection and auxiliary connections shall be in accordance with the following.

For welded plugs and fittings, the material shall:

– be the same material grade as the body;

– meet the requirements of 6.5; and

– meet the toughness test requirements of 6.6.

For non-welded removable plugs and fittings, the material shall:

– be of the same material grade as the trim and minimum grade 316 stainless steel; and

– prevent galling and atmospheric corrosion.

To prevent galling between austenitic or duplex/super duplex plug and body materials, the threaded portion of the plug may be silver plated in accordance with SAE AMS 2410.

For flanged auxiliary connections, the gasket and bolting material shall be specified by the purchaser. The drain/vent auxiliary blind flange shall be a forging and of the same chemical composition as the body.

As a minimum, austenitic stainless-steel gaskets (spiral wound or ring joint) shall be in the solution-annealed condition and shall be able to successfully pass an intergranular corrosion test in accordance with ASTM A262, Practice E.

Spiral wound gaskets with filler materials shall comply with:

– Annex T for expanded graphite;

– ASTM D4894 or ASTM D4895 for PTFE.

Each gasket shall be free from sharp edges, burrs, organic substances or any other foreign particulate matter. Paints, coating or plating shall not contain cadmium, zinc or any other detrimental metals.

Gasket material shall be in accordance with Table 13.

Table 13 − Gasket Materials for Drain, Vent, Injection and Auxiliary Connections

Body Material	**NTCS**		**LTCS**			**SS 316**	**DSS**	**SDSS**	
Trim Material	**ENP trim**	**SS trim**	**ENP trim**	**SS trim**	**Cladded**				
Service	**Sweet**	**Sour**	**Sour**	**Sour**	**Sour**	**Sour**	**Sour**	**Sour**	**Seawater**
RF	SWG 316 + graphite	SWG 316 + graphite	SWG 316 + graphite	SWG 316 + graphite	SWG 625 + graphite	SWG 316 + graphite	SWG DSS + graphite	SWG SDSS + graphite	SWG SDSS + PTFE
RTJ	Octagonal Soft Iron	Octagonal Soft Iron	Octagonal Soft Iron	Octagonal Soft Iron	Octagonal Alloy 625	Octagonal SS 316	Octagonal DSS	Octagonal SDSS	Octagonal SDSS
NOTE When fire safe gaskets are required in sea water service, RTJ gaskets shall be used.									

Bolting material shall be in accordance with the body/bolting material defined in Annex Q.

The following requirements are applicable to parallel thread designs:

- The plug shall have a primary seal (an elastomeric O-ring or a thermoplastic lip seal inboard of the thread) in order to protect the thread against crevice corrosion.
- The primary inboard seal type and material shall be the same as that specified for the main valve static primary seals for the given service condition i.e. elastomeric O-ring or thermoplastic lip seal.
- The connection between the plug and the body shall provide a fire safe secondary graphite seal outboard of the thread in order to protect the thread against atmospheric corrosion.
- In case a separate seal ring is used, the seal material shall be grade 316 stainless steel.
- The plug locking ring and body securing parts shall be manufactured from grade 316 stainless steel.

Add new section

6.11 Internal Coatings and Hardfacing

Wear resistance, erosion resistance, and anti-galling internal coatings to enhance performance reliability of mating parts in dynamic contact, shall be in accordance with Annex Q and IOGP S-563.

A corrosion resistant alloy weld overlay shall meet the requirements in Section 7.

Add new section

6.12 Surface Finish

All corrosion resistant alloy components shall be supplied with a surface finish in accordance with the applicable datasheet in IOGP S-563 as referenced in Annex Q, unless subsequently machined to final shape.

The surface of all such finished components shall be completely free of surface contamination including debris, dirt and weld spatter.

Add new section

6.13 Valves Manufactured from Bar Material

Valves and valve parts may be manufactured from bar material, within the limits specified in ASTM A961 and the following:

a) Where allowed by the material standard for the final product form, hollow cylindrically shaped pressure-containing valve parts, including valve bodies for welded-end valves and integral flanged valves in sizes up to and including NPS 4 (DN 100), may be manufactured from hot rolled, hot rolled and cold finished or forged round bar, or from seamless tubular materials, provided that the axial length of the part is approximately parallel to the metal flow lines of the starting stock.

b) Valve bodies for welded-end valves and integral flanged valves manufactured from round bar shall be restricted to the limitations stated in the MDS in IOGP S-563 and in Table Q.1.

c) The minimum body to integral flange transition radius shall be 0.4 in. (10 mm).

d) The extent of NDE on the machined part shall be as defined in Annex J.

7 Welding

7.2 Welding Procedure and Welder/Welding Operator Qualifications

Add to section

Qualification shall be based upon weld procedure testing.

Welding, weld repairs, corrosion resistant weld overlay procedures and supporting welding procedure qualification records shall be submitted for the purchaser's approval.

When applicable, corrosion resistant weld overlays shall comply with the EDS in IOGP S-563, as referenced in Table Q.1.

Stainless steel weld overlay, as referenced in Table Q.1 Note b), for use in non-sour, sweet service shall comply with the requirement of EDS IO001 as modified below:

- Welding consumable: welding consumable shall be of type 309LMo for the first layer and type 316L for the remaining (top) layer(s).
- Procedure qualification testing:
  - Chemical composition: the specified chemical composition of the 316L filler metal shall be met at a depth of 0.06 in. (1.5 mm) minimum from minimum qualified overlay thickness.
  - When PWHT is required, weld procedure qualification tests shall include corrosion testing according to ASTM A262 practice E.

Corrosion-resistant weld overlays shall have a final finished thickness of at least ⅛ in. (3 mm).

7.5 Repair

Replace last two paragraphs with

Weld repair of materials shall comply with the applicable datasheet in IOGP S-563 as referenced in Annex Q.

Weld repair of forgings, plates, seamless products and bars is not permitted for the purpose of correcting material defects. Minor weld repair to correct machining errors shall be subject to the purchaser's approval.

Weld repair of castings shall be in accordance with the applicable material datasheet in IOGP S-563 as referenced in Annex Q, and the following:

- Weld repairs are not permitted for castings that leak during pressure testing.
- All major weld repairs shall be documented in accordance with the MDS and the requirements of 13.1.
- All weld repairs shall be inspected to the same standard as used to inspect the casting, in accordance with Section 8 and Annex J.
- Except for weld repair procedures qualified and executed by the casting manufacturer, any subsequent repair procedures and supporting welding procedure qualification records shall be submitted for the purchaser's acceptance.

7.6 Repair of Welds

Add to section

Weld repairs of corrosion resistant weld overlays and hard facing shall comply with the applicable EDS in IOGP S-563, as referenced in Annex Q.

All repairs to welds shall be performed in accordance with a documented procedure specifying requirements for defect removal, welding, heat treatment and NDE as applicable.

All repairs to welds shall be documented in accordance with the requirements of 13.1.

8 Quality Control

8.1 NDE Requirements

Replace first sentence with

NDE requirements shall conform to Annex G except as modified below and in Annex J.

Add to section

Weld ends shall be subjected to volumetric and surface NDE as specified in 8.5.

Pressure-containing welds shall be subjected to volumetric inspection in accordance with G.13 or G.14 and surface inspection in accordance with G.15 or G.16.

8.3 Qualification of Personnel

8.3.1 NDE Personnel

Replace section (including note) with

NDE personnel shall be qualified to ASNT SNT-TC-1A or ISO 9712 Level 2 as a minimum. Certification shall be performed by an independent third-party certification body or authorized qualifying body in accordance with the ASNT Central Certification Program (ACCP) or ISO 9712.

8.4 NDE of Repairs

Add to second paragraph

Additionally, examination of major repair welds on pressure-containing cast parts shall also include RT or UT.

8.5 Weld End NDE

Replace section with

Weld ends shall be subjected to volumetric and surface NDE. The examination and acceptance criteria shall be in accordance with Annex J.

8.6 Visual Inspection of Castings

Replace section with

Visual inspection of castings shall comply with the applicable datasheet in IOGP S-563 as referenced in Annex Q.

8.7 Quality Specification Levels (QSLs)

Replace section with

Mandatory requirements for NDE, pressure testing and documentation of the manufacturing process shall be in accordance with Annex J for the QSL specified by the purchaser.

9 Pressure Testing

9.1 General

Replace second paragraph with

The test equipment shall be of a design that does not subject the valve to externally applied loads that could affect the results of the test. When end-clamping devices are used, the valve manufacturer shall be able to demonstrate that, during the valve closure test, they do not serve to reduce the resultant leakage.

Testing shall be performed in accordance with Table J.3 and the QSL level shall be specified by the purchaser.

Testing shall be performed as per the sequence detailed in Table J.3.

For valves NPS 8 (DN 200) and below can be tested in any orientation independent of the orientation specified in the purchasing documentation.

For valves NPS 10 (DN 250) and larger, the valve shall be tested in the orientation specified in the purchasing documentation. If no orientation is specified, the valve shall be tested with horizontal flow bore and stem vertical upward.

Table 14 – Acceptance Criteria

Ball valve type	Type of test / Test pressure applied from	Hydrostatic seat test Max. leak rate (ISO 5208)		Low-pressure gas seat test Max. leak rate (ISO 5208)		High-pressure gas seat test Max. leak rate (ISO 5208)	
		One valve end [a]	Both valve ends [b]	One valve end [a]	Both valve ends [b]	One valve end [a]	Both valve ends [b]
Soft seated		A	A	A	A	A	A
Metal seated		B	2 X B	B	2 X B	2 X C	4 X C

a The acceptance criteria is applicable to seat testing when pressure is applied from one valve end only and also to DIB-2 testing when pressure is applied from one valve end and the cavity.

b Acceptance criteria applicable to DBB testing when pressure is applied from both ends simultaneously.

Add to fifth paragraph

The pH of the water shall be between 6 and 8.5. Test media reservoirs shall be drained, and biocide flushed at least one time per annum.

9.3 Hydrostatic Shell Test

Add to section

All final drain, vent, sealant injection facilities (only primary sealing barrier), ancillary connections and blind flanges shall be installed to carry out this testing. Sealant injection fittings shall not be removed thereafter.

The valve shall be isolated from the supply pressure source.

9.4 Hydrostatic Seat Test

9.4.3 Acceptance Criteria

Replace first and second paragraph with

Maximum permissible seat leakage rates for hydrostatic seat tests, low-pressure gas seat test and high-pressure gas seat test shall conform to Table 14.

9.4.4 Seat Test Procedures for Block Valves

9.4.4.1 Unidirectional

Add to first paragraph

The valve shall be isolated from the supply pressure source with the volume beyond the pressurized seat being at atmospheric pressure. Water loss (draining) is not allowed from the valve body cavity or from the opposite valve end.

Add to second paragraph

The opposite valve end shall be isolated (closed) from the atmospheric pressure during the leakage measurement.

9.4.4.2 Bidirectional

Add to first paragraph

The valve shall be isolated from the supply pressure source with the volume beyond the pressurized seat being at atmospheric pressure. Water loss (draining) is not allowed from the valve body cavity or from the opposite valve end.

Add to second paragraph

The opposite valve end shall be isolated (closed) from the atmospheric pressure during the leakage measurement.

Add new section

9.8 Anti-static Testing

Anti-static testing shall be performed in accordance with Table J.3.

Add new section heading

9.9 Fugitive Emissions

Add new section

9.9.1 Type Testing

Valve designs shall be qualified by type testing in accordance with ISO 15848-1 and ISO 15848-1/Amd.1, Tightness Class BH, endurance class isolation valve C01 with the exceptions specified in Annex X.

The manufacturer shall engage an independent qualification accreditation body, to perform the inspections, examinations, and tests described in this section. The testing facility and independent qualification accreditation body used shall be mutually agreeable to the purchaser and the manufacturer.

Add new section

9.9.2 Production Valve Testing

Production valves shall be fugitive emission tested in accordance with Table J.3. and Annex V acceptance criteria FE Class B.

Add new section

9.10 Valve End Thrust Effect

Valves shall be tested with full pressure end thrust effect to check the effectiveness of body joints and tightness as per Table 15 (limited to Table 1, for coincident size and rating). Where quantity 1 is noted in Table 15, 10 % of QSL 3G valves and 100 % for QSL-4 shall be tested.

All tests as specified in Table J.3 shall be performed as well as production fugitive emission tests as specified in Annex V.

For the purpose of this test, flanged-end valves shall be tested using end flanges (i.e. with blind flanges) and welded-ends valves shall be tested using temporary caps.

Table 15 – Valve End Thrust Effect

Size	Rating					
NPS (DN)	**150**	**300**	**600**	**900**	**1500**	**2500**
2 (50)						
3 (80)						
4 (100)						1
6 (150)					1	1
8 (200)				1	1	1
10 (250)			1	1	1	1
12 (300)			1	1	1	1
14 (350)		1	1	1	1	100
16 (400)	1	1	1	1	1	100
18 (450)	1	1	1	1	1	100
20 (500)	1	1	1	1	1	100
22 (550)	1	1	1	1	1	-
24 (600)	1	1	1	1	1	-
26 (650)	100	100	100	100	100	-

NOTE 1 1 = 1 valve per valve batch.

NOTE 2 100 = All valves to be tested.

NOTE 3 For sizes equal to or greater than NPS 26 (DN 650), NOTE 2 applies.

NOTE 4 Valve selection is made at random by the purchaser.

NOTE 5 Where the sample valve in NOTE 1 fails the test, two other valves of the same valve batch shall be tested and if either of these valves fail the test, the manufacturer shall provide a structured root cause analysis, corrective action and preventive action report to the purchaser's representative for acceptance. After the purchaser's acceptance, all valves in the valve batch shall be subsequently tested per NOTE 2 unless otherwise agreed.

NOTE 6 When NOTE 5 becomes effective, the manufacturer shall be responsible for extending the scope of testing and any modifications to other valve batches which form part of same purchase order, including those already shipped, when deemed necessary by the manufacturer or the purchaser.

10 Coating/Painting

Replace first and second paragraphs with

When specified, valves and parts shall be painted using coating systems and coating products approved by the purchaser.

Add to section

Unpainted surfaces shall be protected by preservation and shall be guaranteed by the manufacturer for a minimum life of 12 months in an external environment in the original packing and shipping condition.

Preservation shall be by corrosion preventative fluids and the manufacturer shall guarantee that these fluids shall not be detrimental to any non-metallic parts.

11 Marking

Add to section

Marking shall be designed to be clearly legible for the valve design life.

More than one plate may be used when necessary.

The nameplate material shall be grade 316 stainless steel or better. Nameplates shall be suitable for constant contamination from and exposure to the operating environment, including ultra-violet, grease, applicable temperatures and cleaning solvents.

The nameplate shall contain both metric and US customary units.

The nameplate minimum letter size shall be 0.12 in. (3 mm).

The nameplate rivet holes shall be pre-drilled prior to FAT.

The nameplate shall be securely fastened to the valve after coating is completed, and located so that it is easily visible. The use of wire for attachment of nameplates shall not be allowed.

Marking on weld bevels, flange faces or surfaces that will be hidden following fabrication, assembly, coating or installation is not allowed.

Each flange shall be provided with an “SPE” mark on the side that contains a single piston effect seat and with a “DPE” mark on the side that contains a double piston effect seat.

FE marking shall be in accordance with X.3.6.6

Add to Table 7

Table 7 – Valve Marking

No.	Marking	Location
19	Operating temperature limitations imposed by the sealing or seating materials	On nameplate
20	Schedule on weld end valves	On body weld ends or nameplate
21	Valve datasheet identification code	On nameplate

12 Preparation for Shipment

Replace second paragraph with

Protective covers shall be made of plastic (at least ⅛ in. (3 mm) thick) or wood, and attached to the valve ends by using bolting and nuts.

Plastic caps with integral molded securing plugs shall be secured in bolt-holes.

Add to section

All valves to be packed in an enclosed vapor proof barrier material and shall:

– have vapor phase inhibitor sachets added at 0.06 oz./ft^3 (60 g/m^3); and

– for carbon steel valves, ensure that the vapor phase inhibitor is not in contact with the paint.

Valve ends and auxiliary connections shall be protected to give mechanical protection and to prevent ingress of water and other foreign matter.

Covers made from wood or any other porous material shall not be in direct contact with flange faces.

For valves NPS 4 (DN 100) and larger, plastic protective covers shall not be used.

Covers shall be designed to prevent ingress of water and dirt into the valve during outdoor storage for at least one year.

The manufacturer shall weigh all valves weighing more than 2205 lb. (1000 kg), excluding transportation equipment. For identical valves, only one representative item needs to be weighed.

Prior to packaging and shipment, valve internals shall be thoroughly cleaned and dried, and the surfaces ensured to be free from test fluids, cleaning agents, loose particles and organic substances.

When handling valves, extreme care shall be taken to ensure that that sealant fittings, body vent fittings, valve stem and/or gearbox are not bent, pinched or otherwise damaged.

13 Documentation

13.1 Minimum Documentation and Retention

Replace section with

Design development, process and personnel qualification and manufacturing records listed below shall be retained by the manufacturer for a minimum of 10 years following the commencement of the contract guarantee period:

a) design calculations;

b) cross-section drawings with parts and materials list;

c) manufacturing, testing and inspection procedures;

d) welding procedures and qualification records;

e) nondestructive testing procedures and qualifications;

f) material qualification records in accordance with S-563;

g) manufacturing, testing and inspection equipment calibration records;

h) nonconformance records;

i) listing of applicable and authorized concessions, waivers and/or material substitutions;

j) listing of applicable manuals (e.g. assembly or maintenance manuals);

k) material test reports and inspection certificates, traceable by heat number to the foundry or mill, including for sour service materials a statement confirming compliance with ISO15156/NACE MR0175 or ISO17945/MR0103;

l) weld maps of major repairs;

m) heat treatment records, including heat treatment charts;

n) relevant fabrication drawings and sketches to facilitate the understanding of welding, heat treatment and NDE records;

o) NDE reports, including sketches if necessary, showing the locations of examination traceable by heat or serial number.

The minimum and maximum design temperature shall be shown on the valve drawings.

13.2 Documentation Provided with Valve(s)

Replace section with

The manufacturer shall supply certification according to Table J.4 and shall provide information in accordance with IOGP S-562L.

The certificates of conformance shall identify the valve type, size, class, end connection and serial numbers, and meet the traceability requirements in accordance with IOGP S-562Q, Annex B.

The inspection certificates for pressure-containing and pressure-controlling parts in Table J.4 shall include any additional test requirements specified in Section 6 or Section 7, Annex Q and the applicable MDS in IOGP S-563, including heat treatment condition.

Inspection documents for sour service shall include a statement confirming compliance with ISO 15156/NACE MR0175 or ISO 17945/MR0103, as applicable.

