International Association of Oil & Gas Producers

SPECIFICATION
S-611

MAY
2019

Supplementary Requirements to API 600 Steel Gate Valves and to API 603 CRA Gate Valves

Revision history

VERSION	DATE	AMENDMENTS
1.0	May 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).

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 supplier 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 standards API Standard 600, Thirteenth Edition 2015, Steel Gate Valves – Flanged and Butt-welding Ends, Bolted Bonnets and API Standard 603, Ninth Edition 2018 – Flanged and Butt-welding Ends, which are indispensable for the application of this specification.

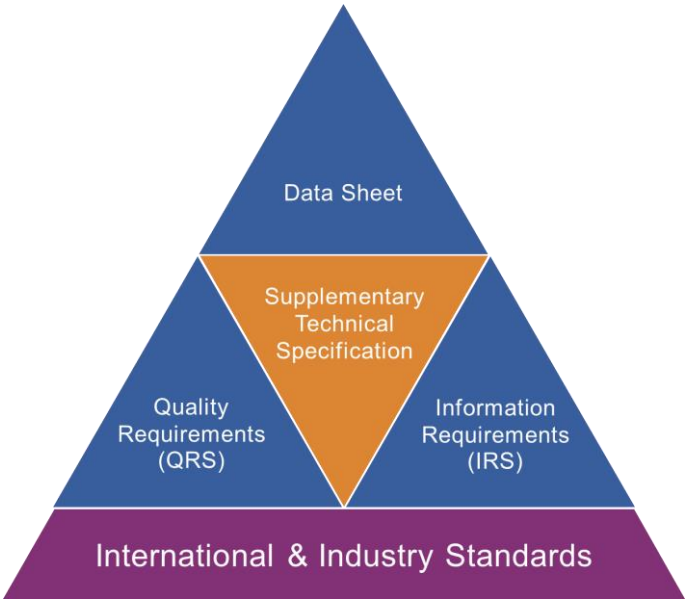
Following agreement of the relevant JIP33 work group and the by the JIP33 Steering Committee, the IOGP Management Committee has agreed to the publication of this specification by IOGP. Where adopted by the individual operating companies, this specification and associated documentation aims to supersede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

Table of Contents

Introduction

The purpose of this specification is to define a minimum common set of supplementary requirements for the specification for the procurement of Gate Valves to API Standard 600, Thirteenth Edition 2015, and API Standard 603, Ninth Edition 2018, for application in the petroleum and natural gas industries.

The JIP33 standardized procurement specifications have a common document structure comprising four documents as shown below, which together with the purchase order scope define the overall technical specification for procurement. It should be noted, however, that this specification for gate valves does not include a datasheet template.



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-611: Supplementary Requirements to API 600 Steel Gate Valves and to API 603 CRA Gate Valves

This specification is written as an overlay to API Standard 600 and API Standard 603, following the section structure of the parent standards, to assist in cross-referencing the requirements. Where sections from the parent standards (API 600 and API 603) 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-611L: Information requirements (IRS) for Steel and CRA Gate 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-611Q: Quality requirements (QRS) for Steel and CRA Gate 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 user in the datasheets.

The IRS is published as an editable document for the user to specify application specific requirements. The supplementary 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) user defined requirements (valve datasheets, IRS, QRS);

d) this specification;

e) API Standard 600 / API Standard 603.

1 Scope

API 600 only: replace first paragraph with

This specification defines the requirements for the design, manufacturing, assembly, testing and documentation for API 600 heavy-duty series of bolted bonnet steel gate valves where corrosion, erosion and other service conditions would indicate a need for full port openings, heavy wall sections, and large stem diameters.

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.

API 600 only: replace fifth and sixth list items in the second paragraph with

- single gate;
- wedge seating;

API 600 only: add to second paragraph

- Manually operated: handwheel, gearbox and bare stem (for actuation);
- Metallic or graphitic sealing.

API 600 only: add to the existing item in the third paragraph

1200

API 600 only: add to the existing item in the fourth paragraph

48

API 600 only: add to section

The dimensions in metric (SI) units are standard; customary units are shown for reference.

This specification covers design temperature ranges from -46 °C (-50 °F) to 455 °C (850 °F).

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

- two-piece split wedge design;
- parallel seat double-disc gate design;
- pressure seal bonnet design;
- short pattern valves;
- actuators (operators), electric, hydraulic or pneumatic devices;

- cryogenic service valves with a design temperature below -46 °C (-50 °F);
- high temperature valves with a design temperature above 455 °C (> 850 °F);
- buried valves with stem extensions;
- piggable valves;
- external body cavity relief by external piping and valves;
- internal painting;
- soft sealing parts: thermoplastics and elastomers;
- NPS 1, 1 ¼ and 1 ½.

1.1

API 603 only: replace first sentence with

This specification defines the requirements for the design, manufacturing, assembly, testing and documentation for API 603 requirements for corrosion-resistant bolted bonnet gate valves meeting the requirements of Standard Class, ASME B16.34 and having full port openings for use in process piping applications. 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.

API 603 only: replace fifth and sixth items in the first paragraph with

- single gate;
- wedge seating;

API 603 only: add to first paragraph

- manually operated: handwheel, gearbox and bare stem (for actuation);
- Metallic or graphitic sealing.

API 603 only: add new section

1.5

This specification covers design temperature ranges from -46 °C (-50 °F) to 455 °C (850 °F).

API 603 only: add new section

1.6

The following items are excluded from scope of this specification:

- two-piece split wedge design;
- parallel seat double-disc gate design;
- pressure seal bonnet design;
- short pattern valves;
- actuators (operators), electric, hydraulic or pneumatic devices;
- cryogenic service valves with a design temperature below -46 °C (-50 °F);
- high temperature valves with a design temperature above 455 °C (850 °F);
- buried valves with stem extensions;
- piggable valves;
- external body cavity relief by external piping and valves;
- internal painting;
- soft sealing parts: thermoplastics and elastomers.

2 Normative References

Add to section

API Recommended Practice 591, *Process Valve Qualification Procedure*

API Specification 6A, *Specification for Wellhead and Christmas Tree Equipment*

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

API Specification 6D:2014, *Specification for Pipeline and Piping Valves*

API Specification 17D:2011, *Design and Operation of Subsea Production Systems — Subsea Wellhead and Tree Equipment*

API Standard 600:2015, *Steel Gate Valves — Flanged and Butt-welding Ends, Bolted Bonnets*

API Standard 603:2018, *Corrosion-resistant, Bolted Bonnet Gate Valves – Flanged and Butt-welding Ends*

ASME B31.4, *Pipeline Transportation Systems for Liquids and Slurries*

ASME B31.8, *Gas Transmission and Distribution Piping Systems*

ASME V:2017, *Nondestructive Examination*

ASME VIII, Division 1:2017, *Rules for Construction of Pressure Vessels*

ASME VIII, Division 2, *Alternative Rules*

ASME PCC-1, *Guidelines for Pressure Boundary Bolted Flange Joint Assembly*

ASNT ACCP-CP-1, *ASNT Central Certification Program*

ASNT SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*

ASTM A578/A578M, *Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications*

ASTM A609/A609M, *Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof*

ASTM A961, *Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications*

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 A4.24, *Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal*

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

EN 12570, *Industrial valves — Method for sizing the operating element*

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 1591, *Flanges and their joints — Design rules for gasketed circular flange connections*

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

IOGP S-563, *Piping Material Specification*

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

ISO 10497, *Testing of valves — Fire type-testing requirements*

ISO 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

ISO 13628-4, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 4: Subsea wellhead and tree equipment*

ISO 15156 / NACE MR 0175, *Petroleum and natural gas industries — Materials for use in H2S-containing environments in oil and gas production*

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

ISO 15848-2:2015, *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 17945 / NACE MR 0103, *Petroleum, petrochemical and natural gas industries — Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments*

ISO 8249, *Welding — Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals*

ISO 9606-1, *Qualification testing of welders — Fusion welding, Part 1: Steels*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

MSS SP-25, *Standard Marking System for Valves, Fittings, Flanges, and Unions*

MSS SP-45, *Bypass And Drain Connections*

API 600 only: add to section

API Standard 602, *Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries*

ASME II, *Materials, Part D, Properties (Customary)*

ASME IX, *Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators*

Replace section heading with

3 Terms, Definitions, Abbreviations and Acronyms

Add new section

3.0 Abbreviations and Acronyms

CE	Carbon Equivalent
DSS	Duplex Stainless Steel
EDS	Equipment Datasheet
FE	Fugitive Emissions
HM	Helium Mix
HP	High Pressure
HSE	Health, Safety and Environment
IRS	Information Requirements Specification
LTCS	Low Temperature Carbon Steel
MDS	Material Datasheet
MPD	Maximum Pressure Differential
NDE	Nondestructive Examination
NTCS	Normal Temperature Carbon Steel
OD	Outer Diameter
PMI	Positive Material Identification
PQR	Procedure Qualification Record
PTFE	Polytetrafluoroethylene
PWHT	Post Weld Heat Treatment
QRS	Quality Requirements Specification
QSL	Quality Specification Level
RTJ	Ring Type Joint
SDSS	Super Duplex Stainless Steel
SWL	Safe Working Load
TGA	Thermogravimetric Analyzer
VDS	Valve Datasheet
WPQ	Welder Performance Qualification
WPS	Weld Procedure Specification

3.4
Shell
Replace section with
The sum of all pressure containing parts, which constitute the pressure boundary of an API 600/603 valve.

Add to section

3.5
Staking
Staking is the process of connecting two components by creating an interference fit between the two pieces. One workpiece has a hole in it while the other has a boss that fits within the hole. The boss is very slightly undersized so that it forms a slip fit. A staking punch is then used to expand the boss radially and to compress the boss axially so as to form an interference fit between the workpieces.

3.6
Peening
Metal upsetting causing deformation of the metal surfaces to create an interference fit.

3.7
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.

3.8
Component batch
Quantity of components of the same design, material, size and rating, from a single production lot, manufactured in one location.

3.9
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.

3.10
Valve batch
Quantity of valves of the same design, material, size and rating, from a single purchase order, manufactured in one location.

3.11
Pressure-containing part
A part whose failure to function as intended results in a release of contained fluid into the environment and, as a minimum, includes the body, bonnet, stem, yoke, gland flange, bolting and body/bonnet gasket that pass through the pressure boundary.

3.12
Pressure-controlling part
A part intended to prevent or permit the flow of fluids and as a minimum includes the gate and seat.

3.13
Drive train
All parts of a valve drive between the operator and the gate including as a minimum, the stem, gate, yoke, stem nut, bonnet and bolting, but excluding the operator.

3.14
Breakaway thrust
Breakaway torque
Maximum thrust or torque required to operate a valve at maximum pressure differential.

3.15
Handwheel
Wheel consisting of a rim connected to a hub, for example by spokes, and used to manually operate a valve requiring multiple turns.

3.16
Maximum pressure differential (MPD)
Maximum difference between the upstream and downstream pressure across the obturator at which the obturator may be operated.

3.17
Operator
Actuator
A mechanical device (or assembly) for opening or closing a valve.
NOTE 1 Handwheel with or without a gearbox.
NOTE 2 This can be an electric, hydraulic, or gas device bolted or otherwise attached to the valve for powered opening and closing of the valve.

3.18
Position indicator
Device to show the position of the valve obturator.

3.19
Tack weld
Temporary weld only, used to fix the workpieces or assemblies to be joined in their proper position for welding.

3.20
Seal weld
Permanent weld intended primarily to provide tightness against leakage of a gas or fluid. Welding shall be supported by a weld procedure specification (WPS) and procedure qualification record (PQR).