Documentation of major weld repairs on castings shall be supplied as specified on the applicable casting datasheet in IOGP S-563 as referenced in Annex Q.

Copies of the following documents, sealed in a waterproof envelope attached to the valve or shipping container, shall be included with each valve delivery:

– procedure for receipt and installation;

– manufacturer's release note; and

– agreed deviations (where applicable for receipt control).

Add new section

15 Regulatory Considerations

If national and/or local regulations exist in which some of the requirements could be more stringent than in this specification, the purchaser shall determine by careful scrutiny which of the requirements are more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects.

In all cases, the purchaser is required to specify the requirements of this specification in order to comply with national and/or local regulations.

The purchaser may then negotiate with the authorities concerned, the objective being to obtain agreement to follow this specification as closely as possible.

Valves supplied to countries where legislative or jurisdictional requirements are in force (e.g. Pressure Equipment Directive (PED) 2014/68/EU – European member state or country in the European Free Trade Association), the purchaser is required to specify requirements in full compliance with these laws and regulations.

Annex F
(normative)
Qualification of Heat-treating Equipment

F.1 General

Add to section

Where the MDS referenced in Annex Q requires compliance with ISO 17782 or NORSOK M-650, heat-treatment facilities for special materials shall comply with the additional requirements given in the relevant standards.

F.2 Temperature Tolerance

Replace first sentence with

The temperature at any point in the working zone shall not vary by more than ± 25 °F (± 14 °C) from the furnace set-point temperature, after the furnace working zone has been brought up to temperature.

F.3 Furnace Calibration

F.3.2 Temperature Survey Method for Calibration of Batch-type Furnaces

Replace second last paragraph with

Before the furnace set-point temperature is reached, none of the temperature readings shall exceed the set-point temperature by more than ± 25 °F (± 14 °C).

F.4 Instruments

Add new section

F.4.4 Records

Records of furnace calibration and surveys shall be maintained for a period of at least two years.

Annex G
(normative)
Requirements for Nondestructive Examination

G.1 General

Replace section with

This annex specifies the requirements for NDE that shall be performed when required by Section 8 and Annex J for the applicable QSL.

Add new section

G.28 Ferrite Content

For duplex and super duplex stainless steel, all welds supplied in the as-welded condition (e.g. welds between duplex/super duplex pup-pieces and valve bodies) shall be subjected to a ferrite content check:

- The percentage ferrite range shall be checked using a ferrite content meter of type approved by the purchaser and calibrated in accordance with AWS A4.2 or ISO 8249. Calibration blocks shall cover ferrite content within the range of 25 % to 70 %.
- Ferrite content checks shall be undertaken on the OD for at least three locations equally spaced around the circumference.
- Surface preparation shall ensure that coatings and surface oxide are removed and the test location ground to a minimum 120 grit finish prior to the test.
- For acceptance, the ferrite content measurement shall be within the range 30 % to 70 % per ISO 17781 for welds in the as welded condition.

Annex H
(normative)
Supplementary Test Requirements

H.1 General

Replace section with

This annex specifies requirements for QSL testing in addition to Section 9, and supplementary testing which shall be performed by the manufacturer, if specified by the purchaser.

The frequency of testing shall be specified by the purchaser, if not defined in this annex.

H.3 Low-pressure Gas Seat Testing

H.3.1 General

Replace section with

Prior to the start of the low-pressure gas seat test:

– The valve shall be drained of hydrostatic test fluid.

– The seat to ball contacts and leakage measurement connection port shall be fully dried.

Following pressurization and prior to measurement of seat leakage commencing, the valve shall be fully stabilized. The valve stabilization period shall not begin until the test pressure in the valve remains constant for at least 2 min.

During the stabilization period, the outlet port from where leakage is to be measured shall remain connected to the leakage detection source (e.g. flow meter or water-filled bubble counter vessel) and shall be monitored for the duration.

The stabilization period duration shall not be less than as specified in Table H.2. The duration can be extended in case stabilization is not achieved.

Table H.2 – Stabilization Period Duration

NPS	Duration
4 (DN 100) and below	5 min
6 (DN 150) to 10 (DN 250)	10 min
12 (DN 300) to 18 (DN 450)	15 min
20 (DN 500) and above	30 min

Following stabilization, the seat leakage test can begin. The test duration shall be in accordance with API 6D Table 6.

H.3.4 Acceptance

Replace section with

The acceptable leakage rate for low-pressure gas seat test shall be in accordance with Table 14.

H.4 High-pressure Gas Testing

H.4.1 General

Add to section

The valve shall be drained of hydrostatic test fluid and the inner parts shall be fully dried prior to the start of the high-pressure gas testing.

The valve shall be isolated from the supply pressure source during pressure testing.

Following pressurization and prior to measurement of seat leakage commencing, the valve shall be fully stabilized. The valve stabilization period shall not begin until the test pressure in the valve remains constant for at least 2 min.

H.4.2 High-pressure Gas Shell Testing

H.4.2.1 General

Replace second sentence with

Test shall be performed using test fluid in accordance with Annex V.

All connections shall be installed prior to the start of the high-pressure gas shell test.

Dismantling of body connections including vent and drain plugs after the high-pressure gas shell test shall not be allowed. Dismantling shall require that an additional high-pressure gas shell test be performed, once all connections are re-connected.

H.4.2.2 Acceptance Criteria

Replace first list item with

– No visually detectable leakage allowed through any pressure-containing part.

– Maximum leakage as defined by Annex V from any external leak path during the hold period.

H.4.3 High pressure Gas Seat Testing

H.4.3.1 General

Add to section

During the stabilization period, the outlet port where leakage is to be measured from shall remain connected to the leakage detection source, e.g. flow meter or water-filled bubble counter vessel, and be monitored for the duration.

The stabilization period duration shall not be less than as specified in Table H.2. The duration can be extended in case stabilization is not achieved.

Following stabilization, the seat leakage test can begin. The test duration shall be in accordance with Table H.1.

The volume beyond the pressurized seat shall be at atmospheric pressure.

H.4.3.2 Acceptance Criteria

Replace first paragraph with

High pressure gas seat leakage rates shall conform to the values specified in Table 14.

Add to section

Seat leakage shall be monitored from each seat via the valve body cavity vent or drain connection.

The opposite valve end shall be isolated (closed) from atmospheric pressure during the leakage measurement.

H.5 Antistatic Testing

Add to section

Valves shall be tested for electrical continuity in accordance with the testing frequency specified in Table J.3.

Replace section heading with

H.6 Torque Measurements and Functional Testing

Add section heading before first paragraph

H.6.1 General

Add to section

Torques measurements and functional testing shall be performed:

– without pressure; and

– at the pressure rating determined in accordance with 5.2 for the material at 100 °F (38 °C).

The maximum torque shall be measured and functional testing shall be performed for all of the following valve operations:

a) Closed to open and open to closed without pressure.

b) Closed to open with one side of the obturator pressurized, and the cavity and opposite side at atmospheric pressure.

c) Repeat step b) but with the other side of the obturator pressurized.

d) Open to closed with the bore pressurized. The cavity shall be at atmospheric pressure, if applicable to the valve design.

e) Closed to open with both sides of the obturator pressurized and the cavity at atmospheric pressure.

Add new section

H.6.2 Torque Measurements

Torque measurements shall be carried out directly on the valve stem.

The procedure for torque measurements shall be as follows:

a) Without pressure – closed to open and open to closed:

   - Torque measurements shall be carried out along the necessary opening and closing angle.
   - The highest value shall be recorded for each opening and closing direction.

b) Valve pressurized – closed to open:

   1) Fill the valve in half-open position with water.
   2) Close the valve.
   3) Apply pressure to the appropriate end(s) of the valve.
   4) With one side of the obturator pressurized, the cavity and opposite side shall be at atmospheric pressure.
   5) With both sides of the obturator pressurized, the cavity shall be at atmospheric pressure.
   6) Open the valve after a minimum of 1 min of pressure stabilization.
   7) Torque measurement shall be performed up to decompression of the pressurized volume.
   8) The highest value shall be recorded.
   9) During valve opening:
      - With one side of the obturator pressurized, the body cavity and opposite side shall be opened to allow water to overflow at atmospheric pressure.
      - With both sides of the obturator pressurized, the body cavity shall be opened to allow water to overflow at atmospheric pressure.

c) Valve pressurized – open to closed:

   1) Fill the valve in half-open position with water.
   2) Open the valve.
   3) Apply pressure into the valve bore.
   4) The cavity shall be at atmospheric pressure if applicable to the valve design.
   5) Close the valve after a minimum of one minute of pressure stabilization.
   6) Torque measurement shall be performed up to decompression of the pressurized volume (if applicable to the valve design).
   7) The highest value shall be recorded.

8) During valve closing, the body cavity shall be opened to allow water to overflow at atmospheric pressure (if applicable to the valve design).

d) Torque values shall be measured and functional testing shall be performed with seats free of sealant. If necessary for assembly, a lubricant with a viscosity not exceeding that of SAE 10W motor oil, or equivalent, may be used.

e) The measured torque results shall be recorded and shall not exceed the manufacturer's documented valve torques.

Add new section heading

H.6.3 Functional Testing

Add new section

H.6.3.1 Manual Valves Equipped with a Wrench (Lever)

Valves shall be tested as delivered with the wrench.

a) Without pressure – 1 cycle:

1) The valve shall be fully operated without pressure.

2) 1 cycle shall be performed (1 cycle = closed to open and open to closed).

b) Valve pressurized – closed to open:

1) Fill the valve in the half-open position with water.

2) Close the valve.

3) Apply pressure to the appropriate end(s) of the valve.

4) With one side of the obturator pressurized, the cavity and opposite side shall be at atmospheric pressure.

5) With both sides of the obturator pressurized, the cavity shall be at atmospheric pressure.

6) Open the valve after a minimum of one minute of pressure stabilization.

7) During the valve opening:

– With one side of the obturator pressurized, the body cavity and opposite side shall be opened to allow water to overflow at atmospheric pressure.

– With both sides of the obturator pressurized, the body cavity shall be opened to allow water to overflow at atmospheric pressure.

c) Valve pressurized – open to closed:

1) Fill the valve in the half-open position with water.

2) Open the valve.

3) Apply pressure into the valve bore.

4) The cavity shall be at atmospheric pressure if applicable to the valve design.

5) Close the valve after a minimum of one minute of pressure stabilization.

6) During the valve closing, the body cavity shall be opened to allow water to overflow at atmospheric pressure (if applicable to the valve design).

d) Acceptance:

1) The valve shall be operable without abnormal observation.

2) The maximum measured force shall in be in accordance with 5.13.

Add new section

H.6.3.2 Manual Valves Equipped with a Gearbox

Valves shall be tested as delivered with the gearbox.

a) Without pressure – 1 cycle:

1) The valve shall be fully operated without pressure.

2) 1 cycle shall be performed (1 cycle = closed to open and open to closed).

3) The gearbox input torque measurements shall be carried out at the start to open and start to close positions (breakaway to open, breakaway to close).

b) Valve pressurized – closed to open:

1) Fill the valve in the half-open position with water.

2) Close the valve.

3) Apply pressure to the appropriate end(s) of the valve.

4) With one side of the obturator pressurized, the cavity and opposite side shall be at atmospheric pressure.

5) With both sides of the obturator pressurized, the cavity shall be at atmospheric pressure.

6) Open the valve after a minimum of one minute of pressure stabilization.

7) The gearbox input torque measurement shall be performed up to decompression of the pressurized volume.

8) The highest value shall be recorded.

9) During the valve opening:

   – With one side of the obturator pressurized, the body cavity and opposite side shall be opened to allow water to overflow at atmospheric pressure.

   – With both sides of the obturator pressurized, the body cavity shall be opened to allow water to overflow at atmospheric pressure.

c) Valve pressurized – open to closed:

1) Fill the valve in the half-open position with water.
2) Open the valve.
3) Apply pressure into the valve bore.
4) The cavity shall be at atmospheric pressure if applicable to the valve design.
5) Close the valve after a minimum of one minute of pressure stabilization.
6) The gearbox input torque measurement shall be performed up to decompression of the pressurized volume.
7) The highest value shall be recorded.
8) During the valve closing, the body cavity shall be opened to allow water to overflow at atmospheric pressure (if applicable to the valve design).

d) Acceptance:

1) The valve shall be operable without abnormal observation.
2) The measured torque results shall not exceed the manufacturer's documented valve torques.
3) The gearbox output torques shall be calculated using gearbox mechanical advantage ratio.
4) Calculated gearbox output torques shall be compared and correlated to the valve torques.
5) The handwheel rim tangential force shall be calculated and checked that it complies with 5.13.

H.7 Drive Train Strength Test

H.7.1 General

Add third list item

c) the maximum operator torque.

Add to section

When specified in the requisition, the strength of the drive train shall be tested by performing a stall test as described below.

In case the order consists of multiple fully identical valve assemblies, only one unit shall be subjected to the stall test. The stall test is done by blocking movement of the valve from its fully open position by inserting a test plug into the valve.

- To ensure the inside of the valve and its sealing areas are not damaged, the test plug shall be of a malleable material "softer" than the relevant valve components that will be in contact with the test plug.
- To prevent deformation of the valve, the test plug dimension shall fit the curvature of the internal bore of the valve resulting in an even distribution of force throughout the valves components.
- Due care must be taken to ensure personal safety when performing the stall test.

Prior to beginning the stall test, using a paint pen, mark the interface flanges between the operator and the mounting kit, and between the mounting kit and the valve. Verify angular alignment between the centerline of the valve and centerline of the operator (either 0° or 90°).

H.8 Cavity Relief Testing

H.8.1 Frequency

Add to section

Testing frequency shall be in accordance with Table J.3.

Replace section heading with

H.8.2 Trunnion-mounted Ball Valves with Internal-relieving Seats

Replace section with new section

H.8.2.1 Test Medium

Cavity relief testing shall use:

- fresh water in accordance with 9.1 for QSL-2, QSL-3; and
- inert gas for QSL-2G, QSL-3G, QSL-4.

Add new section

H.8.2.2 Internal Relieving Seat Testing Using Fresh Water

The procedure for cavity relief testing using fresh water shall be as follows:

a) Fill the valve in the half-open position with water.

b) Close the valve and allow water to overflow from the test connection at each end of the valve.

c) Apply pressure to the valve cavity until one seat relieves the cavity pressure into the valve end. Record this relief pressure.

d) For valve types with second-seat relief, continue to increase the pressure to the cavity until the second seat relieves and record the relief pressure of the second seat.

Add new section

H.8.2.3 Internal Relieving Seat Testing Using Inert Gas

The procedure for cavity relief testing using inert gas shall be as follows:

a) The valve shall be drained of the hydrostatic test fluid and the inner parts shall be fully dried prior to the start of the high-pressure gas testing.

b) Close the valve – each end of the valve shall be at atmospheric pressure.

c) Apply pressure to the valve cavity until one seat relieves the cavity pressure into the valve end. Record this relief pressure.

d) For valve types with second-seat relief, continue to increase the pressure to the cavity until the second seat relieves. Record the relief pressure of the second seat.

Add new section

H.8.2.4 Acceptance Criteria

Valve cavity relief pressure shall not exceed the following:

- Class 150: 100 psig (7 barg);
- Class 300: 145 psig (10 barg);
- Class 600/900: 220 psig (15 barg);
- Class 1500: 360 psig (25 barg);
- Class 2500: 435 psig (30 barg).

H.9 Double Block and Bleed (DBB) Valves

H.9.1 General

Add to section

The valve shall be isolated from the supply pressure source during pressure testing.

The pressure shall be stabilized prior to the start of pressure testing.

The valve shall be drained of the hydrostatic test fluid and the inner parts shall be fully dried prior to the start of the high-pressure gas testing.

H.9.2 Acceptance

Replace section with

For soft-seated and metal-seated valves, leakage rates shall conform to the values specified in Table 14.

H.11 Double Isolation and Bleed DIB-2 (One Seat Unidirectional and One Seat Bidirectional)

H.11.1 General

Add to section

Testing as described in API 6D H.11 and H.12 shall be included for all valves.

H.11.2 Acceptance

Replace section with

The allowable leakage rate during the hydrostatic seat test shall conform to the values specified in Table 14.

Replace annex heading with

Annex J
(normative)
Quality Specification Level (QSL) for Pipeline and Piping Valves

J.1 General

Replace section with

This annex specifies quality levels for ball valves. The QSLs increase in stringency of requirements with the QSL number. The QSLs include specific requirements for NDE, pressure testing, and documentation of the manufacturing process. The QSLs shall be specified in the purchasing documentation. All of the requirements of a specific QSL shall be adhered to.

J.2 Specification of Quality Levels for NDE

Replace section with

Table J.1 specifies NDE requirements by inspection code for QSL-1, QSL-2, QSL-3 and QSL-4. These requirements vary by the type of material product form and the finished valve part being inspected. Table J.2 specifies the extent, method, and acceptance criteria for the various inspection codes used in Table J.1.

Independent of the extent specified in Table J.1, qualification and NDE requirements for pilot casting for cast of pressure-containing and pressure-controlling parts shall be according to IOGP S-563 and the applicable material datasheet referenced in Annex Q.