3.21
Intermittent, fillet, groove, seam welds
Series of permanent welds made at defined intervals along the joint. For the purpose of this specification, the lengths of the weld segment shall be at least 15 mm (0.6 in.) long and welding shall be supported by a WPS and PQR.

3.22
Seam weld
A continuous permanent weld produced between overlapping members.

4 Pressure/Temperature Ratings

Delete section **4.2**

4.4

API 600 only: add to section

The use of valves at lower temperatures is the user's responsibility, and consideration shall be given to the loss of ductility and impact strength per ASME B31.3 and ASME B31T.

Add to section

When specified, lagging requirements indicated in Annex K shall be applied.

NOTE By design, gate valves above DN 40 (NPS 1 ½) have bonnets which meet this requirement.

4.5

Add to section

The requirement for body cavity relief shall be specified by the purchaser.

Body cavity relief shall be a pressure equalizing hole with a diameter of at least 3 mm (0.12 in.) drilled in the closure member outside the seat facing area. The pressure relief hole shall connect the valve body cavity with the high pressure (HP) side of the closure member when this is in the closed position.

This renders the valve as unidirectional and such valves shall be marked clearly as detailed in 8.2.

The maintenance manual shall show how the closure member must be assembled.

5 Design

5.1 Body Wall Thickness

5.1.1

API 600 only: add to section

For sizes defined in the scope, Table 1 includes 3 mm (0.12 in.) body wall thickness corrosion allowance relative to ASME B16.34, with the exception of DN 250 (NPS 10) Class 2500.

For DN 250 (NPS 10) Class 2500 and nominal pipe sizes not listed in Table 1, the manufacturer shall add a 3 mm (0.12 in.) corrosion allowance in addition to ASME B16.34.

Corrosion allowance greater than 3 mm (0.12 in.) shall be specified by the purchaser.

Add new section

5.1.3

Valves shall meet the requirements of ASME B16.34 for standard class and any additional requirements as specified in this specification.

Design and calculations for pressure-containing parts shall be in accordance with an internationally recognized design code or standard with consideration for operating and external loads.

NOTE Examples of internationally recognized design codes or standards are: ASME BPVC, Section VIII, Division 1 or Division 2 and ASME B16.34.

The allowable stress values shall be consistent with the selected design code or standard.

5.3 Body Dimensions *(API 600)*
5.3 Body *(API 603)*

5.3.1 Flanged Ends

5.3.1.2

API 600 only: replace entire section (including 5.3.1.2.1 and 5.3.1.2.2) with

Face-to-face dimensions shall be in accordance with ASME B16.10. For sizes not listed, dimensions shall be as agreed between the purchaser and the manufacturer. Body end flanges and bonnet flanges shall be cast or forged integral with the body. For valves in sizes DN 1000, 1050 and 1200 (NPS 40, 42 and 48) up to Class 600, face-to-face dimensions shall be in accordance with Table 10.

Add new table

Table 10 – Face-to-face Dimensions

DN (NPS)	Class 150 mm (in.)	Class 300 mm (in.)	Class 600 mm (in.)
1000 (40)	as per ASME B16.10	1930 (76)	2286 (90)
1050 (42)	787 (31)	1981 (78)	2438 (96)
1200 (48)	864 (34)	2235 (88)	2540 (100)

API 600 only: delete Table 2

5.3.1.3

The back face of flanges shall be machined flat, either as spot facings at the nut bearing positions or machined over the entire flange back face area. The surface plane of the nut-bearing area on the back face of the flange shall be parallel to within 1° of the machined flange face.

Add new section

5.3.1.4

For valves up to and including DN 50 (NPS 2), the maximum lateral misalignment of flange centerlines shall be 1.5 mm (0.06 in.). For valves larger than DN 50 (NPS 2), the maximum lateral misalignment of flange centerlines shall be 2 mm (0.08 in.).

Add new section

5.3.1.5

For valves up to and including DN 600 (NPS 24), the maximum parallel misalignment between flanges shall be 2.5 mm/m (0.03 in./ft.). For valves larger than DN 600 (NPS 24), the maximum parallel misalignment between flanges shall be 1.75 mm/m (0.02 in./ft.).

Add new section

5.3.1.6

For valves up to and including DN 100 (NPS 4), the maximum allowable misalignment shall be 2 mm (0.08 in.) at the bolt holes. For valves larger than DN 100 (NPS 4), the maximum allowable misalignment shall be 3 mm (0.12 in.) at the bolt holes.

Add new section

5.3.1.7

Valve end connections shall be designed to allow ASME B18.2.2 heavy series nuts to be used for the piping connections. the design shall allow for at least two threads of the stud to protrude above the nut face without contacting other valve body parts. Where space is limited for Class 150, a one full nut thread shall be met.

5.3.2 Butt-welding Ends

5.3.2.1

API 600 only: replace second paragraph up to the end of the list with

The chemical composition of carbon steel valves and valve parts shall comply with the applicable material datasheet (MDS) in IOGP S-563 as referenced in Annex D.

Where the material selection table does not reference an MDS, the material shall comply with the applicable material standard, except for welding end valves which shall fulfil the following additional requirements:

- the carbon content shall not exceed 0.23 % by mass;
- the sulfur content shall not exceed 0.020 % by mass;
- the phosphorus content shall not exceed 0.025 % by mass;
- the carbon equivalent (CE) shall not exceed 0.43 % as determined by the formula:

  CE = % C + % Mn/6 + (% Cr + % Mo + % V)/5 + (% Ni + % Cu)/15

Add to section

When specified by the purchaser, butt-welded end valves shall be provided with extension (pup) pieces in accordance with Table 11.

Table 11 – Pup Lengths

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

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.

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

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

Valves requiring extension (pup) pieces welded to the valve body, shall be supplied complete from the manufacturer or their designated sub-contractor to ensure seal performance and welding compatibility with the body.

Outside diameter, wall thickness, material grade and composition of the extension (pup) pieces shall be as specified in the purchase order and as follows:

a) The ratio of the specified minimum yield strength of the extension (pup) piece material to the valve body material or extension (pup) piece to the pipe shall not exceed 1.5:1.

b) Where the specified minimum yield strength of the pipe material exceeds the specified minimum yield strength of the valve material by more than 1.5:1, the extension (pup) piece shall be of an intermediate strength, so that the maximum yield strength ratio of 1.5:1 across the valve to extension (pup) piece weld and extension (pup) piece to pipe weld is satisfied.

   For example, the extension (pup) piece between a A350 LF2 valve and a API 5L X60 pipeline may be of A694 F52/API 5L X52 material.

c) If the ratio of the valve body thickness to the pipe wall thickness is greater than 1.5:1, the extension (pup) piece material shall be of an intermediate strength and the ratios of specified minimum yield strength stated under 5.3.2.1 a) and b) shall apply.

d) Extension (pup) piece material shall comply with the requirements in the applicable MDS in IOGP S-563.

The butt welding end profile of the valve body and transition taper of the valve body to extension (pup) piece shall comply with ASME B16.25 Figures 1 to 3. The butt weld end profile of the extension (pup) piece, as well as the trimming and misalignment shall comply with ASME B31.3:2016, Figure 328.4.2 and Figure 328.4.3.

Where extension (pup) pieces are to be attached to the valve by the manufacturer's sub-contractor, the manufacturer shall take the following actions:

- Advise the party responsible for welding the extension (pup) pieces 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.

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

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

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

5.3.2.2

Replace section with

End-to-end dimensions shall be in accordance with ASME B16.10. For sizes not listed, dimensions shall be as agreed to between the purchaser and the manufacturer.

5.3.3 Body Seats

5.3.3.1

API 600 only: add to list

- for all classes in sizes above DN 1050 (NPS 42), ASME B16.34;

- for Class 600 in sizes DN 650 to 1050 (NPS 26 to 42), ASME B16.34.

5.3.3.3

API 603 only: replace section with

Where separate seat rings are provided, they shall be shoulder- or bottom-seated, and seal welded in place, except that for DN $\leq$ 50 (NPS $\leq$ 2) rolled or pressed-in seat rings may be used. The material used for seal. welding shall provide the same corrosion resistance as the valve body material. Tack welding or stitch welding is not permitted.

5.4 Bonnet

5.4.2

API 600 only: replace first item with

- a bushing positively secured by tab and permanent weld for threaded backseat bush, or seal weld, against coming loose. Tab shall not be welded to the backseat bush.

API 600 only: add to section

When the back seat is not integral with the bonnet, the back seat shall be positively secured in place. Positive securing by tack welding or metal upsetting (such as peening or staking) is not permitted.

Welds are only permitted if supported by a WPS and PQR.

If a welded tab is used, its thickness shall be calculated and its material chosen to ensure adequate strength and durability, as well as compatibility with the bonnet and backseat materials.

The size of the tab permanent weld shall consider the strength requirements of the joint, the dimensions and material of the tab, and the welding process used.

5.4.4

Add to section

Mechanical retention of one side of each eye bolt pin to the yoke anchor lug shall be by permanent weld and shall cover at least 30 % of the outside circumference.

Welds are only permitted if supported by a WPS and PQR.

5.5 Bonnet-to-body Joint

5.5.1

Add to section

Flanges with a circular or a non-circular shape shall have a flange facing finish in accordance with ASME B16.5.

5.5.2

Replace section with

Class 150 valves with non-circular bonnet to body joint shall be flat face or raised face types illustrated in ASME B16.5.

5.5.3

Replace section with

For Class > 150 valves, the bonnet-to-body joint shall be one of the following types illustrated in ASME B16.5:

- tongue and groove;
- spigot and recess (i.e. male and female);
- ring joint.

For valves having pressure class designation Class > 150, the bonnet gasket shall be fully confined in a groove.

5.5.4

Replace section with

The bonnet flange gasket shall be one of the following:

- octagonal ring joint;
- spiral wound metal gasket with filler, an outer ring (centering/compression) and inner ring;
- spiral wound metal gasket with filler but without a centering/compression ring, to be used only in “tongue and groove” or “spigot and recess” joints that prevent the gasket from unwinding and from buckling damage.

The valve design and assembly procedures shall incorporate controlled and even compression in order to prevent crushing the gasket.

For Class 150, the following are also permitted:

- solid metal, corrugated or grooved (profiled) metal gasket with graphite filler;
- when approved by the purchaser, expanded metal stainless steel with flexible graphite sheet.

Ring Type Joint (RTJ) gasket hardness shall be no greater than:

- the requirement specified in ASME B16.20;
- 130 HBW for austenitic stainless steel gaskets;
- 125 HBW for Monel gaskets.

In ring-joint designs, the difference in hardness between the ring-joint gasket and the body/bonnet sealing surfaces shall be at least 30 HBW.

5.5.5

API 600 only: replace section with

The gasket shall not extend beyond the inner edge of the bolt holes.

5.5.9

Replace section with

The total cross-sectional area of the bolts in valve bonnet bolting (bonnet-to-body joint including gasket compression) shall be in accordance with the requirements of ASME B16.34:2017 or ASME BPVC Sec VIII Div 1 (refer to Appendix 2 – Rules for bolted flange connections with ring type gaskets) provided that requirements of ASME B16.34 are met.

Add new section

5.5.12 *(API 600)*
5.5.11 *(API 603)*

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.

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.

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 loss of pressure containment during test, or relaxation in preload and potentially 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.

5.6 Gate

5.6.1

5.6.1.1

Add to section

Up to and including DN 40 (NPS 1 ½), the valve shall be furnished with a solid wedge. Above DN 40 (NPS 1 ½), the valve shall be furnished with a flexible wedge.