Replace Table J.1

Table J.1 – NDE Requirements

Part	QSL-1			QSL-2			QSL-3			QSL-4		
	Cast	Forged	Plate	Cast	Forged	Plate	Cast	Forged	Plate	Cast	Forged	Plate
Body or closures and end connections or bonnet or cover or gland housing [g] or integral lifting lugs [l]	VT1	VT2	N/A	VT1 and RT1[a,i] and MT1[i] or PT1[i]	VT2 and MT1[i] or PT1[i]	N/A	VT1 and RT1[a] and MT1[i] or PT1[i]	VT2 and UT2 and MT1[i] or PT1[i]	N/A	VT1 and RT1[a,f] and UT1 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	N/A
Welding ends (including pipe pup welding ends) [b]	VT1 and RT3 or UT4	VT2 and UT2	VT2 and UT2	VT1 and RT3 or UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2and MT1 or PT1	VT1 and RT3 or UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT1 and RT3 or UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Stem or shaft [c,g]	N/A	VT2	N/A	N/A	VT2	N/A	N/A	VT2 and MT1 or PT1	N/A	N/A	VT2 and UT2 and MT1 or PT1	N/A
Trunnion [d,g] or Trunnion/bearing plates	VT1	VT2	VT2	VT1	VT2	VT2[j]	VT1	VT2 and MT1[i] or PT1[i]	VT2 and MT1[i] or PT1[i]	VT1 and UT1 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Bolting – pressure-containing	N/A	VT2	N/A	N/A	VT2	N/A	N/A	VT2 and MT1[i] or PT1[i]	N/A	N/A	VT2 and MT1 or PT1	N/A
Ball [c]	VT1	VT2	N/A	VT1	VT2	N/A	VT1 and MT1[i] or PT1[i]	VT2 and MT1[i] or PT1[i]	N/A	VT1 and MT1 or PT1	VT2 and MT1 or PT1	N/A
Seat rings [c,g]	VT1	VT2	N/A	VT1	VT2	N/A	VT1 and MT1[i] or PT1[i]	VT2 and MT1[i] or PT1[i]	N/A	VT1 and MT1 or PT1	VT2 and MT1 or PT1	N/A
Corrosion-resistant overlay	VT3 and PT1						VT3 and UT3 [h] and PT1			VT3 and UT3 and PT1		
Seals gaskets	VT4											

Part	QSL-1			QSL-2			QSL-3			QSL-4		
	Cast	Forged	Plate	Cast	Forged	Plate	Cast	Forged	Plate	Cast	Forged	Plate
Seat springs	VT4											
Pressure-containing welds	VT3 and RT2 or UT3						VT3 and RT2 and MT1 or PT1 or VT3 and UT3 and MT1 or PT1					
Reinforcement and stiffening welds	VT3											
Fillet and attachment welds to pressure-containing parts	VT3						VT3 and MT1 or PT1					
Pipe pup to valve welds or pipe pups [e]	VT3 and RT2 and MT1 or PT1											
Plating	VT4											
Hard facing	VT4						VT4 and PT1					
Welded on Lifting Lugs	VT3 and MT1 or PT1											
Sealing surfaces	-						VT4 and MT2 or PT2					

NOTE 1 See Table J.2 for specification of the examinations referred to in this table.
NOTE 2 N/A means that the manufacturer is not allowed to use this material form for that specific part.
NOTE 3 All the NDE activities listed above for a specific part and product form or forms shall be conducted.
NOTE 4 Qualification and NDE requirements for pilot casting shall be according to IOGP S-563 and the applicable material datasheet in IOGP S-563 as referenced in Annex Q.

[a] RT1 may be replaced by UT4 by agreement.
[b] ASME B16.34, 8.3.1.1 (a) (1).
[c] MT or PT to be performed prior to coating, plating, or overlay.
[d] Trunnion may be pressure-containing or pressure-controlling, depending on design type. If the trunnion is a pressure-containing part, the requirements for body apply.
[e] NDE requirements of pipe pups shall comply with the applicable MDS in IOGP S-563, unless specified otherwise by the purchaser.
[f] RT1 plus UT1 may be replaced by RT3.
[g] Requirements for examination of bar material shall be as for forgings.
[h] Machined surfaces only.
[i] 5 % or minimum (QSL-1 & and 2) and 10 % or minimum (QSL-3), 1 part per component batch to be examined. If defects outside acceptance criteria are detected, two or more parts shall be tested, and if any of these two fails, all item represented shall be examined.
[j] Sour service: when specified by the purchaser, plate shall be UT tested according to the MDS in IOGP S-563 as referenced in the material selection table in Annex Q, regardless of the QSL.
[k] VT examination shall cover all areas of threads, shanks and heads. Discontinuities shall comply with requirements specified in ASTM F788 for bolts/studs and ASTM F812 for nuts.
[l] For integral lifting lugs, RT1 or UT2 are also applicable for QSL 1 and 2.

Replace table J.2 with

Table J.2 – Extent, Method, and Acceptance Criteria of NDE/Item Examination Code

Examination	NDE	Extent	Method	Acceptance
RT1	RT casting [a]	Areas defined by ASME B16.34 for special class valves, at abrupt changes in sections and at the junctions of risers, gates or feeders to the casting.	ASME BPVC, Section V, Article 2	ASME BPVC, Section VIII, Div. 1, Appendix 7
RT2	RT weldments	100 % where practicable	G.13	G.13
RT3	RT casting [a]	100 %	ASME BPVC, Section V, Article 2	ASME BPVC, Section VIII, Div. 1, Appendix 7
UT1	UT casting [a]	Remaining areas not covered by RT1	ASME BPVC, Section V, Article 5	ASTM A609/A609M, Table 2, Quality Level 2
UT2	UT forging and plate	All surfaces	ASME BPVC, Section V, Article 5	Forgings: ASME BPVC, Section VIII, Div. 1, UF-55 for angle beam and ASME B16.34 for straight beam. Plate: ASTM A578/A578M:2017, Acceptance standard level B. When specified by the purchaser, for sour service plate shall be UT tested according to the MDS in IOGP S-563 as referenced in Table Q.1, regardless of the QSL.
UT3	UT weldments	G.14	G.14	G.14
	UT overlay	G.17	G.17	G.17
UT4	Casting [a]	100 %	ASME BPVC, Section V, Article 5	ASTM A609/A609M, Table 2, Quality Level 1
MT1	MT [a]	G.6, G.7, G.11, G.15, G.18, G.20 or G.26	G.6, G.7, G.11, G.15, G.18, G.20 or G.26	G.6, G.7, G.11, G.15, G.18, G.20 or G.26

Examination	NDE	Extent	Method	Acceptance
MT2	MT	G.22	G.22	G.22
PT1	PT [a]	G.8, G.9, G.12, G.16, G.19, G.21, G.24 or G.25	G.8, G.9, G.12, G.16, G.19, G.21, G.24 or G.25	G.8, G.9, G.12, G.16, G.19, G.21, G.24 or G.25
PT2	PT	G.23	G.23	G.23
VT1	VT castings [a]	8.6	8.6	8.6
VT2	VT forging and plate	Per applicable MDS	Per applicable MDS.	Per applicable MDS
VT3	VT weldments	100 % accessible surfaces	ASME BPVC, Section V, Article 9	Undercut shall not reduce the thickness in the area (considering both sides) to below the minimum thickness
	VT weld overlay	Per applicable EDS	Per applicable EDS	Per applicable EDS
VT4	Other	100 % accessible surfaces	Per applicable MDS, EDS or material standard	Per applicable MDS, EDS or material standard

NOTE Where the table refers to MDS or EDS, NDE shall comply with the requirements in the applicable MDS or EDS referenced in Annex Q. Where no MDS or EDS is referenced in Annex Q, the applicable material standard shall apply without additional requirements.

[a] NDE requirements for pilot casting shall be according to the applicable datasheet in IOGP S-563 as referenced in Annex Q.

J.3 Hydrostatic/Gas Testing

Replace table J.3 with

Table J.3 – Pressure Testing Requirements for Quality Specification Levels

Sequence	Type	Quality Specification Levels						
		QSL-1	QSL-2	QSL-2G	QSL-3	QSL-3G	QSL-4	
1	Antistatic Testing per H.5	One valve of each unique design/ size/ rating/ material to be tested per H.5	One valve of each unique design/size/ rating/material to be tested per H.5	One valve of each unique design/size/ rating/material to be tested per H.5	Test per H5	Test per H5	Test per H5	
2	High-pressure hydrostatic shell test at 1.5 times the rated pressure per 9.3.	Test per 9.3	Test per 9.3	Test per 9.3	2 tests required. After 1st test reduce pressure to zero and repeat test.	2 tests required. After 1st test reduce pressure to zero and repeat test.	3 tests are required. Reduce pressure to zero between each test.	Tests 1 and 3 shall have test duration as specified in Table 5. Test 2 shall have an extended duration of four times that stated in Table 5.
3	Torque test per H.6 at 1.0 times the rated pressure per H.6.1	None	Only for valves supplied bare stem	Only for valves supplied bare stem	Test per H.6 on valve stem	Test per H.6 on valve stem	Test per H.6 on valve stem	
4	High-pressure hydrostatic seat test at 1.1 times the rated pressure per 9.4.	Test per 9.4	Test per 9.4	Test per 9.4	2 tests each seat required. After 1st test, reduce pressure to zero and cycle fully open and fully closed and repeat test.	2 tests each seat required. After 1st test, reduce pressure to zero and cycle fully open and fully closed and repeat test.	3 tests each seat is required. Reduce pressure to zero and cycle fully open and fully closed after each test.	Tests 1 and 3 shall have test duration as specified in Table 6. Test 2 shall have an extended duration of four times that stated in Table 6.

Sequence	Type	Quality Specification Levels						
		QSL-1	QSL-2	QSL-2G	QSL-3	QSL-3G	QSL-4	
5	Functional test per H.6 with operator at 1.0 times the rated pressure per H.6.1	None	Test per H.6 with lever/ gearbox fitted except for bare stem valve.	Test per H.6 with lever/ gearbox fitted except for bare stem valve.	Test per H.6 with lever/gearbox fitted except for bare stem valve.	Test per H.6 with lever/gearbox fitted except for bare stem valve.	Test per H.6 with lever/gearbox fitted except for bare stem valve.	
6	Seat cavity relief test per H.8	None	One valve of each unique design/size/rating/material to be tested per H.8	One valve of each unique design/size/rating/material to be tested per H.8	Test per H.8	Test per H.8	Test per H.8	
7	Low-pressure pneumatic seat test at 80 psi (6 bar) to 100 psi (7 bar) per H.3.3 Type II	None	None	None	None	2 tests each seat required. Reduce pressure to zero and cycle valve fully open and fully closed and repeat test of each seat.	3 tests each seat is required. Reduce pressure to zero and cycle fully open and fully closed after each test.	Tests 1 and 3 shall have test duration as specified in Table 6. Test 2 shall have an extended duration of four times that stated in Table 6.
8	High-pressure pneumatic seat test at 1.1 times the rated pressure per H.4.3	None	None	Test each seat per H.4.3	None	2 tests each seat required. After 1st test, reduce pressure to zero and cycle fully open and fully closed and repeat test.	3 tests each seat is required. Reduce pressure to zero and cycle fully open and fully closed after each test.	Tests 1 and 3 shall have test duration as specified in Table H.1. Test 2 shall have an extended duration of four times that stated in Table H.1.
9	DBB testing	Test per H.9. when DBB is specified	Test per H.9. when DBB is specified.	Test per H.9. when DBB is specified	Test per H.9. when DBB is specified	Test per H.9. when DBB is specified	Test per H.9. when DBB is specified	Test per H.9 when DBB is specified
10	Low-pressure pneumatic seat test at 80 psi (6 bar) to 100 psi (7 bar) per H.3.3 Type II	Test each seat per H.3.3 Type II	Test each seat per H.3.3 Type II	Test each seat per H.3.3 Type II	2 tests each seat required. Reduce pressure to zero and cycle valve fully open and fully closed and repeat test of each seat.	2 tests each seat required. Reduce pressure to zero and cycle valve fully open and fully closed and repeat test of each seat.	3 tests each seat is required. Reduce pressure to zero and cycle fully open and fully closed after each test.	Tests 1 and 3 shall have test duration as specified in Table 6. Test 2 shall have an extended duration of four times that stated in Table 6.

Sequence	Type	Quality Specification Levels						
		QSL-1	QSL-2	QSL-2G	QSL-3	QSL-3G	QSL-4	
11	Low-pressure shell test at 80 psi (6 bar) to 100 psi (7 bar)	none	For threaded plug or flange connections	none	For threaded plug or flange connections	none	none	none
12	High-pressure pneumatic shell test at 1.1 times the rated pressure per H.4.2	None	None except for seal welded plug	Test per H.4.2	None except for seal welded plug	2 tests required. After 1st test reduce pressure to zero and repeat test.	3 tests are required. Reduce pressure to zero between each test.	Tests 1 and 3 shall have test duration as specified in Table H.1. Test 2 shall have an extended duration of four times that stated in Table H.1.
13	Sample Fugitive emission testing per Annex V	None	None	Test per Annex V	Test per Annex V	Test per Annex V	Test per Annex V	Test per Annex V

NOTE 1 Pressure end thrust effect (end flanges) (Table 15):

NOTE 2 QSL-1, QSL-2: According to Table 15.

NOTE 3 QSL-2G, QSL-3, QSL-3G and QSL-4 shall be considered for all valves for pressure end thrust effect of end flanges.

NOTE 4 2G/3G - Designation used for gas test for QSL-2/QSL-3 valves.

NOTE 5 Sequence 13 related to sample fugitive emission testing may be combined with sequence 12. In that case, fugitive emission test pressure will be increased to 1.1 rated pressure.

J.4 Documentation

Replace table J.4 with

Table J.4 – Documentation Requirements

Required Documentation to Be Sent with the Valve(s)		Required	Inspection document type [a]		Traceability Levels [b]	API 6D sections	S-562 / IOGP sections [c]
			QSL-1, 2, 3	QSL-4			
1	General arrangement drawings.	X				Annex N l)	13.1
2	Cross-sectional assembly drawings with parts list and materials list	X				Annex N e)	13.1
3	Gearbox assembly	X	2.1	2.1	II		5.18.6
4	Name plate drawing	X				11	11
5	Design calculations	X				5	5.1, 5.19, 5.3, Annexes P, R and S
6	Heat treatment procedures	X				6.10, Annex F	Annex F and S-563
7	NDE procedures	X				8.4, 8.5 and Annex G	8.3, 8.4, 8.5, Annex G, J.2 and S-563
8	Pressure test procedures	X				9 and Annex H	9, Annex H and J.3
9	Painting procedures	X				10	10
10	Installation, operation and maintenance instructions/manuals	X				Annex N p)	13.1 and 13.2
11	Lifting points certification and lifting handling instructions.	X	2.2	2.2		5.19	
12	Fire type-testing certification of the design.	X	3.1	3.1		5.22, O.5 and Annex N j)	
13	Calibration certificates on pressure test equipment used (e.g. pressure gauges, transducers and chart recorders)	X	3.1	3.1		8, I.2.2.i), I.2.3 and Annex N a)	

	Required Documentation to Be Sent with the Valve(s)	Required	Inspection document type [a]		Traceability Levels [b]	API 6D sections	S-562 / IOGP sections [c]
			QSL-1, 2, 3	QSL-4			
14	Heat-treatment records including times and temperatures, e.g. charts	X	3.1	3.1	I	6.1 and Annex N o)	13.1
15	Hardness test report on metallic pressure-controlling parts	X	3.1	3.1	I	6.1 and Annex N n)	
16	Hardness test report on metallic pressure-containing parts	X	3.1	3.1	I	6.1 and Annex N m)	
17	Hardness survey test report on pressure-containing and pressure-controlling welds in valves required to meet ISO 15156/NACE MR0175 (all parts) or ISO17945/ NACE MR0103	X	3.1	3.2	I	7.4	
18	Metallic materials pressure-containing and pressure-controlling parts.	X	3.1	3.2	I	6.1 and Annex N q)	6,13.1 and 13.2
19	Metallic materials non-pressure-containing and non-pressure-controlling parts	X	2.2	2.2	II		6
20	Non-metallic materials shall have a certificate of compliance in conformance based on batch testing	X	2.2	2.2	III		6, Annexes T and U
21	Weld repair documentation including extent of repairs, repair weld maps, WPS, WPQ, PQR, post weld heat treatment and NDE following the repair(s)	X	3.1	3.1	I	7.5, 7.6, Annex N u), x) and y)	6.8, 7.6, 13.1 and 13.2
22	NDE records (metallic parts, welds, overlay cladding, hard facings, platings)	X	3.1	3.1	I	Annex N r), s) and t)	13.1
23	Final Inspection documentation (dimensional marking, and visual report, including straightness and cylindricity for pig valves)	X	3.1	3.1	I		5.6, 11 and S-562Q
24	Pressure test report (including pressure, test duration, test medium and acceptance criteria) including copy of chart recorder used on pressure test	X	3.1	3.1		Annexes N v), I.2.2 and I.2.4	13.1 and 13.2.b
25	Fugitive emission test report	X	2.2	2.2			Annex V
26	Painting/Coating Certification	X	2.2	2.2	III		
27	Certificate of conformance to this specification	X	2.1	2.1			13.2
28	For sour service valves, certificate of conformance to ISO 15156/ NACE MR0175 or ISO 17945/NACE MR0103	X	2.1	2.1		Annex N b) and c)	13.1 and 6.8.c
29	Manufacturer's Valve Data Report (MDR)	X					

Required Documentation to Be Sent with the Valve(s)		Required	Inspection document type [a]		Traceability Levels [b]	API 6D sections	S-562 / IOGP sections [c]
			QSL-1, 2, 3	QSL-4			
30	Studded connection gasket certification (SWG / RTJ)	X	2.2 / 3.1	2.2 / 3.1	II		5.9.1 and 6.9
31	Nonconformance reports required to demonstrate the product non-compliance and acceptance by the purchaser	X					13.1
32	Listing of applicable and authorized concessions, waivers and/or material substitutions	X					13.1 and 13.2

[a] Inspection document types specified here conform to definitions specified in EN 10204 / ISO 10474.

[b] Traceability Levels:

- Level I - Full Traceability - the material is uniquely identified and its history tracked from manufacture through stockists (where applicable) to the manufacturer and to actual position on the equipment with specific location defined on a material placement record (the traceability to a specific location only applies to skids / packaged equipment).
- Level II - Type Traceability – the manufacturer maintains a system to identify material throughout manufacture, with traceability to a material certificate.
- Level III - Compliance Traceability – the manufacturer maintains a system of traceability that enables a declaration of compliance to be issued by the manufacturer.

[c] Documentation shall also include the additional requirement in the applicable MDS in IOGP S-563 as referenced in Annex Q.

Annex O
(informative)
Purchasing Guidelines

O.5 Fire Type-testing

Replace first paragraph with

The fire-tested design of valves shall be qualified by fire type-testing in accordance with 5.22.

Add new section

O.9 Purchaser Options

Purchaser options specified in this specification are listed in Table O.2, which can be used to assist with preparation of the valve datasheet.

Table O.2 defines the requirements to be specified by the purchaser.

Default selections are marked with an asterisk (*).

Allowed combinations of material related options are detailed in Annex Q.

Add new table

Table O.2 – Purchaser Options

Item	Description	S-562 options					
1	Valve size	2" - 60"					
2	Pressure class	150	300	600	900	1500	2500
3	Orientation	Horizontal Flow with vertical stem upward *					
4	End connection	RF	RTJ	Weld end			
5	Body material	NTCS	LTCS	LTCS + Clad	SS 316	DSS	SDSS
6	Service	Sweet	Sour NACE	Sea-water + Sour NACE			
7	Trim material for valves in NTCS and LTCS	Stainless Steel *	ENP + Carbon Steel				
8	Valve type	BB *	DBB	DIB-2			
9	Bore	Full	Reduced				
10	Seals [a]	O-ring * [b]	Lip Seal * [c]				
11	Seats	Metal	Soft				
12	Quality Specification Level	QSL-1 *	QSL-2	QSL-2G	QSL-3	QSL-3G	QSL-4
13	Operation	Manual	Bare stem				
14	Corrosion allowance for valves in NTCS and LTCS	3 mm *	6 mm				

Item	Description	S-562 options					
15	Body type	Split body *	Top entry	Fully Welded			
16	Auxiliary connections	NPT *	Parallel	Studded flange			
17	Injection	None	Stem and Seat	Stem only			
18	Equalizing hole	None *	Included				
19	Fugitive emission class according to 9.9 and Annex V [d]	AH	BH *				

[a] Metal gaskets and V-packing are acceptable for both options

[b] O-rings suitable for temperatures ≥ -20 °F (-29 °C) – as per material selection table in Annex Q

[c] Lip seals suitable for temperatures ≥ -50 °F (-46 °C) – as per material selection table in Annex Q

[d] For fugitive emission production testing, sampling strategy for X equal or less than 10 to be one unless otherwise agreed with purchaser.

Add new annex

Annex P (new)
(normative)
Load on Valves

This annex provides bending moments and axial forces to be used for the design of valve bodies in accordance with 5.1 and where the manufacturer has selected ASME VIII as the design basis, which requires "consideration for pipe loads, operating forces, etc.". The purchaser may specify alternative loads and forces for specific applications.

Design of reduced bore valves shall be based on the larger size. For example, an NPS 6 (DN 150) × NPS 4 (DN 100) reduced bore valve shall be based on the bending moments and forces of an NPS 6 (DN 150) valve.

The manufacturer shall run 3 sets of calculations at the rated pressure of the valves:

- Load case 1 for bending moment only;
- Load case 2 for axial force only;
- Load case 3 for 50 % bending moment + 50 % axial force.

Acceptance criteria:

- Stresses shall be within the allowable limits of the design code.
- Deflections shall not result in seal performance degradation, extrusion, pinching or other effects that could reduce valve functionality.

Bending moment values shall be in accordance with Table P.1.

Axial force values shall be in accordance with Table P.2.

Table P.1 – Bending Moment

NPS	DN	OD	Class 150 to 600		Class 900		Class 1500		Class 2500	
		in. (mm)	Bore ID in. (mm)	Moment ft. lbf (Nm)	Bore ID in. (mm)	Moment ft. lbf (Nm)	Bore ID in. (mm)	Moment ft. lbf (Nm)	Bore ID in. (mm)	Moment ft. lbf (Nm)
2	50	2.375 (60.3)	1.94 (49)	532 (728)	1.94 (49)	532 (728)	1.94 (49)	532 (728)	1.69 (42)	713 (988)
2 ½	65	2.875 (73)	2.44 (62)	819 (1099)	2.44 (62)	819 (1099)	2.44 (62)	819 (1099)	2.06 (52)	1253 (1702)
3	80	3.5 (88.9)	2.94 (74)	1541 (2152)	2.94 (74)	1541 (2152)	2.94 (74)	1541 (2152)	2.44 (62)	2344 (3160)
4	100	4.5 (114.3)	3.94 (100)	2690 (3643)	3.94 (100)	2690 (3643)	3.94 (100)	2690 (3643)	3.44 (87)	4296 (5844)
6	150	6.625 (168.3)	5.94 (150)	7363 (10362)	5.94 (150)	7363 (10362)	5.69 (144)	9489 (13031)	5.19 (131)	12975 (17773)
8	200	8.625 (219.1)	7.94 (201)	12943 (18073)	7.94 (201)	12943 (18073)	7.56 (192)	18819 (25420)	7.06 (179)	25311 (34355)
10	250	10.75 (273)	9.94 (252)	23923 (32836)	9.94 (252)	23923 (32836)	9.44 (239)	36049 (49449)	8.81 (223)	48814 (66491)
12	300	12.75 (323.8)	11.94 (303)	34261 (46642)	11.94 (303)	34261 (46642)	11.31 (287)	56505 (76553)	10.44 (265)	81675 (110264)
14	350	14 (355.6)	13.19 (334)	41665 (58726)	12.69 (322)	63831 (86793)	12.44 (315)	73975 (101781)	11.5 (292)	107000 (144446)
16	400	16 (406.4)	15.19 (385)	55017 (76928)	14.69 (373)	84865 (114813)	14.19 (360)	111816 (151929)	13.13 (333)	160242 (217150)
18	450	18 (457)	17.19 (436)	70226 (96431)	16.69 (423)	108900 (149548)	16 (406)	156852 (211993)	14.75 (374)	229244 (310025)
20	500	20 (508)	19.19 (487)	87290 (119988)	18.56 (471)	147960 (201571)	17.88 (454)	206867 (279604)	16.5 (419)	307389 (414831)
22	550	22 (559)	21.19 (538)	106209 (146119)	20.56 (522)	180817 (246545)	19.69 (500)	273157 (370335)	-	-
24	600	24 (610)	23.19 (589)	126984 (174824)	22.44 (570)	233279 (317685)	21.5 (546)	352264 (478822)	-	-
26	650	26 (660)	24.94 (633)	192972 (260571)	24.31 (617)	296594 (400047)	23.38 (594)	435511 (582392)	-	-
28	700	28 (711)	26.94 (684)	224787 (303739)	26.19 (665)	368603 (496992)	25.25 (641)	532215 (718526)	-	-
30	750	30 (762)	28.94 (735)	259031 (350216)	28.06 (712)	453516 (619624)	27 (686)	664695 (894294)	-	-
32	800	32 (813)	30.69 (779)	361162 (497206)	29.94 (760)	548160 (748144)	28.75 (730)	817354 (1107800)	-	-
34	850	34 (864)	32.69 (830)	409203 (563640)	31.81 (808)	657837 (893287)	30.5 (775)	991612 (1339717)	-	-
36	900	36 (914)	34.44 (874)	542363 (737148)	33.69 (855)	778206 (1053643)	32.25 (819)	1188892 (1598076)	-	-
38	950	38 (965)	36.44 (925)	606384 (824582)	35.63 (904)	892022 (1216785)	-	-	-	-
40	1000	40 (1016)	38.44 (976)	673978 (916918)	37.63 (956)	993067 (1335062)	-	-	-	-
42	1050	42 (1067)	40.19 (1020)	856828 (1179892)	39.63 (1006)	1099540 (1501275)	-	-	-	-
48	1200	48 (1219)	45.94 (1166)	1274040 (1738092)	45.25 (1149)	1664226 (2247708)	-	-	-	-
54	1350	54 (1371.6)	51.69 (1312)	1808523 (2474614)	-	-	-	-	-	-
56	1400	56 (1422)	53.56 (1360)	2051965 (2766306)	-	-	-	-	-	-
60	1500	60 (1524)	57.44 (1458)	2474799 (3383886)	-	-	-	-	-	-

Table P.2 – Axial Force

NPS	DN	OD	Class 150 to 600		Class 900		Class 1500		Class 2500	
		in. (mm)	Bore ID in. (mm)	Force lbf (N)	Bore ID in. (mm)	Force lbf (N)	Bore ID in. (mm)	Force lbf (N)	Bore ID in. (mm)	Force lbf (N)
2	50	2.375 (60.3)	1.94 (49)	12899 (58202)	1.94 (49)	12899 (58202)	1.94 (49)	12899 (58202)	1.69 (42)	19136 (88220)
2 ½	65	2.875 (73)	2.44 (62)	15889 (69979)	2.44 (62)	15889 (69979)	2.44 (62)	15889 (69979)	2.06 (52)	27640 (123700)
3	80	3.5 (88.9)	2.94 (74)	24784 (114380)	2.94 (74)	24784 (114380)	2.94 (74)	24784 (114380)	2.44 (62)	43270 (191286)
4	100	4.5 (114.3)	3.94 (100)	32481 (144411)	3.94 (100)	32481 (144411)	3.94 (100)	32481 (144411)	3.44 (87)	57839 (258969)
6	150	6.625 (168.3)	5.94 (150)	59149 (274491)	5.94 (150)	59149 (274491)	5.69 (144)	79131 (357618)	5.19 (131)	116515 (526086)
8	200	8.625 (219.1)	7.94 (201)	77979 (358321)	7.94 (201)	77979 (358321)	7.56 (192)	118457 (524998)	7.06 (179)	168693 (752277)
10	250	10.75 (273)	9.94 (252)	115171 (519541)	9.94 (252)	115171 (519541)	9.44 (239)	181763 (820333)	8.81 (223)	260777 (1168672)
12	300	12.75 (323.8)	11.94 (303)	137437 (614375)	11.94 (303)	137437 (614375)	11.31 (287)	238098 (1059224)	10.44 (265)	368138 (1631497)
14	350	14 (355.6)	13.19 (334)	151353 (701927)	12.69 (322)	240280 (1072887)	12.44 (315)	283455 (1283012)	11.5 (292)	438105 (1940909)
16	400	16 (406.4)	15.19 (385)	173619 (798088)	14.69 (373)	276291 (1226727)	14.19 (360)	375526 (1675771)	13.13 (333)	574540 (2557506)
18	450	18 (457)	17.19 (436)	195885 (883714)	16.69 (423)	312301 (1409947)	16 (406)	467312 (2074064)	14.75 (374)	731463 (3250276)
20	500	20 (508)	19.19 (487)	218152 (984654)	18.56 (471)	381590 (1706969)	17.88 (454)	551879 (2447992)	16.5 (419)	877928 (3887862)
22	550	22 (559)	21.19 (538)	240418 (1085593)	20.56 (522)	421174 (1884814)	19.69 (500)	661823 (2944348)	-	-
24	600	24 (610)	23.19 (589)	262684 (1186532)	22.44 (570)	497869 (2224248)	21.5 (546)	781717 (3486414)	-	-
26	650	26 (660)	24.94 (633)	371076 (1645142)	24.31 (617)	584304 (2587620)	23.38 (594)	889099 (3900162)	-	-
28	700	28 (711)	26.94 (684)	400214 (1774921)	26.19 (665)	674056 (2982754)	25.25 (641)	1006353 (4459805)	-	-
30	750	30 (762)	28.94 (735)	429352 (1904701)	28.06 (712)	774064 (3473031)	27 (686)	1175152 (5185890)	-	-
32	800	32 (813)	30.69 (779)	564375 (2550722)	29.94 (760)	876872 (3928672)	28.75 (730)	1356837 (6035109)	-	-
34	850	34 (864)	32.69 (830)	600385 (2714148)	31.81 (808)	990453 (4412304)	30.5 (775)	1551407 (6874009)	-	-
36	900	36 (914)	34.44 (874)	755165 (3370301)	33.69 (855)	1106319 (4918368)	32.25 (819)	1758862 (7758242)	-	-
38	950	38 (965)	36.44 (925)	798048 (3562566)	35.63 (904)	1199226 (5372548)	-	-	-	-
40	1000	40 (1016)	38.44 (976)	840931 (3754832)	37.63 (956)	1264375 (5575699)	-	-	-	-
42	1050	42 (1067)	40.19 (1020)	1022340 (4622335)	39.63 (1006)	1329524 (5958957)	-	-	-	-
48	1200	48 (1219)	45.94 (1166)	1329890 (5956695)	45.25 (1149)	1762298 (7811256)	-	-	-	-
54	1350	54 (1371.6)	51.69 (1312)	1677814 (7537116)	-	-	-	-	-	-
56	1400	56 (1422)	53.56 (1360)	1837130 (8128117)	-	-	-	-	-	-
60	1500	60 (1524)	57.44 (1458)	2066112 (9274547)	-	-	-	-	-	-

For Information only:

Design basis and assumptions:

- the pipe is assumed to have a standard pipe outside diameter in accordance with ASME B36.10M. Because not covered by ASME B36.10M, the NPS 54 is assumed to have a standard pipe outside diameter of 54 in. (1371.6 mm);
- the pipe bore is based on the full bore sizes in API 6D;
- pipe material is assumed to be ASTM A106 Gr. B.

Bending moment:

- the bending moment to be applied to the valve is considered the moment that would produce a stress value equal to 25 % SMYS in the outer fibers of the attached pipe, and without axial force;
- torsion in the pipe is not considered.

Axial force:

- the force to be applied to the valve is considered the axial force that would produce a membrane stress value equal to 25 % SMYS in the pipe section, and without any bending moment.

Bending moment and axial force for pipe are calculated in accordance with the following equations:

Bending moment:

$$M = \frac{0.25 \times I \times SMYS}{(\mathrm{OD} \div 2)}$$

where

M is bending moment,

I is moment of inertia = $\frac{\pi}{64} \times (\mathrm{OD}^4 - \mathrm{ID}^4)$,

OD is pipe outside diameter,

SMYS is the ASTM A106 Gr. B specified minimum yield strength axial force:

$$F = 0.25 \times SMYS \times A$$

where

F is axial force,

A is area = $\frac{\pi}{4} \times (\mathrm{OD}^2 - \mathrm{ID}^2)$.

EXAMPLE

Sample calculation for bending moment and axial force based on NPS 10 (DN 250) class 1500 valve.

Pipe OD from ASME B36.10 = 10.75 in. (273 mm)

Valve bore size from API 6D = 9.44 in. (239 mm)

Minimum specified yield strength for A106 Gr. B = 35000 psi (240 MPa)

Imperial System:

$$I = \frac{\pi}{64} \times (10.75^4 - 9.44^4)$$

$$I = 265.73 \text{ in}^4$$

$$A = \frac{\pi}{4} \times (10.75^2 - 9.44^2)$$

$$A = 20.7729 \text{ in}^2$$

Bending Moment:

$$M = \frac{0.25 \times 265.73 \times 35\,000}{12\,(10.75 \div 2)}$$

$$M = 36049 \text{ ft lbf}$$

Axial Force:

$$F = 0.25 \times 35\,000 \times 20.7729$$

$$F = 181763 \text{ lbf}$$

Metric System:

$$I = \frac{\pi}{64} \times (273^4 - 239^4)$$

$$I = 112\,496\,663 \text{ mm}^4$$

$$A = \frac{\pi}{4} \times (273^2 - 239^2)$$

$$A = 13672.21 \text{ mm}^2$$

Bending Moment:

$$M = \frac{0.25 \times 112\,496\,663 \times 240}{1000\,(273 \div 2)}$$

$$M = 49449 \text{ Nm}$$

Axial Force:

$$F = 0.25 \times 240 \times 13672$$

$$F = 820333 \text{ N}$$

Add new annex

Annex Q (new)
(normative)
Material Table for Valves

Q.1 General

This annex provides acceptable and optional component materials for the following basic materials:

– normal temperature carbon steel;

– low temperature carbon steel;

– low temperature carbon steel with cladding;

– austenitic stainless steel type 316;

– ferritic/austenitic stainless steel, type 22Cr duplex and 25Cr superduplex.

The materials shall be delivered in accordance with the MDS in IOGP S-563 as referenced in the material selection tables in this annex and any applicable additional requirements specified in this document.

Unless otherwise specified in the MDS, all the requirements of the referenced material product standard shall apply.

The latest issue of the product reference standard shall apply unless a specific year of issue is specified.

Where the material selection table references a material standard and/or grade but there is no corresponding MDS, the material may be procured to the standard without additional requirements except as specified below and in other sections of this document.

Materials selection tables in this annex cover both sweet and sour services. For sour service, the requirements and limitations in the following sections and, where available in the referenced MDS included in IOGP S-563 shall apply:

– 6.8;

– Table 12.

Table Q.1 – Materials Selection Table

Basic Material				NTCS [-20 °F (-29 °C) to 302 °F (150 °C)]										NTCS [-20 °F (-29 °C) to 302 °F (150 °C)]									
Valve options to be specified by purchaser:																							
- Service				Sweet [a]										Sour NACE [a]									
- Valve trim				NT Carbon Steel + ENP[f]										Stainless Steel									
- Corrosion Allowance				0.118 in. (3 mm)										0.118 in. (3 mm) / O: 0.236 in. (6 mm)									
- Seat Sealing				Soft (RPTFE / PCTFE / PEEK)										Soft (RPTFE / PCTFE / PEEK) or Metal (TCC)									
- Seal				O-rings [≥ -20 °F (-29 °C)]										O-rings [≥ -20 °F (-29 °C)]									
- CRA weld overlay seal pockets				-										Note b									
				PC			PR	PW						PC			PR	PW					
Valve parts: Grouped as follows: PC = Pressure-containing parts as defined by API 6D 3.1 PR = Pressure-controlling parts as defined by API 6D 3.1 PW = Process-wetted parts as defined by API 6D 3.1 excluding PC and PR				Body / Bonnet / Auxiliary Flange	Stem	Bolting	Ball, Seat, Trunnion / Trunnion plates [8]	Springs	Bearings	Seat sealing ≤ 600#	Seat sealing ≥ 600#	Seals ≤ 600#	Seals ≥ 900#	Body/Bonnet/ Auxiliary Flange	Stem	Bolting	Ball, Seat, Trunnion / Trunnion plates [8]	Springs	Bearings	Seat sealing ≤ 600#	Seat sealing ≥ 600#	Seals ≤ 600#	Seals ≥ 900#
Material selection (specification and/or grade)	**MDS / EDS**	**Notes**	**Mat. Type**	**A=Acceptable alternative / O=Option to be specified by Purchaser**										**A=Acceptable alternative / O=Option to be specified by Purchaser**									
A105	IC004		Body, bonnet and trim material	A			A[f]							A									
A216 WCB	IC006			A			A[f]							A									
A216 WCC	IC006			A			A[f]							A									
A350 LF2 Class 1	IC104			A			A[f]							A									
A350 LF6 Class 1 or 2	IC104			A										A									
A352 LCC	IC106			A			A[f]							A									
A694 F52	IX124						A[f]																
A694 F60	IX124						A[f]																
A694 F65	IX124						A[f]																
A182 F6A	-				A																		
A182 FXM-19	-				A										A								
A479 UNS S20910 XM-19	-				A										A								
A479 UNS S41000	-				A																		
A276 T410/A276 T420	-				A																		
A564 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3			A										A		A						
A705 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3			A										A		A						
A182 F316/316L	IS104	2			A										A		A						
A276 316/316L	IS107				A										A		A						
A479 316/316L	IS107				A										A		A						
A351 CF3M/CF8M	IS106																A						
A182 F51	ID144				A										A		A						
A182 F53/F55	ID254																A						
A276 UNS S31803	ID147				A										A								
A276 UNS S32750 / UNS32760	ID257																						
A479 UNS S31803	ID147				A										A								
A479 UNS S32750 / UNS32760	ID257																						
A995 Gr. 4A	ID146																A						
A995 Gr. 6A	ID256																A						
A494 CW-6MC	IN106S																						
B446 UNS N06625	IN107S				A										A		A						
B564 UNS N06625	IN104S														A		A						
B637 UNS N07718	-	5			A										A		A						
UNS N06625	-		Spring material					A										A					
UNS N07718	-							A										A					
UNS N07750	-							A										A					
UNS N10276	-							A										A					
UNS R30003	-							A										A					
316 + PTFE	-		Bearing Material						A										A				
625 + PTFE	-								A										A				
A193 B7 / A194 2H	IX120	3	Bolting materials			A																	
A193 B7M / A194 2HM	IX120	3				A										A							
A193 B8M Class 1 / A194 8M / A194 8MA	-																						
A193 B8M Class 2 / A194 8M / A194 8MA	-																						
A193 B8M2 Class 2B / A194 8M / A194 8MA	-																						
A193 B8M3 Class 2C / A194 8M / A194 8MA	-																						
A193 B8MLCuNA / A194 Gr. 8MLCuNA	-																						
A193 B8MLCuN-CLASS 1B / A194 Gr. 9CA	-																						
A320 L43 / A194 7	IX100	3				A																	
A320 L7 / A194 7	IX100	3				A																	
A320 L7M / A194 7M	IX100	3				A										A							
UNS N07718 to API 6ACRA (120K)	IN120S																						
A1082 UNS S32750, S32760	ID260																						
RPTFE	-		Seat sealing							A										A			
PCTFE	-	4								O	O[4]									O	O[4]		
PEEK	-										A										A		
Tungsten Carbide Coating HVOF hardfacing	IH002																A[2]			A[2]	A[2]		
FKM LT RGD	-		Sealing									O										O	
FKM LT RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
HNBR RGD	-											O										O	
HNBR RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
PTFE Lip Seal + Elgiloy Spring + Anti Collapse	-																						
V-packing (chevron) seals	-																						