5.6.3 *(API 600)*
5.6.5 *(API 603)*

Add to section before first paragraph

The design of gate and body guides shall be optimized with respect to chamfers, clearances and machining to ensure valves operate smoothly during operation in any orientation without self-locking, seizure, internal wear or galling effects in the absence of any form of lubrication.

API 600 only: add to section

The possible loss of metal due to corrosion, erosion, abrasive wear or a combination of these factors shall be considered in the design of the body and gate guide surfaces.

Add to section

Smooth operation shall be demonstrated in accordance with Annex H.

API 600 only: delete last sentence

5.6.5

API 600 only : add to section

For sizes above DN 1050 (NPS 42), minimum wear travel and maximum stem projection shall be within the limits defined for DN 1050 (NPS 42) in Table 4.

The manufacturer shall be able to demonstrate compliance of minimum wear travel and maximum stem projection requirements.

5.7 Yoke

5.7.3

API 600 only: add to section

5.7.2

API 603 only: replace last sentence

Separate yokes shall be attached to the bonnet with through holes in yoke and bonnet and studs/nuts. Slotted holes, drilled and tapped holes (studding connections) are not allowed.

Add new section

5.7.5 *(API 600)*
5.7.4 *(API 603)*

The yoke sleeve and/or bush shall be positively secured against loosening.

5.8 Stem and Stem Nut

5.8.1

Delete last sentence

5.8.5 *(API 600)*
5.8.6 *(API 603)*

Add to section

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

5.8.6 *(API 600)*
5.8.7 *(API 603)*

Add to section

The "T" orientation shall be transverse to the pipe axis as per Figure C.1.

5.8.8 *(API 600)*
5.8.9 *(API 603)*

Add to section

The anti blow-out stem retention configuration shall be located internally to the valve to ensure stem ejection is impossible when external non body/bonnet fasteners are removed.

The weakest part of the drive train, including the stem, shall be located outside of the valve pressure boundary. The stem to gate connection of each valve design shall comply with the strength requirements of API RP 591 and be validated by qualification testing.

The anti blow-out stem retention configuration and weakest part of the drive train shall be clearly identified on the valve construction drawing and clear instructions provided in the maintenance manual.

5.8.11 *(API 603)*

Replace second sentence with

The stem nut arrangement shall be designed to:

5.8.12 *(API 600)*
5.8.13 *(API 603)*

Replace section

Mechanical retention of the stem nut to the yoke shall be by permanent weld and shall cover at least 30 % of the outside circumference of the threaded bushing.

Welds are only permitted if supported by a WPS and PQR.

Add new section

5.8.15 *(API 600)*
5.8.16 *(API 603)*

When specified by the purchaser, valves shall be equipped with a fully enclosed weatherproof stem protector. With the valve in the fully open position, the stem protector design shall provide 25 mm (1 in.) minimum clearance between the top of the stem and the inside top of the stem protector.

If the stem protector obscures the position of the stem, the design shall be provided with a position indicator.

The standard design shall have a stem nut grease injector.

5.9 Packing and Packing Box

5.9.1

Replace first sentence with

The packing shall consist of die formed, exfoliated graphite rings with anti-extrusion braided end (top and bottom) rings or fully braided packing set per Figure 4 and Figure 5.

Add to section

The stem packing arrangement, stuffing box and gland follower tolerances shall be designed to prevent extrusion.

The bottom of the packing box shall be flat and perpendicular to the axis of the stem.

Add new figure

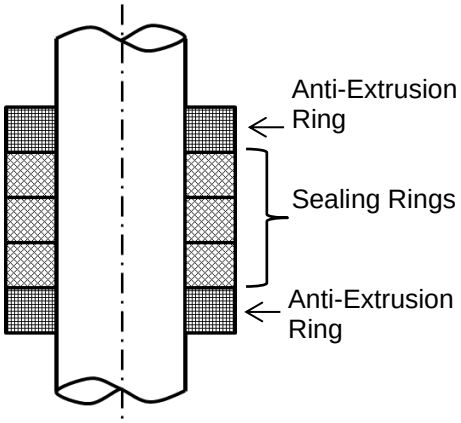


Figure 4 − Die-Formed Flexible Graphite Packing

Add new figure

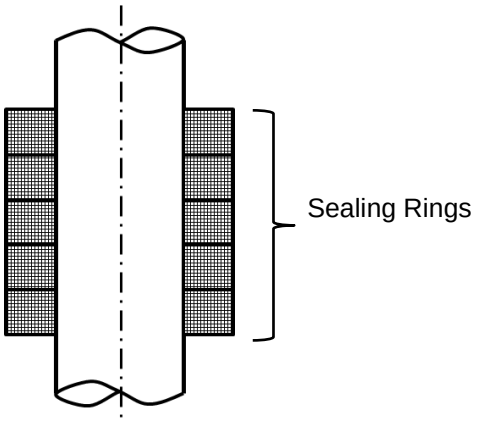


Figure 5 − All Braided Graphite Rings Packing

5.9.2

Replace first sentence with

The nominal depth of the packing box shall accommodate a minimum of four and maximum of seven uncompressed rings of packing.

If a spacer ring is required to reduce the depth of the stuffing box, the spacer ring shall be of the same material as the gland ring. The clearance between the bush (or spacer ring) and the stem shall be sufficient to prevent galling.

5.9.4 *(API 600)*
5.9.3 *(API 603)*

Add to section

The gland follower shall be designed to protrude into the stuffing box by at least 1 mm (0.04 in.) before compressing the packing rings.

Threaded glands shall not be used.

The gland flange shall be one-piece. Split type gland flanges are not permitted.

Valve shall be supplied with the gland flange 90° to the stem.

5.9.6 *(API 600)*
5.9.5 *(API 603)*

Add to section

The stem shall be supported and have clearances designed, such that with all anticipated side loads the stem does not make rubbing contact with the adjacent static metallic components (bonnet, gland ring, etc.), which may lead to galling.

5.9.7 (API 600)

5.9.6 *(API 603)*

Add to section

Valves shall be qualified by type testing to meet the fugitive emissions (FE) requirements of ISO 15848-1 and ISO 15848-1/Amd.1, Tightness Class BH, endurance class isolation valve CO1 with the exceptions specified in Annex J.

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.

5.11 Operation

5.11.1

Replace section with

Handwheel shall open the valve when turned in a counter-clockwise direction.

Valves provided with a handwheel or gearbox shall be rated to operate against the pressure determined in accordance with Section 4 for material at 38 °C (100 °F) at MPD.

The manufacturer shall provide the following data to the purchaser, if requested:

- flow coefficient Cv or Kv;
- breakaway thrust or torque for new valve and the breakaway travel or angle;
- valve run thrust or torque;

- maximum allowable stem thrust or torque on the valve and, if applicable, the maximum allowable input torque to the gearbox;
- number of turns for manually operated valves.

The rim pull force required to operate the handwheel shall not exceed 360N (81 lbf).

This applies to seating, unseating and stroking at maximum pressure differential at minimum and maximum design temperatures.

Valves with bore sizes equal to or greater than those specified in Table 12 shall have gearboxes fitted.

Add new table

Table 12 – Minimum Bore Sizes at which Gearbox is Required

Class	Valve size at which gearbox is required
150	≥ DN 300 (NPS 12)
300	≥ DN 250 (NPS 10)
600	≥ DN 150(NPS 6)
900	≥ DN 100 (NPS 4)
1500 & 2500	≥ DN 80 (NPS 3)

5.11.2

Add to section

The handwheel shall be a spoke-rim type with a maximum of six spokes and shall be free from burrs and sharp edges. Spokes shall not extend beyond the perimeter of the handwheel.

The handwheel shall be of a solid material (one-piece casting or forging or a multi-piece fabrication). Fabricated handwheels shall have strength and toughness characteristics comparable to that of handwheels made from a one-piece castings or forgings.

Hollow components shall not be allowed.

The handwheel diameter shall not exceed the end-to-end length of the valve for classes 300 and above. Handwheel dimensions for Class 150 valves shall not exceed twice the end to end dimensions or 800 mm (32 in.), whichever is the smaller.

5.11.3

Replace section with

Handwheel shall be marked with the word “OPEN” and an arrow pointing in the direction of opening.

5.11.4

Replace section with

The handwheel shall be secured by a nut or dowel pin with additional locking to provide robust double retention with the valve stem in any orientation (for example with a second nut or retention pin to prevent dowel pin from ejecting).

5.11.5

Replace the second item with

- bevel gear and the position of the gearing handwheel relative to the pipe axis;

API 603 only: add item

- for chainwheel operation, the dimension from the centerline of the valve stem or gear input shaft to the bottom of the chain loop.

5.11.6

Replace section with

Valve-to-gearbox or power actuator flange mating dimensions shall be according to ISO 5210.

The material of the gear box or actuator mounting bracket shall ensure sufficient ductility at -40 °C (-40 °F).

Gear operators, actuators and their mounting bracketry shall not be attached to any part of the valve that would result in external leakage if the attachment bolting is loosened or removed.

The output of the gearbox at maximum input torque shall not produce stresses that exceed the stress limits of the drive train permitted under 5.11.9.

Add new section

5.11.7 When chainwheels are specified:

- the design shall be of the direct mounted adjustable sprocket rim type with chain guides;
- clamp-on type chainwheels are not acceptable;
- chainwheels shall be securely attached and provided with safety cables;
- chainwheels for greater than or equal to DN 150 (NPS 6), on valves operated without gearbox shall incorporate a “hammer blow” device.

Add new section

5.11.8 If the force or dimensional limitations are exceeded on directly installed handwheel per 5.11.1 and 5.11.2, the valve shall be provided with a gearbox.

Gearboxes shall be:

- heavy-duty type manual design;
- designed with rolling element thrust bearings;
- provided with continuous seals and have EN 60529 IP 67 protection class as a minimum. The design shall be suitable for operation from -40 °C (-40 °F) up to 80 °C (176 °F);
- filled with grease or heavy-duty gear oil to ensure that all moving parts are submerged and sufficiently lubricated;

- equipped with one or more easily accessible injection fittings and weather proof vent connection, permitting easy packing in-situ and lubrication of rotating shafts penetrating the gearbox;
- supplied with external shafts manufactured from a material that resist corrosion caused by environmental conditions, rated for the maximum design torque, e.g. 13Cr material or austenitic grades of stainless steel;
- mounted with the pinion shaft perpendicular to the flow through the valve and with the plane of the handwheel parallel to the valve stem and to the pipe axis unless otherwise specified by the purchaser;
- designed to allow the handwheel to be orientated on site at any 90° increment relative to the initial position supplied (i.e. designed with four or eight mounting bolts).

The dimensions of the gearbox shall not exceed the valve end-to-end dimension for classes 300 and above. Gearboxes dimensions for Class 150 valves shall not exceed twice the end to end dimensions.

Handwheel diameters shall not exceed dimensions defined in 5.11.2.

When the number of handwheel turns on a gear operator exceeds 100 from the fully open position to the fully closed position, the manufacturer shall specify the number of handwheel turns on the quotation.

Add new section

5.11.9

The drive train and gearbox shall withstand the maximum output torque/force of the operator without permanent deformation.

The maximum output torque/force of a direct mounted handwheel or gearbox (if equipped) shall be calculated applying the MSS SP-91 and EN 12570 maximum momentary input force.

5.11.9.1

The design thrust or torque for all drive train calculations shall be at least two times the maximum required seating or breakaway thrust or torque, whichever is larger.

Allowable stresses for tensile stress, shear stress (including torsional shear stress) and bearing stress shall comply with ASME BPVC, Section VIII except that the design stress intensity value, S_m, shall be taken as 67 % of SMYS.

In addition the average primary shear stress across a section loaded under design conditions in pure shear (e.g. keys, shear rings, screw threads, etc.) shall be limited to 0.6 S_m.

The maximum primary shear under design conditions, exclusive of stress concentration at the periphery of a solid circular section in torsion, shall be limited to 0.8 S_m.

NOTE Allowable values of bearing stress can be found in the general notes section of ASME BPVC, Section II, Part D.

These stress limits do not apply to the components of rolling-element or other proprietary bearings or high bearing strength capable materials that are included in the drive train where manufacturer's recommendations or limits derived from tests and service experience apply. These limits shall be justified in design documents.

The drive train shall be designed such that the weakest component is outside the pressure boundary. A strength efficiency factor of 0.75 shall be used for fillet welds.

5.11.9.2

Deflections of the extended drive train shall not prevent the obturator from reaching the fully closed or fully open position.

For all valves, attention shall be paid to deflection and strain. Adherence to the allowable stress limits of design codes alone might not result in a functionally acceptable design. The manufacturer shall demonstrate, by calculation or test, that under loads resulting from design pressure and any defined pipe or external loads, distortion of the obturator or seat does not impair functionality or sealing.

5.12 Bypasses and Other Auxiliary Connections

Add to section

The bypass valve shall be external to the primary valve and be of a size that is specified in ASME B16.34 and MSS SP-45 and of a pressure class at least equal to that of the primary valve. The bypass shall be located on the side of the valve connecting either the A-B or the E-F locations as shown in MSS SP-45.

The bypass valve shall conform to API 602 and be of an outside-screw-yoke rising stem globe valve type, with a flanged or welded bonnet. The bypass valve stem shall have the same general orientation as the primary valve stem. Other valve types and orientations may be agreed if specified by the purchaser.

Add new section

5.13 Tack Welding

Tack welds are permitted for temporary assembly purposes only. Tack welds are not permitted as a permanent assembly joint. Tack welds do not meet the requirements for positive securing against loosening.

Add new section

5.14 Lifting

5.14.1

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

Lifting lugs shall be provided for valves over 250 kg (550 lbs.) 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 and ISO 13628-4, 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.

Add new section

5.15 Fire Testing

When specified by the purchaser, valves shall be fire type-tested certified in accordance with ISO 10497.

In the case that the fire test is not specified, the valve design shall still be able to pass the fire testing requirements in accordance with ISO 10497.

Add new section

5.16 Pressure Containing and Controlling Parts

Design of pressure-containing and controlling parts not covered by the preceding design sections shall comply with ASME BPVC, Section VIII, Div 1 or Div 2.

6 Materials

Rename section heading

6.1 General Material Requirements

Replace section with

6.1.1

Materials for body, bonnet, and valve parts other than trim items shall be selected from Table 13 and Annex D. Materials shall comply with the material datasheets (MDS) in IOGP S-563 as referenced in Table D.1. See Annex C for identification of valve terms.

The manufacturer shall list the material designation (e.g. ASTM) of all valve parts on the valve general arrangement drawing or bill of materials.

Bolting and other valve components shall not be cadmium plated. Galvanized bolting and components shall not be used in continuous service at temperature exceeding 200 °C (392 °F).

The material of the gearbox housing shall be nodular cast iron, carbon steel or equivalent to the valve body material.

API 600 only: delete Table 7

API 603 only: delete Table 4

Add new table

Table 13 – Materials for Parts

Part	Material
Body and bonnet	As per Annex D. As selected from ASME B16.34.
Gate	As per Annex D.
Yoke, separate	Separate carbon steel yokes shall only be used for service temperatures between minus 20 °C (68 °F) and 400 °C (752 °F) or same material group as the bonnet as per Annex D.
Bolting: body to bonnet	As per Annex D.
Bonnet gasket	As per Section 6 and suitable for temperature range as per Annex D. The metallic portion exposed to the service environment shall be of a material that has a corrosion resistance at least equal to that of the body material.
Bolting: gland and yoke	As per Annex D.
Seat ring	As per Annex D.
Gland flange	As per Annex D. Shall be the same material composition as the body and bonnet.
Packing Gland	As per Annex D.
Packing	As per 5.9 and suitable for temperature range as per Annex D.
packing spacer or backseat bushing	As per Annex D.
Stem nut	Austenitic ductile iron (not allowed when used in combination with austenitic stainless steel stem material), or copper alloy having a melting point above 955 °C (1750 °F).
Handwheel	Malleable iron, carbon steel, ductile iron or Grade 316 Stainless Steel.
Handwheel nut (retaining)	Steel, malleable iron, ductile iron, 13Cr Stainless steel, Grade 316 Stainless Steel, Carbon Steel or non-ferrous copper alloy.
Pipe plugs	Nominal composition shall be the same as the body material. Cast iron plugs shall not be used.
Bypass piping and valves	Nominal composition shall be the same as the body material.
Pin, double disc stem to gate	Nominal composition shall be the same as the stem material. Austenitic stainless steel shall be used on 13Cr stem.
Identification plate	316 stainless steel or nickel alloy, attached to the valve by corrosion-resistant fasteners or by welding.

6.1.2

The manufacturer shall verify that the materials selected by purchaser using Annex D are compatible with the service conditions if specified.

6.1.3

Internal pressure controlling, containing and wetted components not specified in Annex D shall have corrosion resistance equivalent to or better than the component they are coupled to, including low/high temperature compatibility.

6.1.4

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 DN 100 (NPS 4), 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 D.1.

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

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

6.1.5

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

NOTE MDS numbers for sour service are suffixed with an “S”.

The purchaser shall specify materials from Table D.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/NACE MR0175-2:2015, Section 9 or ISO 15156-3/NACE MR0175-3:2015, 7.2 as specified by purchaser.

6.1.6

Metal based gaskets and metallic reinforcement in graphite based gaskets shall be in a material with equal or better corrosion resistance than the mating surfaces on the body and bonnet and shall be as a minimum of material grade 316 stainless steel.

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 E for expanded graphite;
- ASTM D4894 or ASTM D4895 for polytetrafluoroethylene (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.

6.1.7

Valves shall be supplied with graphite materials in accordance with Annex E and Annex F.

6.2 Trim

6.2.2

Replace section with

The trim material shall be as listed in Annex D. When applicable, materials shall comply with the material datasheets (MDS) in IOGP S-563 as referenced in Table D.1.

Where multiple options for hard-facing of gate and seat ring are specified in the valve datasheets (VDSs), the following combinations are allowed:

- E/ERCoCr-A against E/ERCoCr-A;
- E/ERCoCr-E against E/ERCoCr-E;
- E/ERCoCr-A against E/ERCoCr-B;
- E/ERCoCr-B against E/ERCoCr-E.

Other combinations may be specified by the purchaser. For example, E/ERCoCr-A and E/ERCoCr-E should not be used in high temperature water service containing hydrazine or similar amine corrosion inhibitors, Hard 13Cr hardfacing should be used instead.

NOTES E/ERCoCr-A : This classification includes such trademark materials as Stellite 6™ or equivalent.
E/ERCoCr-B : This classification includes such trademark materials as Stellite 12™ or equivalent.
E/ERCoCr-E : This classification includes such trademark materials as Stellite 21™ or equivalent.

Hard 13Cr hardfacing shall comply with the requirement of EDS IH001 as modified below:

- Welding consumable: welding consumable shall be of type 410 (ER410).
- Heat treatment: preheating to minimum 150 °C (300 °F) and post weld heat treatment (PWHT) shall be required.

API 600 only: add to section

If a single trim (e.g. trim 5) is furnished, both the seating surface of the body seat ring and the seating surface of the gate shall be made of the type of material shown in Table 8.

Table 8 *(API 600)*

API 600 only: replace Table 8 Footnote d with

Manufacturer's standard hardness. Hardness differential between seating surfaces shall be 50 HB minimum. Seat ring surface shall be the harder material.

API 600 only: replace Table 8 Footnote i with

Hardness differential between the integral body seat and gate seat surfaces shall be 50 HB minimum. Integral body seat surface shall be the harder material.

Add new section

6.3 Welding

6.3.1

Welding, including repair welding, of pressure-containing and pressure-controlling parts shall be performed in accordance with procedures qualified to ASME BPVC, Section IX or ISO 15607, ISO 15609, and ISO 15614-1. For weld overlay and hardfacing, qualification shall be in accordance with ASME BPVC, Section IX or ISO 15614-7.

Welders and welding operators shall be qualified in accordance with ASME BPVC, Section IX or ISO 9606-1.

6.3.2

Qualification shall be based upon weld procedure testing. The results of all qualification tests shall be documented in a PQR.

Weld procedure qualification for ferritic-austenitic (duplex and super duplex) stainless steel shall include microstructural examination including ferrite measurement, impact testing and corrosion testing in accordance with ISO 17781.

6.3.3

Corrosion resistant weld overlay and hardfacing shall comply with the EDS in IOGP S-563, as referenced in Table D.1.

6.3.4

All butt welds (including transition pieces) shall be carried out as full penetration welds.

6.3.5

If post weld heat treatment is required this shall be performed in accordance with the applicable material specification or design code prior to final valve assembly.

7 Testing, Inspection and Examination

7.1 Inspection and Examination

7.1.1

Replace section with

The valve manufacturer shall inspect and examine each valve demonstrating compliance with the requirements of this specification in accordance with the applicable quality specification level (QSL).

The QSL defines the extent of inspection and testing to be undertaken by the manufacturer. The QSL is selected on the basis of service risk, with the QSL number increasing with the extent of inspection and testing required.

7.1.2

Replace section with

Inspection and examination shall be in accordance with API 598 with amendments as detailed in Annex H. The requirements for NDE including frequency, methods, extent and acceptance criteria shall be according to the QSL specified by the purchaser and Table H.1 and H.2.

7.2 Pressure Tests

Replace section with

Each valve shall be pressure tested as specified in API 598 with amendments as detailed in Annex H.

Add to section

Production valves shall be fugitive emission tested in accordance with Table H.3 and Annex G acceptance criteria FE Class BH.

7.3 Repairs of Defects

Replace section with

Weld repair of materials shall comply with the applicable MDS specified in IOGP S-563 as referenced in Annex D.

Weld repair of forgings, plate, seamless products and bars is not permitted.

Weld repair of castings shall be in accordance with the applicable MDS specified in IOGP S-563 as referenced in Annex D and the following:

- Weld repairs are not permitted for castings that leak during pressure testing.
- Weld repairs shall meet the requirements of 6.3.
- All major weld repairs shall be documented in accordance with the MDS and the requirements of 10.2.
- All weld repairs shall be inspected to the same standard as used to inspect the casting, in accordance with Section 7 and Annex H.
- All welding procedures and supporting welding procedure qualification records for major weld repairs shall be submitted for the purchaser's acceptance.
- Additional weld repairs are not permitted on areas that have undergone major weld repair.

API 603 only: delete section 7.4

Add new section

7.4 Repairs of Welds *(API 600)*
7.5 Repairs of Welds *(API 603)*

Repair of welds shall be performed in accordance with the applicable design code or standard listed in 6.3.

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

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

8 Marking

8.1 General

Replace section with

Valves shall be marked in accordance with the requirements of Table 14. Marking shall be designed to be clearly legible for the valve design life.

Body, end connector and bonnet/cover marking shall be performed using a low-stress die-stamp (rounded "V" or dot face type) or cast.