Basic Material				LTCS [-50 °F (-46 °C) to 302 °F (150 °C)]										LTCS [-50 °F (-46 °C) to 302 °F (150 °C)]									
Valve options to be specified by purchaser:																							
- Service				Sour NACE [a]										Sour NACE [a]									
- Valve trim				LT Carbon Steel + ENP[f]										Stainless Steel									
- Corrosion Allowance				0.118 in. (3 mm)										0.118 in. (3 mm) / O: 0.236 in. (6 mm)									
- Seat Sealing				Soft (RPTFE / PCTFE / PEEK)										Soft (RPTFE / PCTFE / PEEK) or Metal (TCC)									
- Seal				O-rings [≥ -20 °F (-29 °C)] or Lip Seals [≥ -50 °F (-46 °C)]										O-rings [≥ -20 °F (-29 °C)] or Lip Seals [≥ -50 °F (-46 °C)]									
- CRA weld overlay seal pockets				-										Notes c and d									
Valve parts: Grouped as follows: PC = Pressure-containing parts as defined by API 6D 3.1 PR = Pressure-controlling parts as defined by API 6D 3.1 PW = Process-wetted parts as defined by API 6D 3.1 excluding PC and PR				PC			PR	PW						PC			PR	PW					
				Body / Bonnet / Auxiliary Flange	Stem	Bolting	Ball, Seat, Trunnion / Trunnion plates [8]	Springs	Bearings	Seat sealing ≤ 600#	Seat sealing ≥ 600#	Seals ≤ 600#	Seals ≥ 900#	Body/Bonnet/ Auxiliary Flange	Stem	Bolting	Ball, Seat, Trunnion / Trunnion plates [8]	Springs	Bearings	Seat sealing ≤ 600#	Seat sealing ≥ 600#	Seals ≤ 600#	Seals ≥ 900#
Material selection (specification and/or grade)	**MDS / EDS**	**Notes**	**Mat. Type**	**A=Acceptable alternative / O=Option to be specified by Purchaser**										**A=Acceptable alternative / O=Option to be specified by Purchaser**									
A105	IC004		Body, bonnet and trim material																				
A216 WCB	IC006																						
A216 WCC	IC006																						
A350 LF2 Class 1	IC104			A			A[f]							A									
A350 LF6 Class 1 or 2	IC104			A			A[f]							A									
A352 LCC	IC106			A			A[f]							A									
A694 F52	IX124																						
A694 F60	IX124																						
A694 F65	IX124																						
A182 F6A	-																						
A182 FXM-19	-				A										A								
A479 UNS S20910 XM-19	-				A										A								
A479 UNS S41000	-																						
A276 T410/A276 T420	-																						
A564 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3																					
A705 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3																					
A182 F316/316L	IS104	2			A										A		A						
A276 316/316L	IS107				A										A		A						
A479 316/316L	IS107				A										A		A						
A351 CF3M/CF8M	IS106																A						
A182 F51	ID144				A										A		A						
A182 F53/F55	ID254																A						
A276 UNS S31803	ID147				A										A								
A276 UNS S32750 / UNS32760	ID257																						
A479 UNS S31803	ID147				A										A								
A479 UNS S32750 / UNS32760	ID257																						
A995 Gr. 4A	ID146																A						
A995 Gr. 6A	ID256																A						
A494 CW-6MC	IN106S																A						
B446 UNS N06625	IN107S				A										A		A						
B564 UNS N06625	IN104S														A		A						
B637 UNS N07718	-	5			A										A		A						
UNS N06625	-		Spring material					A										A					
UNS N07718	-							A										A					
UNS N07750	-							A										A					
UNS N10276	-							A										A					
UNS R30003	-							A										A					
316 + PTFE	-		Bearing Material						A										A				
625 + PTFE	-								A										A				
A193 B7 / A194 2H	IX120	3	Bolting materials																				
A193 B7M / A194 2HM	IX120	3																					
A193 B8M Class 1 / A194 8M / A194 8MA	-																						
A193 B8M Class 2 / A194 8M / A194 8MA	-																						
A193 B8M2 Class 2B / A194 8M / A194 8MA	-																						
A193 B8M3 Class 2C / A194 8M / A194 8MA	-																						
A193 B8MLCuNA / A194 Gr. 8MLCuNA	-																						
A193 B8MLCuN-CLASS 1B / A194 Gr. 9CA	-																						
A320 L43 / A194 7	IX100	3																					
A320 L7 / A194 7	IX100	3																					
A320 L7M / A194 7M	IX100	3				A										A							
UNS N07718 to API 6ACRA (120K)	IN120S																						
A1082 UNS S32750, S32760	ID260																						
RPTFE	-		Seat sealing							A										A			
PCTFE	-	4								O	O[4]									O	O[4]		
PEEK	-										A										A		
Tungsten Carbide Coating HVOF hardfacing	IH002																A[2]			A[2]	A[2]		
FKM LT RGD	-		Sealing									O										O	
FKM LT RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
HNBR RGD	-											O										O	
HNBR RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
PTFE Lip Seal + Elgiloy Spring + Anti Collapse	-											O	O									O	O
V-packing (chevron) seals	-											O	O									O	O

Basic Material				LTCS + Clad [≥ 4" (DN 100)] [-50 °F (-46 °C) to 302 °F (150 °C)]										SS316 [-50 °F (-46 °C) to 302 °F (150 °C)]									
Valve options to be specified by purchaser:																							
- Service				Sour NACE [a]										Sour NACE [a]									
- Valve trim				Alloy 625										Stainless Steel									
- Corrosion Allowance				N/A										N/A									
- Seat Sealing				Soft (RPTFE / PEEK) or Metal (TCC)										Soft (RPTFE / PEEK) or Metal (TCC)									
- Seal				O-rings [≥ -20 °F (-29 °C)] or Lip Seals [≥ -50 °F (-46 °C)]										O-rings [≥ -20 °F (-29 °C)] or Lip Seals [≥ -50 °F (-46 °C)]									
- CRA weld overlay seal pockets				Note 1										N/A									
Valve parts: Grouped as follows: PC = Pressure-containing parts as defined by API 6D 3.1 PR = Pressure-controlling parts as defined by API 6D 3.1 PW = Process-wetted parts as defined by API 6D 3.1 excluding PC and PR				PC			PR	PW						PC			PR	PW					
				Body / Bonnet / Auxiliary Flange	Stem	Bolting	Ball, Seat, Trunnion / Trunnion plates[8]	Springs	Bearings	Seat sealing ≤ 600#	Seat sealing ≥ 600#	Seals ≤ 600#	Seals ≥ 900#	Body / Bonnet / Auxiliary Flange	Stem	Bolting	Ball, Seat, Trunnion / Trunnion plates[8]	Springs	Bearings	Seat sealing ≤ 600#	Seat sealing ≥ 600#	Seals ≤ 600#	Seals ≥ 900#
Material selection (specification and/or grade)	**MDS / EDS**	**Notes**	**Mat. Type**	**A=Acceptable alternative / O=Option to be specified by Purchaser**										**A=Acceptable alternative / O=Option to be specified by Purchaser**									
A105	IC004		Body, bonnet and trim material																				
A216 WCB	IC006																						
A216 WCC	IC006																						
A350 LF2 Class 1	IC104			A			A[e]																
A350 LF6 Class 1 or 2	IC104			A			A[e]																
A352 LCC	IC106			A			A[e]																
A694 F52	IX124																						
A694 F60	IX124																						
A694 F65	IX124																						
A182 F6A	-																						
A182 FXM-19	-														A		A						
A479 UNS S20910 XM-19	-														A		A						
A479 UNS S41000	-																						
A276 T410/A276 T420	-																						
A564 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3																					
A705 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3																					
A182 F316/316L	IS104	2												A	A		A						
A276 316/316L	IS107						A								A		A						
A479 316/316L	IS107														A		A						
A351 CF3M/CF8M	IS106													A			A						
A182 F51	ID144														A		A						
A182 F53/F55	ID254																A						
A276 UNS S31803	ID147														A								
A276 UNS S32750 / UNS32760	ID257																						
A479 UNS S31803	ID147														A								
A479 UNS S32750 / UNS32760	ID257																						
A995 Gr. 4A	ID146																A						
A995 Gr. 6A	ID256																A						
A494 CW-6MC	IN106S						A										A						
B446 UNS N06625	IN107S				A										A								
B564 UNS N06625	IN104S				A		A								A		A						
B637 UNS N07718	-	5			A		A								A		A						
UNS N06625	-		Spring material					A										A					
UNS N07718	-							A										A					
UNS N07750	-																						
UNS N10276	-							A										A					
UNS R30003	-							A										A					
316 + PTFE	-		Bearing Material																A				
625 + PTFE	-								A										A				
A193 B7 / A194 2H	IX120	3	Bolting materials																				
A193 B7M / A194 2HM	IX120	3																					
A193 B8M Class 1 / A194 8M / A194 8MA	-															A							
A193 B8M Class 2 / A194 8M / A194 8MA	-															A							
A193 B8M2 Class 2B / A194 8M / A194 8MA	-															A							
A193 B8M3 Class 2C / A194 8M / A194 8MA	-															A							
A193 B8MLCuNA / A194 Gr. 8MLCuNA	-															A							
A193 B8MLCuN-CLASS 1B / A194 Gr. 9CA	-															A							
A320 L43 / A194 7	IX100	3																					
A320 L7 / A194 7	IX100	3																					
A320 L7M / A194 7M	IX100	3				A																	
UNS N07718 to API 6ACRA (120K)	IN120S															A							
A1082 UNS S32750, S32760	ID260																						
RPTFE	-		Seat sealing							A										A			
PCTFE	-	4								O	O[4]									O	O[4]		
PEEK	-										A										A		
Tungsten Carbide Coating HVOF hardfacing	IH002						A[2]			A[2]	A[2]						A[2]			A[2]	A[2]		
FKM LT RGD	-		Sealing									O										O	
FKM LT RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
HNBR RGD	-											O										O	
HNBR RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
PTFE Lip Seal + Elgiloy Spring + Anti Collapse	-											O	O									O	O
V-packing (chevron) seals	-											O	O									O	O

Basic Material	DSS [-50 °F (-46 °C) to 302 °F (150 °C)]	SDSS [-50 °F (-46 °C) to 302 °F (150 °C)]
Valve options to be specified by purchaser:		
- Service	Sour NACE [a]	Seawater / Sour NACE [a]
- Valve trim	Duplex Stainless Steel	Super Duplex Stainless Steel
- Corrosion Allowance	N/A	N/A
- Seat Sealing	Soft (RPTFE / PEEK) or Metal (TCC)	Soft (RPTFE / PEEK) or Metal (TCC)
- Seal	O-rings [≥ -20 °F (-29 °C)] or Lip Seals [≥ -50 °F (-46 °C)]	O-rings [≥ -20 °F (-29 °C)] or Lip Seals [≥ -50 °F (-46 °C)]
- CRA weld overlay seal pockets	N/A	N/A

Valve parts:
Grouped as follows:
PC = Pressure-containing parts as defined by API 6D 3.1
PR = Pressure-controlling parts as defined by API 6D 3.1
PW = Process-wetted parts as defined by API 6D 3.1 excluding PC and PR

A=Acceptable alternative / O=Option to be specified by Purchaser

Material selection (specification and/or grade)	MDS / EDS	Notes	Mat. Type	DSS PC: Body / Bonnet / Auxiliary Flange	DSS PC: Stem	DSS PC: Bolting	DSS PR: Ball, Seat, Trunnion / Trunnion plates[8]	DSS PW: Springs	DSS PW: Bearings	DSS PW: Seat sealing ≤ 600#	DSS PW: Seat sealing ≥ 600#	DSS PW: Seals ≤ 600#	DSS PW: Seals ≥ 900#	SDSS PC: Body / Bonnet / Auxiliary Flange	SDSS PC: Stem	SDSS PC: Bolting	SDSS PR: Ball, Seat, Trunnion / Trunnion plates[8]	SDSS PW: Springs	SDSS PW: Bearings	SDSS PW: Seat sealing ≤ 600#	SDSS PW: Seat sealing ≥ 600#	SDSS PW: Seals ≤ 600#	SDSS PW: Seals ≥ 900#
A105	IC004		Body, bonnet and trim material																				
A216 WCB	IC006																						
A216 WCC	IC006																						
A350 LF2 Class 1	IC104																						
A350 LF6 Class 1 or 2	IC104																						
A352 LCC	IC106																						
A694 F52	IX124																						
A694 F60	IX124																						
A694 F65	IX124																						
A182 F6A	-																						
A182 FXM-19	-																						
A479 UNS S20910 XM-19	-																						
A479 UNS S41000	-																						
A276 T410/A276 T420	-																						
A564 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3																					
A705 Gr. 630 UNS S17400 (H1150M / H1150D)	-	3																					
A182 F316/316L	IS104	2																					
A276 316/316L	IS107																						
A479 316/316L	IS107																						
A351 CF3M/CF8M	IS106																						
A182 F51	ID144			A	A		A																
A182 F53/F55	ID254				A		A							A	A		A						
A276 UNS S31803	ID147				A																		
A276 UNS S32750 / UNS32760	ID257				A										A								
A479 UNS S31803	ID147				A																		
A479 UNS S32750 / UNS32760	ID257				A										A								
A995 Gr. 4A	ID146			A			A																
A995 Gr. 6A	ID256						A							A			A						
A494 CW-6MC	IN106S						A										A						
B446 UNS N06625	IN107S				A										A								
B564 UNS N06625	IN104S				A		A								A		A						
B637 UNS N07718	-	5			A		A								A[9]		A[9]						
UNS N06625	-		Spring material					A										A					
UNS N07718	-							A										A[9]					
UNS N07750	-																						
UNS N10276	-							A										A					
UNS R30003	-							A										A					
316 + PTFE	-		Bearing Material																				
625 + PTFE	-								A										A				
A193 B7 / A194 2H	IX120	3	Bolting materials																				
A193 B7M / A194 2HM	IX120	3																					
A193 B8M Class 1 / A194 8M / A194 8MA	-																						
A193 B8M Class 2 / A194 8M / A194 8MA	-																						
A193 B8M2 Class 2B / A194 8M / A194 8MA	-																						
A193 B8M3 Class 2C / A194 8M / A194 8MA	-																						
A193 B8MLCuNA / A194 Gr. 8MLCuNA	-					A										A							
A193 B8MLCuN-CLASS 1B / A194 Gr. 9CA	-					A										A							
A320 L43 / A194 7	IX100	3																					
A320 L7 / A194 7	IX100	3																					
A320 L7M / A194 7M	IX100	3																					
UNS N07718 to API 6ACRA (120K)	IN120S					A										A							
A1082 UNS S32750, S32760	ID260					A										A							
RPTFE	-		Seat sealing							A										A			
PCTFE	-	4								O	O[4]									O	O[4]		
PEEK	-										A										A		
Tungsten Carbide Coating HVOF hardfacing	IH002						A[2]			A[2]	A[2]						A[2]			A[2]	A[2]		
FKM LT RGD	-		Sealing									O										O	
FKM LT RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
HNBR RGD	-											O										O	
HNBR RGD + Back-up rings both sides (RPTFE or PEEK)	-												O										O
PTFE Lip Seal + Elgiloy Spring + Anti Collapse	-											O	O									O	O
V-packing (chevron) seals	-											O	O									O	O

Notes where options need to be specified by the purchaser:

a) For valves to be used in sour service, reference is made to 6.8. For elastomer selection refer to Table 12.
b) Stainless steel weld overlay on seal pockets and stem sealing areas as per 7.2.
c) Alloy 625 weld overlay on seal pockets and stem sealing areas as per 7.2 Class Fe 10 and EDS IO01.
d) Alloy 625 weld overlay on all sealing areas as per agreement with the purchaser, per 7.2 Class Fe 10 and EDS IO01.
e) For stainless steel trim, alternative alloy 625 weld overlay of LTCS ball as per 7.2 Class Fe 10 may be used.
f) When the purchaser specify CS + ENP (electroless nickel coating) trim for 'NTCS' and 'LTCS' valves, the ENP shall meet the requirements of EDS IH04 (Type V (10 % P), service condition SC4 and heat treatment Class 2 - Type V).
g) Not applicable for seawater service.

Notes to highlight issues towards the manufacturer:

1) Full CRA weld overlay on all wetted body surfaces per API 6D, 7.2 Class Fe 10 and EDS IO01.
2) For valves specified with metal-to-metal seat sealing TCC HVOF hard facing on ball and seats.
3) Galvanized bolt/nut selection for bolt size > 0.4 in. (10 mm). For galvanizing, reference is made to 6.7 and MDS IX20. CRA bolting shall be used for bolting sizes 0.4 in. (10 mm) and below.
4) Manufacturer to recommend max. operating temperature limitation for PCTFE for each allowable pressure rating (150#, 300#, 600#, 900# and 1500#).
5) Wrought precipitation-hardened nickel base alloy to UNS N07718 shall comply with the requirements in API 6ACR.

Add new annex

Annex R (new)
(normative)
Drive Train Design

The following section provides design instructions for establishing tolerable maximum torque of ball and drive train for valve designs. The sketches are provided to give a general calculation method and are not intended to either:

– limit the design to those depicted; or

– preclude the manufacturer offering an alternative design basis for the purchaser's consideration and approval.

In addition to 5.20, the drive train calculation shall consider the maximum operator output torque.