Each valve shall be provided with a nameplate. Nameplates shall be suitable for constant contamination from and exposures to the operating environment, including ultra-violet, grease, applicable temperatures and cleaning solvents.

More than one plate may be used when necessary.

The nameplate shall contain both metric and US customary units.

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

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

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.

The marking on the body, end connector and bonnet/cover shall be visually legible. Marking on the body closure/end connector and bonnet/cover shall be not less than 6 mm (0.25 in.). Marking shall not be obscured by painting or coating.

The mandatory safe lifting points and the SWL of each lifting point shall be visibly marked on the valve.

8.2 Marking for Unidirectional Valves

Add to section

For valves having a body cavity relief, "HP" shall be permanently marked on the high pressure side of unidirectional valve body.

Table 14 – Valve Marking

Item No.	Marking	Location
1a	Manufacturer's name	On body and/or nameplate
1b	Trademark or mark (optional)	On body and/or nameplate
2a	Pressure class (except when Item 2b applies)	On both body and nameplate
2b	Intermediate pressure rating (upon agreement)	Agreed upon rated class on body and nameplate
3	Pressure-temperature rating: − Maximum operating pressure at maximum operating temperature; and − Maximum operating pressure at minimum operating temperature.	On nameplate
4	Face-to-face/end-to-end dimensions, if not according to ASME B16.10	On nameplate
5a	Body/end connector/bonnet/cover material designation [a c] material grade	On both body/ end connector/bonnet/cover and nameplate
5b	Body/end connector/bonnet/cover melt identification (e.g. case or heat number)	On body/end connector/bonnet/cover only
6a	Body/bonnet material designation [c] material grade	On body/bonnet
6b	Body/bonnet melt identification (e.g. heat number)	On body/bonnet
7	Trim identification [b]: material grade symbols indicating material of stem and sealing faces of closure members if different from that of body	On nameplate
8	Nominal valve size	On both body and nameplate
9	Ring joint groove number	On valve flange OD
10	SMYS (units) of valve ends, where applicable	On body weld ends
11	QSL level: QSL-1, QSL-2/2G, QSL-3/3G or QSL-4	On nameplate
12	Unique serial number	On both body and nameplate
13	Date of manufacture (month and year)	On nameplate
14	API 600 or API 603 E9 (as applicable)	On nameplate
15	ASME B16.34	On nameplate
16	Product specification license number (if applicable)	On nameplate
17	Schedule on weld end valves	On weld ends or nameplate
18	Valve datasheet identification code	On nameplate

[a] When body is manufactured from more than one type of material, both body and end connector material shall be identified.

[b] MSS SP-25 gives guidance on marking

[c] Where the grade and class does not uniquely identify the material specification, the material specification, grade and class shall be marked. Example A516-70.

9 Preparation for Shipment

9.1 Coatings

9.1.1

Add to section

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

If external coating or painting operations are performed by the manufacturer or their coating or painting contractor, preventative measures shall be taken to assure that no foreign material enters the internal cavity of the valve that may impact the valve function.

9.1.2 *(API 600)*

Replace section with

Flange faces, gearbox mounting flanges, sealing surfaces, weld bevel ends, and exposed stems shall not be coated.

Corrosion protection of unpainted surfaces shall be provided using the manufacturer's documented requirements for flange faces, weld bevel ends, exposed stems, and internal surfaces of the valve. This preservation shall be guaranteed by the manufacturer for a minimum life of 12 months in an external environment.

The manufacturer shall guarantee that these corrosion preservation coatings or fluids shall not be detrimental to any non-metallic parts and shall be easily removable.

Add new section

9.1.3

External coatings for end connections shall be as per API 6D, Annex L.

9.2 Openings

9.2.1

Replace section with

Flanged and welding ends shall be blanked off to give mechanical protection to gasket surfaces and welding ends, and to prevent ingress of water and other foreign matter, during shipment and outdoor storage for at least one year. Protective covers shall be made of plastic (at least 3 mm ($^1/_8$ in.) thick) or wood that are attached to the valve ends by using bolting and nuts. For valves DN 100 (NPS 4) and larger, plastic covers shall not be used.

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

Protective covers made of wood shall be fitted with a nonporous moisture barrier between the cover and the metal flange or welding ends.

The design of the covers shall prevent the valves from being installed unless the covers have been removed.

9.4 Stem Packing

Add to section

No adjustment shall be made to stem packing and gland flange bolts after final production testing. Gland flange bolt torque values and instructions for tightening the packings shall be included in the operation and maintenance manual.

9.5 Packaging

Add to section before 9.5.1

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

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

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

- have vapor phase inhibitor sachets added at 60 g/m^3 (0.06 oz./ft.^{3}), and;
- for carbon steel valves ensure that the vapor phase inhibitor is not in contact with the paint.

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

When handling valves, extreme care shall be taken to ensure that valve stem, gearbox and auxiliary connections are not bent, pinched or otherwise damaged.

Add new section

10 Documentation

10.1 Minimum Documentation and Retention

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 (the minimum and maximum design temperature shall be shown on the valve drawings);

c) manufacturing, testing and inspection procedures;

d) welding procedures and qualification records;

e) non-destructive testing procedures and qualifications;

f) material qualification records in accordance with IOGP 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 ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103;

l) weld maps of major repairs;

m) heat treatment records, including heat treatment charts;

n) relevant fabrication drawings and sketches shall be included 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 retention period for NDE reports shall be five years;
- the retention period for radiographs shall be at least one year.

10.2 Documentation Provided with Valves

The manufacturer shall provide information in accordance with IOGP S-611L noting the following specific requirements for the certification of valves in accordance with Table I.1.

The certificates shall identify the valve type, size, class, end connection, serial numbers and provide traceability in accordance with IOGP S-611Q:2019, Annex B.

The inspection certificates for pressure-containing and pressure-controlling parts in Table I.1 shall include any additional test requirements specified in Section 6 or Section 7 and in the applicable datasheet in IOGP S-563 as referenced in Table D.1, including heat treatment condition.

Inspection documents for sour service shall include a statement confirming compliance with ISO 15156/ NACE MR0175 or ISO 17945/NACE 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 Table D.1.

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

11 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, and supplement the requirements in this specification where necessary, 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.

Replace Annex B with

Annex B
(normative)
Information to be Specified by the Purchaser

The purchaser's options specified in this specification are listed in Table B.1, which can be used to assist with preparation of the valve datasheet.

Table B.1 defines the requirements to be specified by the purchaser.

Default selection are marked with an asterisk (*).

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

Table B.1 – Information to be Specified by the Purchaser

Item	Description	S-611 options					
a)	Valve size	1/2-48”					
b)	Pressure class	150	300	600	900	1500	2500
c)	End connection	RF	RTJ	Weld End	Pup Piece	FF	
k)	Chainwheel and chain	Not Included *	Included				
o)	Material of valve shell	NTCS	LTCS	LTCS + Clad	SS 316	DSS	SDSS
z)	Export packaging	Not Included *	Included				
ac)	Quality Specification Level (QSL)	QSL-1 *	QSL-2	QSL-2G	QSL-3	QSL-3G	QSL-4
ad)	Corrosion allowance (for valves in NTCS and LTCS)	3 mm * (0.12 in.)	6 mm (0.24 in.)				
ae)	Lagging extension	Not Included *	Included				
af)	Stem protector	Not Included *	Included				
ag)	Body cavity relief	Not Included *	Included				
ah)	Min./max. design temperature						
ai)	Wall thickness and inner diameter of the mating pipe						
aj)	Bypass	Not Included *	Included				
ak)	Orientation	Horizontal flow with vertical stem upward *					
al)	Fire type-tested certified	Not Included *	Included				
am)	Design code	API 600	API 603				
an)	Service	Sweet	Sour NACE	Sea-water + Sour NACE			
ao)	Fugitive emission class according to Annex G and Annex J	AH	BH *				
ap)	End to end dimensions if not according to ASME B16.10						

API 600: replace annex with
API 603: add new annex

Annex D
(normative)
Valve Material Combinations

D.1 General

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

- normal temperature carbon steel;
- low temperature carbon steel (LTCS);
- low temperature carbon steel with cladding;
- austenitic stainless steel type 316;
- ferritic/austenitic stainless steel, type 22Cr duplex and 25Cr super duplex.

The materials shall be delivered in accordance with the MDSs in IOGP S-563 as referenced in Table D.1 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 6.1.5 and, where available, in the referenced MDS (number suffixed with an “S”) included in IOGP S-563 shall apply.

Table D.1 – Materials Selection Table

Basic Material				**NTCS**						**NTCS**					
Design Minimum / Maximum Temperature range				**[-29 °C (-20 °F) to +425 °C (+800 °F)]**						**[-29 °C (-20 °F) to +425 °C (+800 °F)]**					
Valve design or options to be specified by purchaser:				**API 600 All Classes**						**API 600 All Classes**					
- Service				Sweet						Sour NACE [a]					
- Valve trim				**API TRIM No. 5**						**API TRIM No. 16**					
- Corrosion Allowance				**3 mm (0.12 in.)**						**3 mm (0.12 in.) or 6 mm (0.24 in.)**					
				PC				**PR**		**PC**				**PR**	
Valve parts: **Grouped as follows:** **PC = Pressure-containing parts** **PR = Pressure-controlling parts**				Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer /lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge [2]	Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer/lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge [2]
Material Selection	MDS/EDS[8 a]	Notes	Mat. type	A=Acceptable alternative						A=Acceptable alternative					
A105	IC004		Body/bonnet/trim basic materials	A				A	A	A				A	A
A216 WCB	IC006			A				A	A	A				A	A
A216 WCC	IC006			A				A	A	A				A	A
A350 LF2 Class 1	IC104														
A352 LCC	IC106														
A182 F6A					A	A		A	A						
A182 FXM-19					A						A				
A479 UNS S20910 XM-19					A						A				
A479 UNS S41000					A	A		A	A						
A276 T410/A276 T420					A	A		A	A						
A217 CA 15								A	A						
A182 F316/316L	IS104				A						A	A			A
A276 316/316L	IS107				A						A	A			A
A479 316/316L	IS107				A						A	A			A
A351 CF3M/CF8M	IS106														
A182 F51	ID144				A						A				
A182 F53/F55	ID254														
A276 UNS S31803	ID147				A						A				
A276 UNS S32750 / UNS32760	ID257														
A995 Gr. 4A	ID146														
A995 Gr. 6A	ID256														
B564 UNS N06625	IN104S				A						A				
B637 UNS N07718	-	7			A						A				
B446 UNS N06625	IN107S														
B564 UNS N10276	-														
A494 CW-6MC	IN106S														
A193 B7 / A194 2H	IX110/IX120		Pressure retaining bolting materials				A								
A193 B7M / A194 2HM	IX110/IX120						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 B8MLCuNA / A194 GRADE 8MLCuNA	-														
A193 B8MLCuN-CLASS 1B / A194 GR 9CA	-														
A320 L43 / A194 7	IX100/IX109														
A320 L7 / A194 7	IX100/IX109						A								
A320 L7M / A194 7M	IX100/IX109						A						A		
A453 GR 660 Class D	IU100														
A1014 UNS N07718 API 6ACRA (120K)	IN120S														
A1082 UNS S32750, S32760	ID260														