R.1 Maximum Stem Torque evaluation

R.1.1 Definitions

A	stem keyway depth
B	key width
C	coupling keyway depth
C_y	specified minimum yield strength of coupling material
D_s	stem diameter
J_1	polar moment of inertia of the stem minimum section (with one keyway). Note that this is normally calculated by the CAD software
J_2	polar moment of inertia of the stem minimum section (with two keyway). Note that this is normally calculated by the CAD software
K_y	specified minimum yield strength of the key material
L_k	key length
S_y	specified minimum yield strength of stem material

R.1.2 Stem with One Keyway

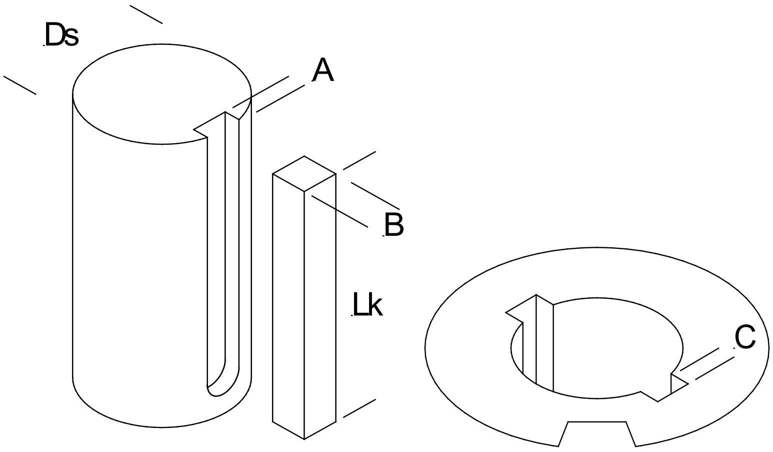


Figure R.1 – Stem and Key Way, Single Key Drive

Maximum stem torque $T_s = S_y \times 0.54 \times \frac{J_1}{D_s \times 0.5}$

Maximum key shear torque $K_s = 0.4 \times K_y \times B \times L_k \times \frac{D_s}{2}$

Maximum key bearing torque K_b is the lesser of:

$K_y \times L_k \times A \times \left(\frac{D_s}{2} - \frac{A}{2}\right)$

and

$K_y \times L_k \times C \times \left(\frac{D_s}{2} + \frac{C}{2}\right)$

Maximum shaft bearing torque = $S_y \times L_k \times A \times \left(\frac{D_s}{2} - \frac{A}{2}\right)$

Maximum coupling bearing torque = $C_y \times L_k \times C \times \left(\frac{D_s}{2} + \frac{C}{2}\right)$

R.1.3 Stem with Two Keyways

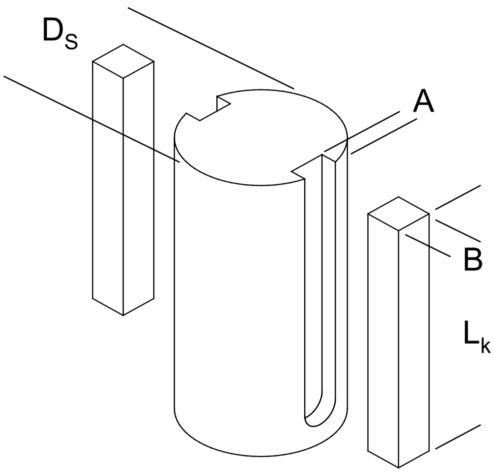


Figure R.2 – Stem with 2 Keys of Equal Length

Maximum stem torque $T_s = S_y \times 0.54 \times \frac{J_2}{D_s \times 0.5}$

Maximum key shear torque $K_s = 0.4 \times K_y \times B \times L_k \times D_s$

Maximum key bearing torque K_b is the lesser of:

$K_y \times L_k \times A \times (D_s - A)$

and

$K_y \times L_k \times C \times (D_s + C)$

Maximum shaft bearing torque = $S_y \times L_k \times A \times (D_s - A)$

Maximum coupling bearing torque = $C_y \times L_k \times C \times (D_s + C)$

NOTE For valves with keys of unequal geometry, the manufacturer may either use the design above on the basis of two keys of the smaller geometry or may modify the formulae to account for two different key sizes.

R.2 Maximum Flange Torque Evaluation

R.2.1 Definitions

P_{sb} bolt preload for the short bolts = 0.5 x Y_{sbt} x A_s

N_s number of short bolts

P valve design pressure

D_b diameter of bonnet to body seal

D_{PCs} PCD of the short bolts

μ coefficient of friction = 0.2

P_{lb} bolt preload for the long bolts = 0.5 x Y_{sbt} x A_l

N_l number of long bolts

D_{PCl} PCD of the long bolts

N_d number of dowels

D_d diameter of the dowel

Y_{sd} dowel yield stress

D_{PCd} PCD of the dowels

E_{db} engagement of the dowel in the body

E_{dn} engagement of the dowel in the bonnet

E_{dt} engagement of the dowel in the top plate

Y_{sb} specified minimum yield strength of body material

Y_{sbn} specified minimum yield strength of bonnet material

T_y specified minimum yield strength of top plate material

A_s root area of the short bolts

A_l root area of the long bolts

Y_{sbt} specified minimum yield strength of bolt material

D_s diameter of the stem seal(s)

R.2.2 Stem Retained by Bonnet Bolting

For designs where stem is retained by bonnet bolting the following procedure shall be followed.

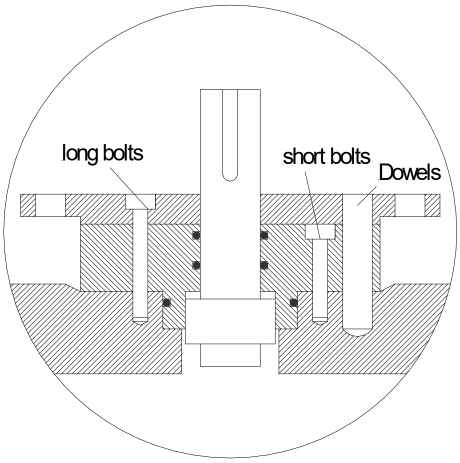


Figure R.3 – Stem Retained by Body Bonnet/Cover

The total equivalent torque resistance is the sum of the torque resistance from bolts and dowels.

Torque resistance of short bolts = $\left[(P_{sb} \times N_s) - 0.5 \times \left(P \times \frac{\pi}{4} \times {D_b}^2\right)\right] \times \frac{D_{PCs}}{2} \times \mu$

Torque resistance of long bolts = $\left[(P_{lb} \times N_l) - 0.5 \times \left(P \times \frac{\pi}{4} \times {D_b}^2\right)\right] \times \frac{D_{PCl}}{2} \times \mu$

Torque resistance of dowels is the lesser of:

$N_d \times \frac{\pi}{4} \times {D_d}^2 \times Y_{sd} \times 0.4 \times \frac{D_{PCd}}{2}$ - dowel in shear

$N_d \times D_d \times E_{db} \times Y_{sd} \times \frac{D_{PCd}}{2}$ - bearing stress on dowel in body

$N_d \times D_d \times E_{dn} \times Y_{sd} \times \frac{D_{PCd}}{2}$ - bearing stress on dowel in bonnet

$N_d \times D_d \times E_{dt} \times Y_{sd} \times \frac{D_{PCd}}{2}$ - bearing stress on dowel in top plate

$N_d \times D_d \times E_{db} \times Y_{sb} \times \frac{D_{PCd}}{2}$ - bearing stress in body due to dowel

$N_d \times D_d \times E_{dn} \times Y_{sbn} \times \frac{D_{PCd}}{2}$ - bearing stress in bonnet due to dowel

$N_d \times D_d \times E_{dt} \times T_y \times \frac{D_{PCd}}{2}$ - bearing stress in top plate due to dowel

R.2.3 Stem not Retained by Bonnet Bolting

For designs where the stem is not retained by bonnet bolting, the following procedure shall be followed.

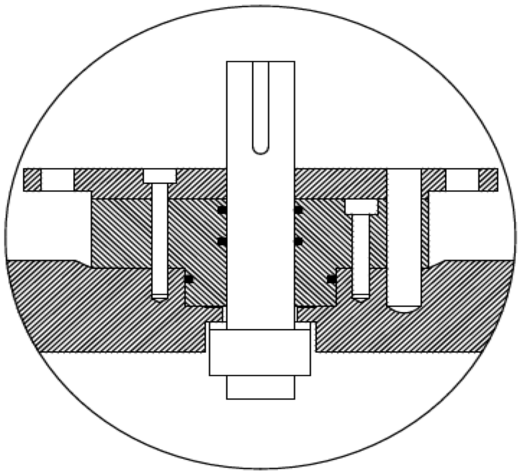


Figure R.4 – Stem Retained by Internal Body Integral Shoulder

The total equivalent torque resistance is the sum of the torque resistance from bolts and dowels.

Torque resistance of short bolts = $\left[(P_{sb} \times N_s) - 0.5 \times \left(P \times \frac{\pi}{4} \times \left({D_b}^2 - {D_s}^2\right)\right)\right] \times \frac{D_{PCs}}{2} \times \mu$

Torque resistance of long bolts = $\left[(P_{lb} \times N_l) - 0.5 \times \left(P \times \frac{\pi}{4} \times \left({D_b}^2 - {D_s}^2\right)\right)\right] \times \frac{D_{PCl}}{2} \times \mu$

Torque resistance of dowels is the lesser of:

$N_d \times \frac{\pi}{4} \times {D_d}^2 \times Y_{sd} \times 0.4 \times \frac{D_{PCd}}{2}$ - dowel in shear

$N_d \times D_d \times E_{db} \times Y_{sd} \times \frac{D_{PCd}}{2}$ - bearing stress on dowel in body

$N_d \times D_d \times E_{dn} \times Y_{sd} \times \frac{D_{PCd}}{2}$ - bearing stress on dowel in bonnet

$N_d \times D_d \times E_{dt} \times Y_{sd} \times \frac{D_{PCd}}{2}$ - bearing stress on dowel in top plate

$N_d \times D_d \times E_{db} \times Y_{sb} \times \frac{D_{PCd}}{2}$ - bearing stress in body due to dowel

$N_d \times D_d \times E_{dn} \times Y_{sbn} \times \frac{D_{PCd}}{2}$ - bearing stress in bonnet due to dowel

$N_d \times D_d \times E_{dt} \times T_y \times \frac{D_{PCd}}{2}$ - bearing stress in top plate due to dowel

Add new annex

Annex S (new)
(normative)
Design Criteria for Pressure Containing Elements

This annex supplements ASME B16.34 or ASME BPVC Sec VIII Div 1 or Div 2 internationally recognized design Codes. Requirements of this annex are not to be interpreted to reduce the requirements defined by ASME B16.34 or ASME BPVC Sec VIII Div 1 or Div 2.

Design and calculations for pressure-containing elements, including bolting, shall be in accordance with ASME B16.34 or ASME BPVC Sec VIII Div 1 or Div 2 and shall meet the minimum requirements of Table S.1.

Table S.1 – Design Criteria for Pressure Containing Elements

Design Code Criteria	ASME B16.34:2017	ASME VIII Div.1 or Div.2
Wall Thickness Criteria	Minimum wall thickness t_m of valve body, including flow passage wall section, thickness of central core section and transition sections shall be in accordance with ASME B16.34, Section 6.	Minimum wall thickness of valve body, including flow passage wall section, thickness of central core section and transition sections shall be designed in accordance with ASME VIII Div.1 or by finite element analysis in accordance with ASME VIII Div 2. The minimum body thickness shall be not less than that required by ASME B16.34:2017 based on the inside diameter of the flow passage in ASME B16.34:2017, 6.1.2.
Ligament Section Criteria	Minimum thickness of ligament section about axial holes in the central core section of a two or three-piece split body shall be calculated in accordance with ASME B16.34. The inside diameter to consider shall not be less than the minimum values defined in ASME B16.34, 6.1.2 (a) and *2/3d'* (where *d'* is the inside diameter of the central core section). Ligament thickness shall be distributed in compliance with ASME B16.34, 6.1.3 (d). Where a corrosion allowance has been specified, the thickness of the inner ligament shall be the minimum thickness as defined above, plus the corrosion allowance.	Minimum thickness of ligament section about axial holes in the central core section of a two or three-piece split body does **not** need to be in compliance with ASME B16.34:2017. Ligament section thickness shall be calculated in accordance with ASME VIII Div 1 or ASME VIII Div 2. Additional thickness may be required to compensate for material removed by the axial holes. NOTE The manufacturer shall ensure that the inner ligament (between axial hole and the inside diameter of the central core section) has sufficient thickness to prevent any inelastic deformation, or loss of pressure containment due to body dilation. Where a corrosion allowance has been specified, the thickness of the inner ligament shall be the minimum thickness as defined above, plus the corrosion allowance.
Corrosion Allowance	Where a corrosion allowance of 3 mm or less has been specified, the actual wall thickness shall not be less than that defined by the wall thickness criteria and ligament section criteria above. No additional wall thickness is required. Where a corrosion allowance of greater than 3 mm has been specified, the wall thickness shall include additional thickness for every mm of corrosion allowance greater than 3 mm. Where a valve body section design does not undergo an increase in wall thickness at the transition from the flow passage to the central core section (e.g. cast top entry body	

	designs, or some two-piece cast body designs) the specified corrosion allowance shall be added to the minimum wall thickness t_m defined by the wall thickness criteria above. It is the supplier responsibility to ensure that there shall be no loss of structural integrity as a result of loss of material due to the corrosion allowance specified.	
Bolting Criteria	Bolting shall comply with ASME B16.34 or ASME BPVC Sec VIII Div 1 & Sec II Part D. The maximum allowable stress value shall be limited to 20 ksi (138 MPa). Bolting design shall consider gasket factors where applicable.	Bolting shall comply with ASME VIII Div 2, by **either**: 1) designed by finite element analysis and Div 2 rules including bending or axial pipe loads, **or** 2) calculated by Div 1 rules and stresses where maximum allowable stress value in design shall be limited to 138 MPa (20 ksi) maximum. Design shall include gasket factors where applicable.
Others pressure-containing elements	Pressure-containing elements not covered by ASME B16.34 shall be designed in accordance with ASME BPVC Section VIII Div 1 or Div 2.	
Piping Loads	Piping loads do **not** need to be considered unless specified otherwise.	Design shall be verified by finite element analysis for consideration of allowable design stresses, deformations, and integrity of sealing areas as a result of the piping loads specified in Table P.1 and Table P.2.

Add new annex

Annex T (new)
(normative)
Graphitic Sealing Material
(Amendments to ASTM F2168)

T.1 Introduction

This annex is written as modifications to ASTM F2168:2013, Standard Specification for Packing Material, Graphitic, Corrugated Ribbon or Textured Tape, and Die-Formed Ring.

The requirements of this annex are not to be interpreted to reduce the requirements defined by ASTM F2168. Amendments to ASTM F2168 are defined in T.3. Section numbers within T.3 correspond to ASTM F2168 but are preceded by "T.3.". Sections of ASTM F2168 that are not revised remain applicable.

Modifications to ASTM F2168 are identified as *Add* (add to section or add new section), *Replace* (part of or entire section) or *Delete*.

T.2 Scope

This annex specifies the requirements for graphite, as applied in sealing components like ribbon, foil and gaskets.

T.3 Amendments to ASTM F2168

T.3. 3 Terminology

T.3. 3.1 Definitions

T.3. 3.1.7 lot

Replace section with

All finished packing materials of one size, type, class and grade, produced on a continuous run under the same relevant conditions, made from the same batch of raw material.

T.3. 4 Classification

T.3. 4.1 Classification

T.3. 4.1.1 Type I

Add to section

This type also includes flat sheet or tape.

Delete section 4.1.3 Class I

Delete section 4.1.5 Grade A

Add new section

T.3. 4.2

Only Type I or Type II, Class 2 and Grade B material shall be used.

T.3. 7 Properties

T.3. 7.1 Chemical and Physical Properties

Add to section

The following amendments shall apply:

- Supplementary requirement S3 shall apply, except that the density of Type II shall be minimum 1500 kg/m³ (94 lb/ft³). The density requirement is applicable to packing rings and not to spiral wound or Kammprofile gaskets.
- Ash (mass) content shall be ≤ 2 %.
- Chlorine content shall be ≤ 50 ppm.
- Sulfur content shall be ≤ 750 ppm.
- Fluorine content shall be ≤ 10 ppm.
- Total halogen content (chlorine, bromine and fluorine) shall be ≤ 310 ppm.
- Graphite purity (mass) shall be ≥ 98 %.

T.3. 9 Dimensions, Mass, and Permissible Variations

T.3. 9.3 Split Rings

Replace the first sentence with

The number of cuts shall be zero or one.

T.3. 10 Workmanship, Finish, and Appearance

Add new section

T.3. 10.2

Supplementary requirement S6.1 shall apply.

T.3. 13 Test Methods

Add new section heading

T.3. 13.7 Oxidation Test

Add new section

T.3. 13.7.1 Purpose

An oxidation test to verify the weight loss of a graphite sample after being heated in a furnace or thermogravimetric analyzer (TGA).

The tools used for subsampling shall be degreased, e.g. by rinsing them with acetone.

A muffle oven (furnace) or a TGA shall be used for this oxidation test, however, if the graphite is to be used in oxygen service then only a TGA (e.g. Leco, Pyris, Netzsch) shall be used.

Add new section

T.3. 13.7.2 Test condition, procedure and recordings

When using the muffle oven (furnace), two procedures may be used for the muffle oven test:

- Calculated absolute weight loss; or
- Relative weight loss against a calibration sample that has a known and acceptable oxidation rate determined by a TGA analysis. In this case, a calibration sample is placed in the muffle oven together with the test lot. The calibration sample shall have the same size, product form and graphite density as the test samples. The lot is accepted when the weight loss per hour of the test sample is equal to or less than that of the calibration sample.

The muffle oven shall be calibrated by thermocouples for temperature accuracy and variance of ± 5 °C (± 9 °F), at the position where the samples will be located, with a frequency of 4 times a year. The temperature setting of the furnace shall be adjusted in such a way that the calibrated thermocouple at the position of the sample, reads 670 °C.

The test shall be carried out in accordance with EN 14772, 6.7 and with the following amendments:

- For testing of graphite foil, the dimensions of the sample shall be 50 mm x 150 mm x 0.5 mm (2 in. x 6 in. x 0.02 in.). For testing of a die-formed packing ring, the dimensions of the sample shall be 25.4 mm x 38.1 mm x 6.4 mm (1 in. x 1.5 in. x 0.25 in.).
- For testing of a die-formed packing ring, the density of the sample shall be 1500 kg/m³ (94 lb/ft³).
- All samples shall be handled using gloves.
- The sample to be tested shall be conditioned at 150 °C (302 °F) for 1 hour and then held in a desiccator until tested.
- After drying the sample, the muffle oven shall run at 670 ± 5 °C (1238 ± 9 °F) for 4 hours. After loading the sample and closing the furnace, at least 15 minutes of waiting time is maintained to equilibrate the system.
- After 4 hours the machine may be allowed to cool down.
- Requirements for the muffle oven shall be in accordance with Table T.7.

When using the TGA:

a) Collect graphite material samples as per Table T.7:
   - 20 mg (0.3 gr) mass for the small crucible (e.g. Netzch, Pyris).
   - 5 g (75 gr) for the large crucible (e.g. LECO).
   - For testing of a die-formed packing ring, the density of the sample shall be 1500 kg/m³ (94 lb/ft³).
   - Dimensions of the graphite samples should be such that they fit into the crucible without sticking out.

b) The TGA composition of the gas at the sample area is either generated by mixing an inert gas and oxygen gas to arrive at a mixture equivalent to that of air, or by using clean, dry and oil free air instead.

c) The sample to be tested shall be put in the TGA, accurately weighed and then conditioned at 150 °C (302 °F) for 1 hour. After drying, the temperature shall be increased to 670 °C (1238 °F) in an inert environment (i.e. N_2). When the temperature has stabilized at 670 °C (1238 °F), the weight loss shall be measured over a period of 4 hours in an (artificial) air environment. This measurement shall be recorded on a graph indicating the temperature and sample weight as function of time.

d) The temperature reading of the testing apparatus shall be calibrated.

e) Requirements for the TGA shall be in accordance with Table T.7.

Add new section

T.3. 13.7.3 Acceptance

Calculate the sample weight loss as follows:

$$\text{Weight loss, } \% = \frac{W1-W2}{W1} \times 100\ \%$$

where

W1 is the initial dry weight of the sample,

W2 is the final weight of the sample.

W2 shall be measured on a continuous basis.

The maximum (accumulated) allowable weight loss shall be < 4 % per hour.

Add new table

Table T.7 − Oxidation Test Equipment

Equipment type	Muffle Oven (furnace)	Thermogravimetric Analyzer (TGA) with large crucible LECO TGA-701,TGA-601	Thermogravimetric Analyzer (TGA) with small crucible e.g. a PYRIS 1,PYRIS 6, NETZCH TG 209 series
Minimum furnace dimensions/specifics	250 mm x 300 mm x 230 mm (10 in. x 12 in. x 9 in.) Place the sample on an open mesh of grade 316 stainless steel with wire of 9.5 mm centers and wire of 1.6 mm diameter. The sample holding mesh should be positioned about 25 mm above the bottom of the furnace chamber.	Equipment standard	Equipment standard
Sample weight range	Up to 5 g (75 gr)	Up to 5 g (75 gr)	Minimum 20 mg (0.3 gr)
Weight loss range	0 % to 100 %	0 % to 100 %	0 % to 100 %
Balance precision	0.01 g (0. 15 gr) weigh scale	0.0001 g (0.0015 gr)	0.001 g (0.015 gr)
Temperature range	100 °C to 1000 °C (212 °F to 1832 °F)	100 °C to 1000 °C (212 °F to 1832 °F)	100 °C to 1000 °C (212 °F to 1832 °F)
Furnace temperature stability	± 4 °C (± 7 °F) ± 5 °C (± 9 °F)	± 4 °C (± 7 °F)	± 4 °C (± 7 °F)
Furnace air refresh rate	Vented no forced air supply	20 times per hour	Minimum 100 ml/min at sample area
Purge Gas and Flow rate	N/A	Sample Gas = Air or Oxygen/inert gas (in a 20/80 % composition)	Balance Chamber Purge Gas = Argon or Nitrogen at a flow of minimum 80 ml/min Sample Chamber Purge Gas = Oxygen at a flow of minimum 20 ml/min and in a 20/80 ratio of Balance Chamber Purge Gas/Sample Chamber Purge Gas.
Material Crucible	N/A	Ceramic or Quartz	Ceramic or Quartz
Air speed at specimen location	N/A	< 0.5 m/s (1.64 ft/s)	

T.3. 14 Inspection and Testing

T.3. 14.1

Replace section with

The gasket manufacturer is responsible for ensuring that the graphite used in the end product meets the requirements of this specification.

Analysis of the graphite material by testing shall be performed on each lot.

Add new section

T.3. 14.2

One sample shall be taken from a lot and three specimens shall be taken from the selected sample. The tests specified in 13.3 through 13.7 shall be executed on each specimen and the results averaged. The average result shall meet the acceptance criteria.

T.3. 15 Rejection

Add new section

T.3. 15.2

Supplementary requirement S10 shall apply.

T.3. 16 Certification

T.3. 16.1

Replace section with

Analysis of the graphite material, through chemical analysis and high temperature oxidation testing, shall be performed on each lot of graphite raw material received by the manufacturer.

T.3. 18 Packaging

Add new section

T.3. 18.2

Packing shall comply with supplementary requirement S6.2.

Add new annex

Annex U (new)
(normative)
Packing Material, Graphite and Carbon Braided Yarn (Amendments to ASTM F2191/F2191M)

U.1 Introduction

This annex is written as modifications to ASTM 2191/F2191M:2013, Standard Specification for Packing Material, Graphitic or Carbon Braided Yarn.

Requirements of this annex are not to be interpreted to reduce the requirements defined by ASTM F2191/F2191M. Amendments to ASTM F2191/F2191M are defined in section U.3. Section numbers within U.3 correspond to ASTM F2191/F2191M but are preceded by "U.3.". Sections of ASTM F2191/F2191M that are not revised remain applicable.

Modifications to ASTM F2191/F2191M are identified as *Add* (add to section or add new section), *Replace* (part of or entire section) or *Delete*.

U.2 Scope

This annex specifies the requirements for carbon/graphite braided filament yarn as applied for static fire seals.

U.3 Amendments to ASTM F2191/F2191M

U.3. 3 Terminology

U.3 .3.15 lot

Replace section with

All finished packing materials of one size, type, class and grade produced on a continuous run under the same relevant conditions, made from the same batch of raw material.

U.3. 4 Classification

U.3. 4.1 Classification

U.3. 4.1.3 Type III

Delete section 4.1.3.1 Class 1

Delete section 4.1.3.3 Class 3

Add new section

U.3. 4.2

Only Class 2 and Grade B material shall be used.

U.3. 7 Properties

U.3. 7.1 Chemical and Physical Properties

Add to section

The following amendments shall apply for all packings:

- Ash (mass) content shall be ≤ 2 %.
- Chlorine content shall be ≤ 50 ppm.
- Sulfur content shall be ≤ 700 ppm.
- Fluorine content shall be ≤ 10 ppm.
- Total halogen (chlorine, bromine and fluorine) ≤ 310 ppm.
- Carbon Assay
    - Graphitic ≥ 98 % by mass.
    - Carbon ≥ 96 % by mass.

U.3. 10 Workmanship, Finish, and Appearance

U.3. 10.2 Construction

Add to section

Supplementary requirement S6.1 shall apply.

U.3. 13 Test Methods

U.3. 13.1 Tests

Add to section

All testing shall be performed on the final product.

Add new section heading

U.3. 13.12 Oxidation Test

Add new section

U.3. 13.12.1 *Purpose*

An oxidation test to verify the weight loss of a graphite or carbon sample, after being heated in a furnace or TGA.

The tools used for subsampling shall be degreased, by rinsing them with acetone, for example.

A muffle oven (furnace) or a TGA shall be used for this oxidation test, however if the graphite is to be used in Oxygen Service then only a TGA (e.g. Leco, Pyris, Netzsch) shall be used.

Add new section

U.3. 13.12.2 Test Condition, Procedure and Recordings

When using the muffle oven (furnace), two procedures may be used for the muffle oven test:

– Calculated absolute weight loss; or

– Relative weight loss against a calibration sample that has a known and acceptable oxidation rate determined by a TGA analysis. In this case, a calibration sample is placed in the muffle oven together with the test lot. The calibration sample shall have the same size, product form and graphite density as the test samples. The lot is accepted when the weight loss per hour of the test sample is equal to or less than that of the calibration sample.

The muffle oven shall be calibrated by thermocouples for temperature accuracy and variance of ± 5 °C (± 9 °F), at the position where the samples will be located with a frequency of 4 times a year. The temperature setting of the furnace shall be adjusted in such a way that the calibrated thermocouple at the position of the sample reads 670°C (1238 °F).

The test shall be carried out in accordance with EN 14772, 6.7 and with the following amendments:

– The dimensions of the packing ring sample shall be 25.4 mm x 38.1 mm x 6.4 mm (1 in. x 1.5 in. x 0.25 in.).

– All samples shall be handled using gloves.

– The sample to be tested shall be conditioned at 150 °C (302 °F) for 1 hour and then held in a desiccator until tested.

– After drying the sample the muffle oven shall run at 670 °C ± 5 °C (1238 °F ± 9 °F) for 4 hours. After loading the sample and closing the furnace, at least 15 minutes of waiting time is maintained to equilibrate the system.

– After 4 hours the machine may be allowed to cool down.

– Requirements for the muffle oven shall be in accordance with Table U.7.

When using the TGA:

a) Collect graphite material samples as per Table U.7:

  – 20 mg (0.3 gr) mass for the small crucible (e.g. Netzch, Pyris);

  – 5 g (75 gr) for the large crucible (e.g. LECO);

  – Dimensions of the graphite samples should be such that they fit into the crucible without sticking out.

b) The TGA composition of the gas at the sample area is either generated by mixing an inert gas and oxygen gas to arrive at a mixture equivalent to that of air, or by using clean, dry and oil free air instead.

c) The sample to be tested shall be put in the TGA accurately weighed and then conditioned at 150 °C (302 °F) for 1 hour. After drying the temperature shall be increased to 670 °C (1238 °F). When the temperature has stabilized at 670 °C (1238 °F) the weight loss shall be measured over a period of 4 hours. This measurement shall be recorded on a graph indicating the temperature and sample weight as function of time.

d) The temperature reading of the testing apparatus shall be calibrated.

e) Requirements for the TGA shall be as per Table U.7.

Add new section

U.3. 13.12.3 Acceptance

Calculate the sample weight loss as follows:

$$\text{Weight loss, \%} = \frac{W1 - W2}{W1} \times 100\ \%$$

where

W1 is the initial dry weight of the sample,

W2 is the final weight of the sample.

W2 shall be measured on a continuous basis.

The maximum (accumulated) allowable weight loss shall be < 4 % per hour.

Add new table

Table U.7 − Oxidation Test Equipment

Equipment type	**Muffle Oven (furnace)**	**Thermogravimetric Analyzer (TGA) with large crucible** **LECO TGA-701,TGA-601**	**Thermogravimetric Analyzer (TGA) with small crucible** **e.g. PYRIS 1,PYRIS 6, NETZCH TG 209 series**
Minimum furnace dimensions/specifics	250 mm x 300 mm x 230 mm (10 in. x 12 in. x 9 in.) Place the sample on an open mesh of grade 316 stainless steel with wire of 9.5 mm centers and wire of 1.6 mm diameter. The sample holding mesh should be positioned about 25 mm above the bottom of the furnace chamber.	Equipment standard	Equipment standard
Sample weight range	Up to 5 g (75 gr)	Up to 5 g (75 gr)	Minimum 20 mg (0.3 gr)
Weight loss range	0 % to 100 %	0 % to 100 %	0 % to 100 %
Balance precision	0.01 g (0. 15 gr) weigh scale	0.0001 g (0.0015 gr)	
Temperature range	100 °C to 1000 °C (212 °F to 1832 °F)	100 °C to 1000 °C (212 °F to 1832 °F)	100 °C to 0.001 g (0.015 gr)1000 °C (212 °F to 1832 °F)
Furnace temperature stability	± 4 °C (± 7 °F) ± 5 °C (± 9 °F)	± 4 °C (± 7 °F)	± 4 °C (± 7 °F)
Furnace air refresh rate	Vented no forced air supply	20 times per hour	Minimum 100 ml/min at sample area
Purge Gas & Flow rate	N/A	Sample Gas = Air or Oxygen/inert gas (in a 20/80 % composition)	Balance Chamber Purge Gas = Argon or Nitrogen at a flow of minimum 80 ml/min Sample Chamber Purge Gas = Oxygen at a flow of minimum 20 ml/min and in a 20/80 ratio of Balance Chamber Purge Gas/Sample Chamber Purge Gas.
Material Crucible	N/A	Ceramic or Quartz	Ceramic or Quartz
Air speed at specimen location	N/A	< 0.5 m/s (1.64 ft/s)	

U.3. 14 Inspection and Testing

U.3. 14.1

Replace section with

The manufacturer is responsible for ensuring that the packing components used in the end product meet the requirements of this specification.

Analysis of the sealing material, by testing, shall be performed on each lot.

Add new section

U.3. 14.2

One sample shall be taken from a lot and three specimens shall be taken from the selected sample. The tests specified in 13.2 through 13.12 shall be executed on each specimen and the results averaged. The average result shall meet the acceptance criteria. The test results shall be compared with the results on the test reports submitted by the graphite manufacturer.

U.3. 15 Rejection

Add new section

U.3. 15.2

Supplementary requirement S10 shall apply.

U.3. 16 Certification

U.3. 16.1

Replace section with

Analysis of the graphite or carbon material, through chemical analysis and high temperature oxidation testing, shall be performed on each lot of graphite raw material received by the manufacturer.

Add new annex

Annex V (new)
(normative)
Fugitive Emission Production Testing (Amendments to ISO 15848-2)

V.1 Introduction

This annex is written as modifications to ISO 15848-2:2015, Industrial valves - Measurement, test and qualification procedures for fugitive emissions - Part 2: Production acceptance test of valves

The requirements of this annex are not to be interpreted to reduce the requirements defined by ISO 15848-2. Amendments to ISO 15848-2 are defined in V.3. Section numbers within V.3 correspond to ISO 15848-2 but are preceded by "V.3.". Sections of ISO 15848-2 that are not revised remain applicable.

Modifications to ISO 15848-2 are identified as *Add* (add to section or add new section), *Replace* (part of or entire section) or *Delete*.

V.2 Scope

This annex specifies the requirements for fugitive emission production testing.

The valve datasheet, purchase order or requisition sheet shall specify the required fugitive emission class.

V.3 Amendments to ISO 15848-2

V.3. 4 Preparation of Test Valves

V.3. 4.1 Valve Selection

Replace section with

Add new section

V.3. 4.1.1 Lot definition

Unless specified otherwise, the lot for each inspection campaign from which the test samples are drawn is defined as, all valves part of the same purchase order, manufactured in the same manufacturing location, having the same fugitive emission class, of the same valve type, design and stem diameter.

Add new section

V.3. 4.1.2 Sample Size

The purchase order quantity per fugitive emission class (X) and the fugitive emission class itself determine how many samples (n) shall be drawn from each lot, as indicated in Table V.3. The sample strategy shall be determined in accordance with this table, which also indicates how many failed production tests per lot are acceptable (acceptance number, Ac).

Add new section

V.3. 4.1.3 Sample Selection

The samples shall be selected at random from each lot. When the lot consists of various sizes and pressure classes, then sampling shall be applied in such a way that it covers the entire production range from that lot.

Add new table

Table V.3 – Sample Strategy for Production Testing

Purchase order size per fugitive emission class	Sample size (n)		Acceptance number (Ac)
	Class AH	Class BH	
X ≤ 10	Minimum 1 or as specified by purchaser	Minimum 1 or as specified by purchaser	0
11 ≤ X ≤ 100	5 %	3 %	0
101 ≤ X ≤ 1000	4 %	3 %	0
X > 1000	3 %	2 %	0
NOTE Actual sample size shall be rounded-up to the next whole number with a maximum total sample size of 10 % of the whole purchase order (rounded-up to the next whole number)			

Add new section

V.3. 4.1.4 Lot Acceptance

The lot shall be accepted when each tested valve meets the acceptance criteria. In case a valve fails, the lot shall be rejected. The valve(s) that failed the test shall be repaired and retested. Additional valves shall be drawn from the failed lot as per Table V.3. Upon subsequent rejection, the failed valve(s) shall be repaired and retested. The retest shall contain all valves from the lot.

Add new section

V.3. 5 Test Conditions

V.3. 5.1 Test Fluid

Add to section

Use 97 % Helium or 10 % Helium + 90 % Nitrogen.

When testing with a 10 % He + 90 % N_2 mixture, in case of 10% He test gas the measured detector reading must be multiplied with a factor 10.

The use of 10 % He + 90 % N_2 mixture is not allowed for sizes below DN 300 (NPS 12).

97 % Helium test gases shall be certified as being a minimum of 97 % pure Helium.

V.3. 5.2 Leakage Management

Replace section with

Leakages shall be measured by sniffing method in accordance with ISO 15848-1:2015, B.1 and shall be expressed in either, mg/s, atm·cm3/s, Pa·m3/s or mbar·l/s .

V.3. 5.3 Test Pressure

Replace section with

The test pressure shall be the rated pressure at ambient temperature.

Add new section

V.3. 5.5 Torque Measurements

The torque exerted on the stem shall be within the design limits and the operating force shall be below the value specified in the design standard or in this specification. The torque shall be measured and documented at the start of the mechanical cycling and after any readjustment of the packing box.

Add new section

V.3. 5.6 Mechanical Adjustments

Only one mechanical adjustment of the valve gland bolting of the packing box or stem seals is allowed. The test report shall show the location and timing of the mechanical adjustment(s).

Add new section

V.3. 5.7 Test Equipment

The test rig shall be designed taking into consideration all HSE precautions that ensure robustness of the test rig and safety to personnel and environment. All test equipment shall have a valid calibration certificate to guarantee accuracy and have a valid calibration date not exceeding six months prior to any test.

The valve gland and body and bonnet joints shall, where practically possible, be sealed with an adhesive aluminum foil tape to create a contained volume. The tape shall have a hole at the highest point to ensure that the sniffer probe picks up any leakage.

The valve mounting shall be with the stem or shaft in the horizontal position.

To ensure measurement readings are not affected by background pollution, there shall be no leakage of the test piping or tubing.

Add new section

V.3. 5.8 Personnel

Personnel performing emission testing shall be qualified in accordance with the manufacturer's documented training program which is based on the Level 1 requirements specified in ISO 9712 or ASNT SNT-TC-1A for the tracer gas method.

Fugitive emissions shall be measured with a mass spectrometer.

V.3. 6 Test Procedure and Evaluation of Test Results

V.3. 6.1 Measurement of Stem (or Shaft) Seal Leakages

Replace item a) with

Half open the test valve and pressurize to the level specified in 5.3. Measure the stem seal leakage using the sniffing method in accordance with ISO 15848-1:2015, B.1.