Basic Material				**LTCS**						**LTCS CLADDED**					
Design Minimum / Maximum Temperature range				**[-46 °C (-50 °F) to +345 °C (+650 °F)]**						**[-46 °C (-50 °F) to +345 °C (+650 °F)]**					
Valve design or options to be specified by purchaser:				**API 600 All Classes**						**API 600 All Classes**					
- Service				Sour NACE [a]						Sour NACE [a]					
- Valve trim				**API TRIM No. 16**						**API TRIM No. 20A**					
- Corrosion Allowance				**3 mm (0.12 in.) or 6 mm (0.24 in.)**						**N/A**					
				PC				**PR**		**PC**				**PR**	
Valve parts: **Grouped as follows:** **PC = Pressure-containing parts** **PR = Pressure-controlling parts**				Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer/lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge [2]	Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer/lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge
Material Selection	MDS/EDS[8 a]	Notes	Mat Type	A=Acceptable alternative						A=Acceptable alternative					
A105	IC004		Body/bonnet/trim basic materials												
A216 WCB	IC006														
A216 WCC	IC006														
A350 LF2 Class 1	IC104			A				A	A	A [c]					
A352 LCC	IC106			A				A	A	A [c]					
A182 F6A															
A182 FXM-19					A										
A479 UNS S20910 XM-19					A										
A479 UNS S41000															
A276 T410/A276 T420															
A217 CA 15															
A182 F316/316L	IS104				A	A			A						
A276 316/316L	IS107				A	A			A						
A479 316/316L	IS107				A	A			A						
A351 CF3M/CF8M	IS106														
A182 F51	ID144				A						A				
A182 F53/F55	ID254										A				
A276 UNS S31803	ID147				A						A				
A276 UNS S32750 / UNS32760	ID257										A				
A995 Gr. 4A	ID146														
A995 Gr. 6A	ID256														
B564 UNS N06625	IN104S				A						A	A		A	A
B637 UNS N07718	-	7			A						A	A			
B446 UNS N06625	IN107S										A	A			
B564 UNS N10276	-											A			
A494 CW-6MC	IN106S													A	A
A193 B7 / A194 2H	IX110/IX120		Pressure retaining bolting materials												
A193 B7M / A194 2HM	IX110/IX120														
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 B8MLCuNA / A194 GRADE 8MLCuNA	-														
A193 B8MLCuN-CLASS 1B / A194 GR 9CA	-														
A320 L43 / A194 7	IX100/IX109														
A320 L7 / A194 7	IX100/IX109														
A320 L7M / A194 7M	IX100/IX109						A						A		
A453 GR 660 Class D	IU100														
A1014 UNS N07718 API 6ACRA (120K)	IN120S														
A1082 UNS S32750, S32760	ID260														

Basic Material				SS316						DSS						SDSS					
Design Minimum / Maximum Temperature range				[-46 °C (-50 °F) to +455 °C (+850 °F)]						[-46 °C (-50 °F) to +260 °C (+500 °F)]						[-46 °C (-50 °F) to +300 °C (+570 °F)]					
Valve design or options to be specified by purchaser:				API 603 CL150-600 / API 600 CL≥900						API 603 CL150-600 / API 600 CL≥900						API 603 CL150-600 / API 600 CL≥900					
- Service				Sour NACE [a]						Sour NACE [a]						Seawater / Sour NACE [a]					
- Valve trim				API TRIM No. 16						Trim Duplex Stainless Steel						Trim Super Duplex Stainless Steel					
- Corrosion Allowance				N/A						N/A						N/A					
				PC				PR		PC				PR		PC				PR	
Valve parts: Grouped as follows: PC = Pressure-containing parts PR = Pressure-controlling parts				Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer/lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge [2]	Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer/lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge [2]	Body/Bonnet/Yoke/ Gland Flange	Stem	Packing Gland, spacer/lantern ring and backseat bushing [3]	Bolting (bonnet, gland and yoke)	Body Seat Rings [1]	Wedge [2]
Material Selection	MDS/EDS [8 a]	Notes	Mat Type	A=Acceptable alternative						A=Acceptable alternative						A=Acceptable alternative					
A105	IC004		Body/bonnet/trim basic materials																		
A216 WCB	IC006																				
A216 WCC	IC006																				
A350 LF2 Class 1	IC104																				
A352 LCC	IC106																				
A182 F6A																					
A182 FXM-19					A																
A479 UNS S20910 XM-19					A																
A479 UNS S41000																					
A276 T410/A276 T420																					
A217 CA 15																					
A182 F316/316L	IS104			A	A	A		A	A												
A276 316/316L	IS107				A	A		A	A												
A479 316/316L	IS107				A	A		A	A												
A351 CF3M/CF8M	IS106			A				A	A												
A182 F51	ID144									A	A	A		A	A						
A182 F53/F55	ID254															A	A	A		A	A
A276 UNS S31803	ID147										A	A									
A276 UNS S32750 / UNS32760	ID257																A	A			
A995 Gr. 4A	ID146									A				A	A						
A995 Gr. 6A	ID256															A				A	A
B564 UNS N06625	IN104S																				
B637 UNS N07718	-	7																			
B446 UNS N06625	IN107S																				
B564 UNS N10276	-											A						A			
A494 CW-6MC	IN106S																				
A193 B7 / A194 2H	IX110/IX120		Pressure retaining bolting materials																		
A193 B7M / A194 2HM	IX110/IX120																				
A193 B8M Class 1 / A194 8M / A194 8MA	-						A														
A193 B8M Class 2 / A194 8M / A194 8MA	-																				
A193 B8M2 Class 2B / A194 8M / A194 8MA	-																				
A193 B8MLCuNA / A194 GRADE 8MLCuNA	-												A						A		
A193 B8MLCuN-CLASS 1B / A194 GR 9CA	-												A						A		
A320 L43 / A194 7	IX100/IX109																				
A320 L7 / A194 7	IX100/IX109																				
A320 L7M / A194 7M	IX100/IX109																				
A453 GR 660 Class D	IU100												A						A		
UNS N07718 API 6ACRA (120K)	IN120S												A						A		
A1082 UNS S32750, S32760	ID260												A						A		

NOTES

1) Integral body seat or body seat facing E/ERCoCr-A [b]

2) Wedge facing E/ERCoCr-A [b]

3) Backseat facing E/ERCoCr-A [b]

4) Body/bonnet gaskets are covered in Section 5.

5) Stem nuts are addressed in Table 13.

6) Stem packing is addressed in 5.9.

7) Wrought precipitation-hardened nickel base alloy to UNS N07718 shall comply with the requirements in API 6ACRA.

8) Where the material selection table references a material specification and/or grade but there is no corresponding MDS/EDS, the material may be procured to the specification without additional requirements, except when specified otherwise in Section 6.

a) For valves to be used in sour service, reference is made to Section 6. MDS numbers will be suffixed with an “S”.

b) Hard facing weld overlay in accordance with 6.2.2 and IH001.

c) Body/bonnet wetted surfaces to include full cladding in Alloy 625 in accordance with EDS IO001.

Add new annex

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

E.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 E.3. Section numbers within E.3 correspond to ASTM F2168 but are preceded by "E.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*.

E.2 Scope

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

E.3 Amendments to ASTM F2168

E.3. 3 Terminology

E.3. 3.1 Definitions

E.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.

E.3. 4 Classification

E.3. 4.1 Classification

E.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

E.3. 4.2

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

E.3. 7 Properties

E.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 %.

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

E.3. 9.3 Split Rings

Replace the first sentence with

The number of cuts shall be zero or one.

E.3. 10 Workmanship, Finish, and Appearance

Add new section

E.3. 10.2

Supplementary requirement S6.1 shall apply.

E.3. 13 Test Methods

Add new section heading

E.3. 13.7 Oxidation Test

Add new section

E.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

E.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 (1238 °F).

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 E.7.

When using the TGA:

a) Collect graphite material samples as per Table E.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, conditioned at 150 °C (302 °F) for 1 hour and then accurately weighed. After drying, the temperature shall be increased to 670 °C (1238 °F) in an inert environment (e.g. 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 E.7.

Add new section

E.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 E.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 (0.37 in.) centers and wire of 1.6 mm (0.06 in.) diameter. The sample holding mesh should be positioned about 25 mm (0.98 in.) 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)	

E.3. 14 Inspection and Testing

E.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

E.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.

E.3. 15 Rejection

Add new section

E.3. 15.2

Supplementary requirement S10 shall apply.

E.3. 16 Certification

E.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.

E.3. 18 Packaging

Add new section

E.3. 18.2

Packing shall comply with supplementary requirement S6.2.

Add new annex

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

F.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 F.3. Section numbers within F.3 correspond to ASTM F2191/F2191M but are preceded by "F.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*.

F.2 Scope

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

F.3 Amendments to ASTM F2191/F2191M

F.3. 3 Terminology

F.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.

F.3. 4 Classification

F.3. 4.1 Classification

F.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

F.3. 4.2

Only Class 2 and Grade B material shall be used.

F.3. 7 Properties

F.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.

The above requirements for carbon assay apply if PTFE lubrication is not specified. If PTFE lubrication is specified the following shall apply instead:

- Carbon Assay:
  - Graphitic purity shall be ≥95 % by mass.
  - Carbon purity shall be ≥ 95 % by mass.
  - PTFE content shall be ≤ 5 % by volume.
  - Fluorine content as per ASTM F2191.

F.3. 10 Workmanship, Finish, and Appearance

F.3. 10.2 Construction

Add to section

Supplementary requirement S6.1 shall apply.

F.3. 13 Test Methods

F.3. 13.1 Tests

Add to section

All testing shall be performed on the final product.

Add new section heading

F.3. 13.12 Oxidation Test

Add new section

F.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.

This test does not apply to packing materials containing polymeric lubricants (e.g. PTFE) or blockers.

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

F.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 F.7.

When using the TGA:

a) Collect graphite material samples as per Table F.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, conditioned at 150 °C (302 °F) for 1 hour and then accurately weighed. 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 F.7.

Add new section

F.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 F.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 (0.37 in.) centers and wire of 1.6 mm (0.06 in.) diameter. The sample holding mesh should be positioned about 25 mm (0.98 in.) 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)	

F.3. 14 Inspection and Testing

F.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

F.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.

F.3. 15 Rejection

Add new section

F.3. 15.2

Supplementary requirement S10 shall apply.

F.3. 16 Certification

F.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 G (new)
(normative)
Fugitive Emission Production Testing (Amendments to ISO 15848-2)

G.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 G.3. Section numbers within G.3 correspond to ISO 15848-2 but are preceded by "G.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*.

G.2 Scope

This annex specifies the requirements for fugitive emission production testing.

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

G.3 Amendments to ISO 15848-2

G.3. 4 Preparation of Test Valves

G.3. 4.1 Valve Selection

Replace section with

Add new section

G.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

G.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 G.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

G.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 G.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

G.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 G.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

G.3. 5 Test Conditions

G.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, 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.

G.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.

G.3. 5.3 Test Pressure

Replace section with

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

Add new section

G.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

G.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

G.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

G.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.

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

G.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.

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 G.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 G.1 – Tightness Classes for Stem Seals

Fugitive Emission Tightness Class	Measured leak rate [a, e, f] Stem 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	≤ 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·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.

e Minimum dilution-corrected allowable leakage rate shall never be lower than 3.5 x 10-7mg/s, 2.0 x 10-7 Pa·m3/s, 2.0 x 10-6 mbar·l/s or atm·cm3/s due to constraints of the sniffing technique.

f Maximum leakage rate per stem diameter is indicated in Table G.5

G.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 G.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 G.2 – Leakage from Body Seals

Fugitive Emission Tightness Class	Measured leak rate [a, e] 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	≤ 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 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 (OD) 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.

e Minimum dilution-corrected allowable leakage rate shall never be lower than 3.5 x 10^{-7}mg/s, 2.0 x 10^{-7} Pa·m^3/s, 2.0 x 10^{-6} mbar·l/s or atm·cm^3/s due to constraints of the sniffing technique.

G.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.

G.3. 8 Certification of Compliance

Replace section with

Certification requirements shall be in accordance with this specification.

G.4 Sampling Plan Example

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

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

Lot	Valve type	Fugitive emission Class	ASME Class	DN (NPS)	Quantity	Stem diameter, mm (in.)	Purchase order (X)	Samples per lot
1	Gate	BH	150	15 (0.5)	136	10 (0.39)	1055	552 x 0.02 12 valves
	Gate	BH	150	20 (0.75)	138	10 (0.39)		
	Gate	BH	300	15 (0.5)	226	10 (0.39)		
	Gate	BH	300	20 (0.75)	52	10 (0.39)		
2	Gate	BH	150	25 (1)	363	16 (0.63)		437 x 0.02 9 valves
	Gate	BH	150	40 (1.5)	14	16 (0.63)		
	Gate	BH	150	50 (2)	48	16 (0.63)		
	Gate	BH	300	25 (1)	4	16 (0.63)		
	Gate	BH	300	50 (2)	8	16 (0.63)		
3	Gate	BH	150	80 (3)	12	19 (0.75)		54 x 0.02 2 valves
	Gate	BH	150	100 (4)	21	19 (0.75)		
	Gate	BH	300	80 (3)	21	19 (0.75)		
4	Gate	BH	150	150 (6)	4	28.6 (1.13)		12 x 0.02 1 valve
	Gate	BH	150	200 (8)	6	28.6 (1.13)		
	Gate	BH	300	150 (6)	2	28.6 (1.13)		

As per the note of Table G.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 G.4.

The valves shall now be selected (as per Table G.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 G.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.

G.5 Mass Spectrometers

Mass spectrometers/helium leak detectors shall have a sensitivity of at least 1.0×10^{-10} Pa·m³/s, 1.0×10^{-9} mbar·l/s or 1.0×10^{-9} atm·cm³/s as specified in ASME V, Appendix IV, section IV-1061.2.

G.6 Leakage Rates per Stem Diameter (informative)

Table G.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 H
(normative)
Supplementary Requirements for Inspection and Testing

H.1 General

This annex specifies the requirements for inspection and examination either amended from, or in addition to, those detailed in API Standard 598:2016.

Where requirements in API standard 598 are amended, the specific sections or tables affected will be referenced. All other requirements in this annex can be assumed to be in addition to the requirements as specified in API standard 598:2016.

This annex specifies quality levels for gate valves. QSL-1 is the default quality level as specified in this supplement. QSL-2 to QSL-4 are optional and may be specified by the purchaser. The QSLs increase in stringency of requirements with the QSL number. When any of the QSLs are specified by the purchaser, all of the requirements of a specific QSL shall be adhered to.

H.2 Inspection and Examination

H.2.1

Table H.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 H.2 specifies the extent, method and acceptance criteria for the various inspection codes used in Table H.1.

H.2.2

NDE activities shall be conducted after final heat treatment or post-weld heat treatment.

H.2.3

Independent of the extent specified in Table H.1, NDE requirements for pilot casting for cast of pressure-containing and pressure-controlling parts shall be according to IOGP S-563:2018, 4.8, the applicable MDS in as referenced in Annex D.

H.2.4

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

a) 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 within the range of 25 % to 70 %.

b) Ferrite checks shall be undertaken on the OD on at least three locations equally spaced around the circumference.

c) 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.

d) For acceptance, the ferrite measurement shall be within the range 30 % to 70 % per ISO 17781 for welds in the as welded condition.

H.2.5

NDE personnel shall be qualified to ASNT SNT-TC-1A or ISO 9712:2012 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-CP-1) or ISO 9712.

H.2.6

Equipment used to inspect, test or examine product shall be identified, controlled, calibrated and adjusted at specified intervals in accordance with documented manufacturer instructions, and consistent with nationally or internationally recognized standards specified by the manufacturer to maintain the accuracy required by this specification.

Table H.1 – NDE Requirements

Part	QSL-1		QSL-2		QSL-3		QSL-4	
	Cast	Forged	Cast	Forged	Cast	Forged	Cast	Forged
Body, bonnet, yoke, gland flange [e]	VT1	VT2	VT1 and RT1[a g] and MT1[g] or PT1[g]	VT2 and MT1[g] or PT1[g]	VT1 and RT1[a] and MT1[g] or PT1[g]	VT2 and UT2 and MT1[g] or PT1[g]	VT1 and RT1[a d] and UT1 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Welding ends (including pipe pup welding ends) [b]	VT1 and RT3[g] or UT4[g]	VT2 and UT2 [g]	VT1 and RT3[g] or UT4[g] and MT1[g] or PT1[g]	VT2 and UT2[g] and MT1[g] or PT1[g]	VT1 and RT3 or UT4 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
Stem [c e]	N/A	VT2	N/A	VT2	N/A	VT2 and MT1 or PT1	N/A	VT2 and UT2 and MT1 or PT1
Bolting – pressure containing	N/A	VT4[h]	N/A	VT4[h]	N/A	VT4[h]	N/A	VT4[h] and MT1 or PT1
Gate [c]	VT1	VT2	VT1	VT2	VT1 and MT1[g] or PT1[g]	VT2 and MT1[g] or PT1[g]	VT1 and MT1 or PT1	VT2 and MT1 or PT1
Seat rings [c e]	VT1	VT2	VT1	VT2	VT1 and MT1[g] or PT1[g]	VT2 and MT1[g] or PT1[g]	VT1 and MT1 or PT1	VT2 and MT1 or PT1
Corrosion-resistant overlay	VT3 and PT1				VT3 and UT3[f] and PT1		VT3 and UT3 and PT1	
Seals gaskets	VT4							
Pressure-containing welds	VT3 and RT2 or UT3				VT3 and RT2 and MT1 or PT1 or VT3 and UT3 and MT1 or PT1			
Fillet and attachment welds to pressure-containing parts	VT3				VT3 and MT1 or PT1			
Hard facing	VT4				VT4 and PT1			
Sealing surfaces	VT4				VT4 and MT2 or PT2			
Welded on lifting lugs	VT3 and PT1 or MT1							
Integrally cast lifting lugs	RT3 or UT4							

NOTE 1 See Table H.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. All parts shall be inspected, unless a reduced inspection frequency is specified.

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 D.

a RT1 may be replaced by UT4 by agreement.

b ASME B16.34:2017, 8.3.1.1 (a) (1).

c MT or PT to be performed prior to coating, or overlay.

d RT1 plus UT1 may be replaced by RT3.

e Requirements for examination of bar material shall be as for forgings.

f Machined surfaces only.

g 5 % or minimum (QSL-1 & 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.

h 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.

Table H.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	ASME BPVC, Section V, Article 2	ASME BPVC, Section VIII, Division 1, UW-51 for linear indications. ASME BPVC, Section VIII, Division 1, Appendix 4 for rounded indications.
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	All surfaces	ASME BPVC, Section V, Article 5	ASME *BPVC*, Section VIII, Div. 1, UF-55 for angle beam and ASME B16.34 for straight beam.
UT3	UT weldments	100 % of full penetration welds	ASME BPVC, Section V, Article 4	ASME *BPVC*, Section VIII, Div. 1, Appendix 12
	UT overlay weld	100 % of overlay weld surface	ASME BPVC, Section V, Article 4 (straight beam method)	ASTM A578/A578M Level C.
UT4	UT Casting [a]	100 %	ASME BPVC, Section V, Article 5	ASTM A609/A609M, Table 2, Quality Level 1
MT1	MT Casting [a]	All accessible external and internal surfaces	ASME BPVC Sec. V, Article 7	ASME BPVC Sec. VIII, Div. 1, Appendix 7
	MT Forgings	All surfaces	ASME *BPVC*, Section V, Article 7	ASME *BPVC*, Section VIII, Div. 1, Appendix 6
	MT welds	100 % of weld surface	ASME *BPVC*, Section V, Article 7	ASME BPVC, Section VIII, Div. 1, Appendix 6
	MT bolting surface area	100 % of bolting surface	ASME *BPVC*, Section V, Article 7	ASME BPVC, Section VIII, Div. 1, Appendix 6
	MT machined surfaces incl. weld bevels	100 % of machined surface	ASME *BPVC*, Section V, Article 7	ASME BPVC, Section VIII, Div. 1, Appendix 6
MT2	MT sealing surfaces	100 % sealing surfaces	ASME BPVC, Section V, Article 7	No indications shall be permitted.
PT1	PT casting [a]	All accessible external and internal surfaces	ASME BPVC Sec. V, Article 6	ASME BPVC Sec. VIII, Div. 1, Appendix 7
	PT Forgings	All surfaces	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8
	PT welds	100 % of weld surface	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8
	PT weld overlay	Per applicable EDS	Per applicable EDS	Per applicable EDS
	PT bolting surface area	100 % of bolting surface	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8
	PT machined surfaces incl. weld bevels	100 % of machined surface	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8

Examination	NDE	Extent	Method	Acceptance
PT2	PT sealing surfaces	100 % sealing surfaces	ASME BPVC, Section V, Article 6	No indication shall be permitted.
VT1	VT castings[a]	Per applicable MDS	Per applicable MDS	Per applicable MDS
VT2	VT forgings	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 1 Where the table refers to MDS or EDS, NDE shall comply with the requirements in the applicable MDS or EDS in IOGP S-563 as referenced in Annex D. Where no MDS or EDS is referenced in Annex D, 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 D.

H.2.7

Visual examination after assembly shall as a minimum include dimensional inspection of the following:

- face to face / end to end dimensions;
- flange dimensions including bolt hole orientation and diameters and flange facings;
- gate seat position and stem projection in compliance with 5.6.5.

H.3 Pressure Testing

H.3.1

API 598:2016, Table 1 shall be replaced by Table H.3. Testing shall be carried out in accordance with the sequence of Table H.3.

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.

Table H.3 − Pressure Testing Requirements for Quality Specification Levels

Sequence	Test description	Size	ASME Class	Quality Specification Levels (R = Required, N = None)					
				QSL-1	QSL-2	QSL-2G (1)	QSL-3	QSL-3G (1)	QSL-4
1	High pressure backseat (water) (2)	All	All	R	R	R	R	R	R
2	Shell (water)	All	All	R	R	R	R	R	R
3	Functional and torque test	All	All	N	R	R	R	R	R
4	High pressure closure (water)	DN ≤ 100 (NPS ≤ 4)	Class ≤ 1500	R	R	N	R	N	R
			Class > 1500	R	R	N	R	N	R
		DN > 100 (NPS > 4)	Class ≤ 600	R	R	N	R	N	R
			Class > 600	R	R	N	R	N	R
5	High pressure gas closure test	DN ≤ 100 (NPS ≤ 4)	Class ≤ 1500	N	N	R	N	R	R
			Class > 1500	N	N	R	N	R	R
		DN > 100 (NPS > 4)	Class ≤ 600	N	N	R	N	R	R
			Class > 600	N	N	R	N	R	R
6	Low pressure closure (air or inert gas)	DN ≤ 100 (NPS ≤ 4)	Class ≤ 1500	R	R	R	R	R	R
			Class > 1500	R	R	R	R	R	R
		DN > 100 (NPS > 4)	Class ≤ 600	R	R	R	R	R	R
			Class > 600	R	R	R	R	R	R
7	High pressure gas backseat test (2)	All	All	N	N	N	N	N	R
8	High pressure gas shell test	All	All	N	N	R	N	R	R
9	Production fugitive emission testing per Annex G	All	All	Test per Annex G	Test per Annex G	Test per Annex G	Test per Annex G	Test per Annex G	Test per Annex G

NOTES

(1) QSL 2G and QSL 3G are designations used for gas service.