Soft seated ball valves shall be set in the fully open position (to prevent possible damage of the soft seats) and subjected to the test pressure.

The measurements shall commence after the test pressure has been stabilized for:

– 15 minutes for valves with fugitive emission class AH; and

– 10 minutes for valves with fugitive emission class BH.

Wherever practical the same technique shall be used to measure stem leakage, this includes valves having operator brackets, stem tapings etc. Where this is not practical on smaller manually operated valves, the stem seal shall be sniffed locally by means of the detector probe in accordance with ISO 15848-1:2015, B.1.

The tests shall be carried in a still (draft free) environment.

Replace 6.1 c) with

The stem leakage shall be measured during the final mechanical cycle, when the closure member moves from the fully closed to the fully open position with the sniffing technique as described in 6.1 a).

Replace 6.1 d) with

If the mass spectrometer reading exceeds the leakage rate (either in atm·cm³/s, Pa·m³/s or mbar·l/s) for the applicable fugitive emission class as specified in Table V.1, the valve has failed the test. The minimum detectable leak rate for direct sniffing, refer to technique B4 of EN 1179: 1 x 10^{-7} Pa·m3/s (1 x 10^{-6} mbar·l/s).

A test shall also be considered as failed, in the case of the test valve requiring more than one mechanical adjustment.

Replace Table 1 with

Table V.1 – Tightness Classes for Stem Seals

Fugitive Emission Tightness Class	Measured leak rate [a] Stem seal leakage rate [b, c, d]			
	[mg/(s·m_{circ})]	[atm·cm³/(s·mm_{dia})]	[Pa·m³/(s·mm_{dia})]	[mbar·l/(s·mm_{dia})]
AH	≤ 10^{-5}	≤ 1.76 x 10^{-7}	≤ 1.78 x 10^{-8}	≤ 1.78 x 10^{-7}
BH	≤ 10^{-4}	≤ 1.76 x 10^{-6}	≤ 1.78 x 10^{-7}	≤ 1.78 x 10^{-6}

a Measured with sniffing in accordance with 6.1 a) with helium test fluid specified in 5.1.

b m_{circ} is per m stem circumference at the point of measurement.mm_{dia} is per mm stem diameter at the point of measurement.

c To be measured in either mg/(s·m_{circ}) or atm·cm³/(s·mm_{dia}) or Pa·m³/(s·mm_{dia}) or mbar·l/(s·mm_{dia})

d The probe shall be held with a distance of ≤ 3 mm from the surface and shall be moved at a speed not exceeding 20 mm/s.

V.3. 6.2 Measurement of Leakage of Body Seal(s)

Replace item a) with

Execute the body seals leakage measurement on the pressurized valve directly after the stem seal leakage test of 6.1 using the sniffing method specified in 6.1 a). The test shall be carried in a still (draft free) environment.

This measurement shall cover all potential leak paths, like the drain, vent, body joint and bolting connections.

Replace item b) with

If the mass spectrometer reading exceeds the leakage rate (either in atm·cm³/s, Pa·m³/s or mbar.l/s) for the applicable fugitive emission class as specified in Table V.2, the valve has failed the test. The minimum detectable leak rate for direct sniffing, refer to technique B4 of EN 1179: 1 x 10^{-7} Pa·m3/s (1 x 10^{-6} mbar·l/s).

Replace Table 2 with

Table V.2 – Leakage from Body Seals

Fugitive Emission Tightness Class	Measured leak rate [a] Body-to-bonnet or body-to-cover seal leakage rate [b, c, d]			
	[mg/(s·m_{circ})]	[atm·cm^3/(s·mm_{dia})]	[Pa·m^3/(s·mm_{dia})]	[mbar·l/(s·mm_{dia})]
AH	$\leq 10^{-6}$	$\leq 1.76 \times 10^{-8}$	$\leq 1.78 \times 10^{-9}$	$\leq 1.78 \times 10^{-8}$
BH	$\leq 10^{-5}$	$\leq 1.76 \times 10^{-7}$	$\leq 1.78 \times 10^{-8}$	$\leq 1.78 \times 10^{-7}$

a Measured with sniffing in accordance with 6.1 a) with helium test fluid specified in 5.1.

b m_{circ} is per m gasket perimeter at the point of measurement. mm_{dia} is per mm gasket outer diameter at the point of measurement. For non-circular gaskets the equivalent diameter shall be taken as the perimeter divided by π.

c To be measured in either mg/(s·m_{circ}) or atm·cm^3/(s·mm_{dia}) or Pa·m^3/(s·mm_{dia}) or mbar·l/(s·mm_{dia})

d The probe shall be held with a distance of ≤ 3 mm from the surface and shall be moved at a speed not exceeding 20 mm/s.

V.3. 7 Marking

Replace section with

Each valve of the accepted lot shall be marked in accordance with X.3.6.6. The marking shall be shown on the valve body or on a durable metal identification plate, securely affixed to the valve.

V.3. 8 Certification of Compliance

Replace section with

Certification requirements shall be in accordance with this specification.

V.4 Sampling Plan Example

A typical purchase order for ball valves is given in Table V.4. The purchase order quantity per fugitive emission class (X) is 1055. All valves are suitable for fugitive emission class BH, therefore Table V.3 indicates that 2 % of each lot shall be tested (rounded-up to the next whole number).

Table V.4 – Sampling Strategy Applied to a Purchase Order

Lot	Valve type	Fugitive emission Class	ASME Class	DN	Quantity	Stem diameter, mm	Purchase order (X)	Samples per lot
1	Trunnion	BH	150	15	136	10	1055	552 x 0.02 12 valves
	Trunnion	BH	150	20	138	10		
	Trunnion	BH	300	15	226	10		
	Trunnion	BH	300	20	52	10		
2	Trunnion	BH	150	25	363	16		437 x 0.02 9 valves
	Trunnion	BH	150	40	14	16		
	Trunnion	BH	150	50	48	16		
	Trunnion	BH	300	25	4	16		
	Trunnion	BH	300	50	8	16		
3	Trunnion	BH	150	80	12	19		54 x 0.02 2 valves
	Trunnion	BH	150	100	21	19		
	Trunnion	BH	300	80	21	19		
4	Trunnion	BH	150	150	4	28.6		12 x 0.02 1 valve
	Trunnion	BH	150	200	6	28.6		
	Trunnion	BH	300	150	2	28.6		

As per the note of Table V.3, the maximum number of valves to be tested is 10 % per purchase order (rounded-up to the next whole number), i.e. 106 valves for the complete purchase. This is larger than the total number of test valves calculated in Table V.4.

The valves shall now be selected (as per Table V.4) at random from each lot and tested as per ISO 15848-2 and this appendix. Each tested valve shall meet the acceptance criteria.

In case there is a failure in any of the tests, for instance any test valve representing the second lot containing 437 valves, then this lot shall be rejected, and the failed valve shall be repaired and retested. In addition, other valves shall be drawn at random from the lot and tested in accordance with Table V.3 (9 valves). Upon subsequent rejection, the lot is rejected and the failed valve(s) shall be repaired and retested. In addition, all valves from that lot have to be retested (and repaired) until all valves pass the tests.

V.5 Mass Spectrometers

Mass spectrometers/helium leak detectors shall have a sensitivity of at least 1.0 x 10^{-10} Pa·m^3/s, 1.0 x 10^{9} mbar·l/s or 1.0 x 10^{-9} atm·cm^3/s as specified in ASME V, Appendix IV, section IV-1061.2.

V.6 Leakage Rates per Stem Diameter (informative)

Table V.5 – Leakage Rates per Stem Diameter

Outer diameter of the stem mm (in)	**Maximum stem leakage rate per fugitive emission class**					
	AH			BH		
	atm·cm³/s	Pa·m³/s	mbar·l/s	atm·cm³/s	Pa·m³/s	mbar·l/s
10 (0.39)	1.76×10^{-6}	1.78×10^{-7}	1.78×10^{-6}	1.76×10^{-5}	1.78×10^{-6}	1.78×10^{-5}
15 (0.59)	2.64×10^{-6}	2.67×10^{-7}	2.67×10^{-6}	2.64×10^{-5}	2.67×10^{-6}	2.67×10^{-5}
20 (0.79)	3.52×10^{-6}	3.56×10^{-7}	3.56×10^{-6}	3.52×10^{-5}	3.56×10^{-6}	3.56×10^{-5}
25 (0.98)	4.40×10^{-6}	4.45×10^{-7}	4.45×10^{-6}	4.40×10^{-5}	4.45×10^{-6}	4.45×10^{-5}
30 (1.18)	5.28×10^{-6}	5.34×10^{-7}	5.34×10^{-6}	5.28×10^{-5}	5.34×10^{-6}	5.34×10^{-5}
35 (1.38)	6.16×10^{-6}	6.23×10^{-7}	6.23×10^{-6}	6.16×10^{-5}	6.23×10^{-6}	6.23×10^{-5}
40 (1.57)	7.04×10^{-6}	7.12×10^{-7}	7.12×10^{-6}	7.04×10^{-5}	7.12×10^{-6}	7.12×10^{-5}
50 (1.97)	8.80×10^{-6}	8.90×10^{-7}	8.90×10^{-6}	8.80×10^{-5}	8.90×10^{-6}	8.90×10^{-5}
60 (2.36)	1.06×10^{-5}	1.07×10^{-6}	1.07×10^{-5}	1.06×10^{-4}	1.07×10^{-5}	1.07×10^{-4}
70 (2.76)	1.23×10^{-5}	1.24×10^{-6}	1.24×10^{-5}	1.23×10^{-4}	1.24×10^{-5}	1.24×10^{-4}
80 (3.15)	1.41×10^{-5}	1.43×10^{-6}	1.43×10^{-6}	1.41×10^{-4}	1.43×10^{-5}	1.43×10^{-4}

Add new annex

Annex W (new)
(informative)
Lagging Extension Lengths Clearance required for Insulation

To accommodate insulation, depending on the individual design, the valve may need a lagging bonnet extension as specified in Table W.1.

Minimum lagging extension lengths are measured from the flange rim/body diameter, whichever is the larger to the upper bonnet flange. The gland must be clear of the lagging so that any stem leakage does not enter the lagging. Lagging extensions do not have a vapor space requirement.

Table W.1 – Lagging Extension Lengths Clearance Required for Insulation

NPS (DN)	Min.	½ (40)	3 (80)	18 (450)
	Max.	2 (50)	16 (400)	48 (1200)
Lagging extension length in. (mm)		2.0 (50)	3.0 (75)	4.0 (100)

Each lagging extended bonnet shall be provided with an insulation collar plate. The collar plate shall be clamped on the extended bonnet with the bolting on the upper side to enable easy adjustment. The gap between the bonnet and the collar plate shall be sealed to avoid condensation entering the insulated area.

The position shall clear the higher of either the bonnet lower flange/connection or the valve end flange, by a distance given in Table W.2.

Table W.2 – Insulation Collar Clearance Required for Insulation

NPS (DN)	Min.	½ (40)	3 (80)	18 (450)
	Max.	2 (50)	16 (400)	48 (1200)
Insulation Collar Clearance in. (mm) tolerance + 0 to + 1.0 in. (+ 0 to + 25 mm)		2.0 (50)	3.0 (75)	4.0 (100)

The diametrical clearance between the stem and the extended bonnet housing shall be minimized to reduce convective heat losses.

A stem guide bushing shall be applied at the lower end of the lagging extension bonnet.

Unless specified otherwise, the wall thickness shall meet the minimum wall thickness requirements of ASME B16.34, 6.1.3 for the applicable pressure class of the valve body. The wall thickness shall take into account the pressure stresses, as well as operating torque, stem thrust and bending stresses induced by handwheels, gears and power actuators.

Add new annex

Annex X (new)
(normative)
Fugitive Emission Type Testing (Amendments to ISO 15848-1)

X.1 Introduction

This annex is written as modifications to 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 and ISO 15848-1:2015/Amd.1:2017.

The requirements of this annex are not to be interpreted to reduce the requirements defined by ISO 15848-1. Amendments to ISO 15848-1 are defined in section X.3. Section numbers within X.3 correspond to sections in ISO 15848-1 but are preceded by "X.3.". Sections of ISO 15848-1 that are not revised remain applicable.

Modifications to ISO 15848-1 are identified as *Add* (add to section or add new section), *Replace* (part of or entire section) or *Delete*.

X.2 Scope

This annex specifies the requirements for fugitive emission type testing.

The valve datasheet, purchase order or requisition sheet shall specify the required fugitive emission class.

X.3 Amendments to ISO 15848-1

X.3. 5 Type Test

X.3. 5.1 Test Conditions

X.3. 5.1.2 Test Fluid

Replace section with

— Test fluid shall be helium gas 97 % minimum purity, or

— Test fluid shall be helium gas 90 % Helium + 10 % Nitrogen.

  — When testing with a 10 % He + 90 % N_2 mixture, in case of 10 % He test gas the measured detector reading must be multiplied with a factor 10.

  — The use of 10 % He + 90 % N_2 mixture is not allowed for sizes below DN 300 (NPS 12).

X.3. 5.1.3 Test Temperature

Replace first paragraph with

Test temperature shall qualify valve designs for minimum and maximum design temperatures specified in Annex Q.

X.3. 5.1.5.1 Stem (or Shaft) Leakage Measurement

Replace second paragraph with

Soft seated ball valves, however, shall be set in the fully open position (to prevent possible damage to the soft seats) and subjected to the test pressure.

Stem leakage measurement shall be performed as follows:

- by the vacuum method according to the procedures described in A.1;
- by the bagging accumulation method as described in A.2 and EN 13185:2001,10.4; or
- by the local leakage measurement (sniffing) according to the procedures described in B.1 and shall be expressed in either, mg/s, atm·cm^3/s, Pa·m^3/s or mbar·l/s.

X.3. 5.2 Test Procedures

X.3. 5.2.2 Test Equipment

Add to section

g) All test equipment shall have a valid calibration certificate, to guarantee accuracy and have a valid calibration date not exceeding 6 months, prior to any test.

h) The valve gland and body and bonnet joints shall, where practically possible, be sealed with an adhesive aluminum foil tape to create a contained volume. The tape shall have a hole at the highest point to ensure that an inserted sniffer probe picks up any leakage and a tube at the bottom of equal diameter to the sniffer probe and at least 20 diameters long, to drain any liquid out as well as to avoid the pressure in the bag to drop below atmospheric pressure and to prevent leaked Helium from escaping to atmosphere. Body and bonnet static seal fugitive emissions testing shall conform to the accumulation technique as specified in A.2 accumulation (bagging) method.

i) Personnel performing emission testing shall be qualified in accordance with the manufacturer's documented training program which is based on the Level 1 requirements specified in ISO 9712 or ASNT SNT-TC-1A for the tracer gas method.

j) Fugitive emissions shall be measured with a mass spectrometer.

h) If the mass spectrometer reading exceeds the leakage rate (either in atm·cm^3/s, Pa·m^3/s or mbar.l/s) for the applicable fugitive emission class as specified in Table V.2, the valve has failed the test. The minimum detectable leak rate for direct sniffing, refer to technique B4 of EN 1179: 1 x 10-7 Pa·m3/s (1 x 10-6 mbar·l/s).

X.3. 5.2.4 Test Description

X.3. 5.2.4.1 General

Replace item b) with

b) The valve mounting shall be with the stem or shaft in the horizontal position.

Add to item e)

This measurement shall cover all potential leak paths, like the drain, vent, body joint and bolting connections.

Add to item g)

Torque measurements shall be in accordance with V.3.5.5.

Replace Table 2 with Table X.2

Table X.2 – Leakage from Body Seals

Fugitive Emission Tightness Class	Measured leak rate [a] Body-to-bonnet or body-to-cover seal leakage rate [a, b, c, d] [mg/(s·m$_{circ}$)]	[atm·cm^3/(s·mm$_{dia}$)]	[Pa·m^3/(s·mm$_{dia}$)]	[mbar·l/(s·mm$_{dia}$)]
AH	≤ 10^{-6}	≤ 1.76 x 10^{-8}	≤ 1.78 x 10^{-9}	≤ 1.78 x 10^{-8}
BH	≤ 10^{-5}	≤ 1.76 x 10^{-7}	≤ 1.78 x 10^{-8}	≤ 1.78 x 10^{-7}

a Measured with sniffing in accordance with B.1.
b m$_{circ}$ is per m gasket perimeter at the point of measurement. mm$_{dia}$ is per mm gasket outer diameter at the point of measurement. For non-circular gaskets the equivalent diameter shall be taken as the perimeter divided by π.
c To be measured in either mg/(s·m$_{circ}$) or atm·cm^3/(s·mm$_{dia}$) or Pa·m^3/(s·mm$_{dia}$) or mbar·l/(s·mm$_{dia}$)
d The probe shall be held with a distance of ≤ 3 mm from the surface and shall be moved at a speed not exceeding 20 mm/s.

X.3. 6 Performance Classes

X.3. 6.3 Endurance Classes

X.3. 6.3.1 Mechanical-cycle Classes for Isolating Valves

Replace section with

Mechanical-cycles for isolation valves CO1 may be carried out at one upper (maximum design) and one lower (minimum design) selected test temperature thermal cycle.

The sequence of testing and the minimum number of mechanical cycles for isolating valves, endurance class CO1, shall be 205 mechanical cycles, full stroke with one upper (maximum design) thermal cycle and one lower (minimum design) thermal cycle as follows:

- 50 cycles at RT, followed by
- 50 cycles at upper selected test temperature, followed by
- 50 cycles at RT, followed by
- 50 cycles at lower selected test temperature, followed by
- 5 cycles at RT.

Delete Figure 4

X.3. 6.6 Marking

Replace section with

Production valves qualified by type testing in accordance with this standard shall be marked with "IOGP FE", followed by the tightness class, endurance cycle, stem seal adjustment number, temperature range, pressure class and this standard

EXAMPLE Performance class: IOGP FE BH — CO1 — SSA 1 — (−46 °C, 150 °C) — CL150 — S-562

X.3. 8 Extension of Qualification to Untested Valves

Replace item e) with

e) stem diameters are from half to twice the tested valve diameter, half stem diameter and double stem diameter included: $Do/2 \leq D \leq 2\ Do$ with Do being the stem diameter of the tested valve;

Bibliography

Add to section

[16] ASME B.36.10M, Welded and Seamless Wrought Steel Pipe

[17] EU 97/23/EC, Directive 97/23/EC of the European Parliament and of the Council on the Approximation of the Laws of the Member States Concerning Pressure Equipment

[18] ISO 13623, Petroleum and natural gas industries - Pipeline transportation systems

[19] SAE AMS 2410, Plating, Silver, Nickel Strike, High Bake

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