(2) Gland packing bolts to be retighten to the manufacturers recommended values after back seat test (refer to 5.9 and 9.4).

H.3.2

API 598:2016, Table 4 shall be replaced by Table H.4.

Table H.4 − Duration of Required Test Pressure

Valve Size		Minimum Test Duration (min) [a]				
DN	NPS	Hydrostatic Shell Test	Gas Shell	Backseat	Hydrostatic Closure	Gas Closure
≤ 100	≤ 4	2	5	2	2	5
150 to 250	6 to 10	5	15	5	5	15
300 to 450	12 to 18	15	15	5	5	15
≥ 500	≥ 20	30	30	5	10	30

[a] The test duration is the period of inspection after the valve is fully prepared and is under full pressure. Test durations start only after the test pressure has stabilized.

H.3.3

Following the backseat test, the packing bolts shall be retightened to the manufacturer recommended torque.

H.3.4

Valves with a gear operator shall be seat tested after assembly of the operating mechanism.

H.3.5

Valves shall be tested with full pressure end thrust effect to check the effectiveness of body joints and tightness as per Table H.5. Test shall be carried out with horizontal flow bore and stem horizontal to demonstrate compliance with 5.6.3/5.6.5 (API 600/API 603). For this selected valve from Table H.5, functional test in accordance with H 3.7.3 Except step a) 2. Shall be carried out over five cycles.

Where quantity 1 is noted in Table H.5, 10 % of QSL 3G valves and 100 % for QSL-4 shall be tested.

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

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.

H.3.6 Torque Measurements and Functional Testing

H.3.6.1 General

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.

Table H.5 − Valve End Thrust Effect

Size	Rating					
DN (NPS)	150	300	600	900	1500	2500
50 (2)						
80 (3)						
100 (4)						1
150 (6)					1	1
200 (8)				1	1	1
250 (10)			1	1	1	1
300 (12)			1	1	1	1
350 (14)		1	1	1	1	1
400 (16) and larger	1	1	1	1	1	1

NOTE 1 1 = 1 valve per batch, per design, per size, per rating and per material.

NOTE 2 Valve selection is made at random by the purchaser.

NOTE 3 Where the sample valve in NOTE 1 fails the test, two other valves of the same 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 batch shall be subsequently tested unless otherwise agreed.

NOTE 4 When NOTE 3 becomes effective, the manufacturer shall be responsible for extending the scope of testing and any modifications to other batches which form part of same purchase order, including those already shipped, when deemed necessary by the manufacturer or the purchaser.

H.3.6.2 Functional and Torque Testing

Manually operated valve (handwheel, gearbox and bare stem) shall be tested with their final operator fitted on.

Torque shall be measured directly on the input shaft of the gear or on the stem for bare stem or directly mounted handwheel.

Gearbox output torques shall be calculated using the gearbox mechanical advantage ratio.

Functional testing of manually operated valves shall be as follows:

a) Without pressure – one cycle:

1) The valve shall be fully operated without pressure.

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

3) Torque measurements shall be carried out at the start to open, start to close and end to close positions (breakaway to open, breakaway to close and ending 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;

NOTE When only one side of the obturator is pressurized, then the opposite side shall be at atmospheric pressure.

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

NOTE During the valve opening, when only one side of the obturator is pressurized, then the opposite side shall be opened to allow water to overflow at atmospheric pressure

5) Torque measurement shall be performed up to decompression of the pressurized volume. The highest value shall be recorded.

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

5) Torque measurement shall be performed. The highest value shall be recorded.

6) Depressurize entirely one side of the valve and verify than pressure of the opposite side remains stable. Opposite side depressurization shall be cause for rejection.

7) Repeat the aforementioned sequences with depressurization of the valve opposite side at step 6.

d) Acceptance:

1) The valve shall demonstrate smooth operability.

2) For direct mounted handwheel and gear operated valve, calculated rim pull shall not exceed value listed in 5.11.1.

3) For bare stem valves, calculated torque/thrust shall not exceed 75 % of the maximum manufacturer design value.

H.3.6.3

Test fluid shall be fresh water containing a corrosion inhibitor.

The chloride content of test water in contact with austenitic and duplex stainless steel wetted components of valves shall not exceed 30 µg/g (30 ppm by mass).The chloride content in the test water shall be tested at least annually.

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.

H.3.6.4

All valves shall be completely drained of test fluid and thoroughly dried immediately after hydrotesting.

Add new annex

Annex I
(normative)
Documentation Requirements

I.1 General

This annex specifies requirements for documentation.

This annex specifies quality levels for gate valves QSL-1 to QSL-4. QSL-1 is the quality level as specified in this supplement. QSL-2 to QSL-4 are optional and may be specified by the purchaser. The QSLs increase in stringency of requirements with the QSL number. When any of the QSLs are specified by the purchaser, all of the requirements of a specific QSL shall be adhered to.

I.2 Documentation Requirements

Table I.1 − Documentation Requirements

Required Documentation to Be Sent with the Valve(s)		Required	Inspection Document Type		Traceability Levels [b]	API 600 and API 603 Sections	IOGP Supplementary Sections [c]
			QSL-1,2,3 [a]	QSL-4			
1	General arrangement drawings	X					6.1.1; 10.1
2	Cross-sectional assembly drawings with parts list and materials list	X					6.1.1 10.1
3	Gearbox assembly	X	2.1	2.1	II		5.11
4	Name plate drawing	X				8.1; A.4.4	8.1
5	Design calculations	X				5	4.4; 5.1; 5.8; 5.11.9; 5.14;
6	Heat treatment procedures	X				5.3.1.2.1	10.1; Annex H
7	NDE procedures	X					6.1; 7.1; 7.4; 7.5; Annex H
8	Pressure test procedures	X					Annex H
9	Painting/Coating procedures	X					S-611Q
10	Installation, operation and maintenance instructions/manuals	X				5.6.3; Annex B	9.4; Annex B
11	Lifting points certification and lifting handling Instructions	X	2.1	2.1			5.14; 8.1
12	Fire type-testing certification of the design	X					5.15
13	Calibration certificates on pressure test equipment used (e.g. pressure gauges, transducers and chart recorders)	X	3.1	3.1			5.7; 10.1
14	Heat-treatment records including times and temperatures, e.g. charts	X	3.1	3.1	I		6.1.6; 10.1
15	Hardness test report on metallic pressure-controlling parts	X	3.1	3.1	I	Table 8	Table 8 Footnotes d and i; Table 13
16	Hardness test report on metallic pressure containing parts	X	3.1	3.1	I	Table 8	Table 8 Footnotes d and i; Table 13

Required Documentation to Be Sent with the Valve(s)		Required	Inspection Document Type		Traceability Levels [b]	API 600 and API 603 Sections	IOGP Supplementary Sections [c]
			QSL-1,2,3 [a]	QSL-4			
17	Hardness survey test report on pressure-containing and pressure-controlling welds in valves required to meet ISO 15156/NACE MR0175 (all parts) or ISO 17945/NACE MR0103	X	3.1	3.2	I		6.1.5
18	Metallic materials pressure-containing (identified as PC in annex D) parts	X	3.1	3.2	I		6.1.6; 7.1; 10.1
19	Metallic materials pressure-controlling (identified as PR in annex D) parts, excluding packing gland, spacer/lantern ring and backseat bushing	X	3.1	3.1	I		6.1.6; 7.1; 10.1
20	Metallic materials non-pressure-containing and non-pressure-controlling parts, including packing gland, spacer/lantern ring and backseat bushing	X	2.2	2.2	II		6.1.6; 7.1; 10.1
21	Non-metallic materials shall have a certificate of compliance in conformance based on batch testing	X	2.2	2.2	III		
22	Bonnet to body gasket certification (metal with graphite – SWG/RTJ)	X	2.2 / 3.1	2.2 / 3.1	II		5.5.4; 6.8.1
23	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		I		6.1.6; 6.3; 7.3; 7.4; 7.5; 10.1
24	NDE records (metallic parts, welds, overlay cladding, hard facings, platings)	X	3.1	3.1	I	7.1	6.1.6; 7.1.2; H.10.2
25	Final Inspection documentation (dimensional marking, and visual report)	X	3.1	3.1	I		8.11; S-611Q
26	Pressure test report (including pressure, test duration, test medium and acceptance criteria)	X	3.1	3.1			10.1; Annex H
27	Fugitive emission test report	X	2.2.	2.2			Annex G
28	Painting/Coating certification	X	2.2	2.2	III		9.1.1
29	Certificate of conformance to this specification	X	2.1	2.1			10.2
30	For sour service valves, certificate of conformance to ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103	X	2.1	2.1			6.1.5; 10.1
31	Manufacturer's valve data report	X					
32	Non-conformance reports required to demonstrate the product non-compliance and acceptance by the purchaser	X				A.5	10.1; S611Q, Section 7
33	Listing of applicable and authorized concessions, waivers and/or material substitutions	X					10.1 10.2

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

[b] Traceability Levels:

- Level I - Full Traceability - 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, not to bulks).
- 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 material datasheet in IOGP S-563 as referenced in Annex D.

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

J.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 J.3. Section numbers within J.3 correspond to sections in ISO 15848-1 but are preceded by "J.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*.

J.2 Scope

This annex specifies the requirements for fugitive emission type testing.

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

J.3 Amendments to ISO 15848-1

J.3. 5 Type Test

J.3. 5.1 Test Conditions

J.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).

J.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 D.

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

Replace second paragraph with

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·cm³/s, Pa·m³/s or mbar·l/s.

J.3. 5.2 Test Procedures

J.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 six 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·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).

J.3. 5.2.4 Test Description

J.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 J.3.5.5.

Replace Table 2 with Table J.2

Table J.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.

J.3. 6 Performance Classes

J.3. 6.3 Endurance Classes

J.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

J.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-611

J.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 ≤ D ≤ 2 Do with Do being the stem diameter of the tested valve;

Add new annex

Annex K (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 K.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 K.1 – Lagging Extension Lengths Clearance Required for Insulation

DN (NPS)	Min.	15 (½)	80 (3)	450 (18)
	Max.	50 (2)	400 (16)	1200 (48)
Lagging extension length mm (in.)		80 (3.0)	110 (4.5)	120 (5.0)

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 K.2.

Table K.2 – Insulation Collar Clearance Required for Insulation

DN (NPS)	Min.	15 (½)	80 (3)	450 (18)
	Max.	50 (2)	400 (16)	1200 (48)
Insulation Collar Clearance mm (in.) tolerance + 0 to + 25 mm (+ 0 to + 1.0 in.)		50 (2.0)	75 (3.0)	100 (4.0)

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 B16.34:2017, 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.

Bibliography

Add to section

[16] The Pressure Equipment Directive (PED) 2014/68/EU (formerly 97/23/EC)

[17] ASME B31T, *Standard Toughness Requirements for Piping*

Registered Office
City Tower
40 Basinghall Street
14th Floor
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
F +44 (0)20 3763 9701
reception@iogp.org

Brussels Office
Bd du Souverain,165
4th Floor
B-1160 Brussels
Belgium

T +32 (0)2 566 9150
F +32 (0)2 566 9159
reception@iogp.org

Houston Office
10777 Westheimer Road
Suite 1100
Houston, Texas 77042
United States

T +1 (713) 470 0315
reception@iogp.org

www.iogp.org

This specification supplements API 600 Steel Gate Valves and API 603 CRA Gate Valves, referring sequentially to the same clause numbers.