International Association of Oil & Gas Producers

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S-708

August
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Supplementary Specification to API Specification 6DSS Subsea Pipeline Valves

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.0	August 2020	Issued for Use

Acknowledgements

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

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Foreword

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

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

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

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2014).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of subsea pipeline valves in accordance with API Specification 6DSS, Specification for Subsea Pipeline Valves, Third Edition, August 2017, including Addendum 1, April 2019 for application in the petroleum and natural gas industries.

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

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

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

IOGP S-708: Supplementary Specification to API Specification 6DSS Subsea Pipeline Valves

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to API Specification 6DSS, following the API Specification 6DSS clause structure. Clauses from API Specification 6DSS not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to API Specification 6DSS defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

IOGP S-708D: Datasheet for Subsea Pipeline Valves

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

IOGP S-708Q: Quality Requirements for Subsea Pipeline Valves

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

IOGP S-708L: Information Requirements for Subsea Pipeline Valves

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

The terminology used within this specification and the supporting datasheet, QRS and IRS follows that of API Specification 6DSS and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

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

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

a) regulatory requirements;

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

c) purchaser defined requirements (datasheet, QRS, IRS);

d) this specification;

e) API Specification 6DSS.

1 Scope

Delete "plug" from first paragraph

Add to section

This specification does not define requirements for plug valves.

2 Normative References

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

API Specification 20A, *Carbon Steel, Alloy Steel, Stainless Steel, and Nickel Base Alloy Castings for Use in the Petroleum and Natural Gas Industry*

API Specification 20B, *Open Die Shaped Forgings for Use in the Petroleum and Natural Gas Industry*

API Specification Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*

ASME B16.34:2017, *Valves—Flanged, Threaded and Welding End*

ASME B18.2.2, *Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)*

ASME *BPVC*, Section V:2019, *Nondestructive Examination*

ASME *BPVC*, Section VIII, Division 1:2019, *Rules for Construction of Pressure Vessels*

ASME *BPVC*, Section VIII, Division 2:2019, *Alternative Rules - Rules for Construction of Pressure Vessels*

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

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

ASTM E186, *Standard Reference Radiographs for Heavy-Walled (1 to $4^1/_2$ in. (50.8 to 114 mm)) Steel Castings*

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

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

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM E446, *Standard Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm) in Thickness*

ASTM A479, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A484/A484M, *Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings*

ASTM A488/A488M, *Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel*

ASTM A694/A694M, *Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service*

ASTM A703/A703M, *Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts*

ASTM A788/A788M, *Standard Specification for Steel Forgings, General Requirements*

ASTM A962/A962M, *Standard Specification for Common Requirements for Bolting Intended for Use at Any Temperature from Cryogenic to the Creep Range*

ASTM B446, *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar*

ASTM B564, *Standard Specification for Nickel Alloy Forgings*

ASTM C633, *Standard Test Method for Adhesion or Cohesion Strength of Thermal Spray Coatings*

ASTM E165/E165M, *Standard practice for liquid penetrant examination for general industry*

BS EN 10228-4, *Non-destructive testing of steel forgings - Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings*

DNVGL-RP-0034, *Steel forgings for subsea applications*

DNVGL-RP-B204, *Welding of subsea production system equipment*

DNVGL-RP-F112, *Duplex stainless steel - design against hydrogen induced stress cracking*

IOGP S-562:2019, *Supplementary Requirements to API Specification 6D Ball Valves*

ISO 4063, *Welding and allied processes -Nomenclature of processes and reference numbers*

ISO 4624, *Paints and varnishes - Pull-off test for adhesion*

ISO 9001, *Quality management systems - Requirements*

ISO 11970, *Specification and qualification of welding procedures for production welding of steel castings*

ISO 17781, *Petroleum, petrochemical and natural gas industries - Test methods for quality control of microstructure of ferritic/austenitic (duplex) stainless steels - First Edition*

ISO 17782, *Petroleum, petrochemical and natural gas industries - Scheme for conformity assessment of manufacturers of special materials*

ISO 23936-1, *Petroleum, petrochemical and natural gas industries - Non-metallic materials in contact with media related to oil and gas production - Part 1: Thermoplastics*

ISO 23936-2, *Petroleum, petrochemical and natural gas industries - Non-metallic materials in contact with media related to oil and gas production - Part 2: Elastomers*

ISO 29001, *Petroleum, petrochemical and natural gas industries - Sector-specific quality management systems - Requirements for product and service supply organizations*

NORSOK M-650, *Qualification of manufacturers of special materials*

NORSOK M-710, *Qualification of non-metallic materials and manufacturers – Polymers*

ASTM A1058, *Standard Test Methods for Mechanical Testing of Steel Products-Metric*

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

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

3.1 Terms and Definitions

3.1.8
block valve

Delete "plug" from definition

3.1.32
obturator / closure member

Delete "plug" from definition

3.1.46
pressure-controlling parts

Delete "plug" from definition

3.1.69
venturi plug valve

Delete term 3.1.69

Add new term

3.1.72
nonelastomeric
metallic or thermoplastic

3.2 Acronyms, Abbreviations, Symbols and Units

AOD argon oxygen decarburization
CSL casting specification level
CVN Charpy V-notch
EDS element datasheet
EF electric furnace
ESR electro slag remelting
GMAW gas metal arc welding
MDS material datasheet
MPQR manufacturing process qualification record
MPS material process specification
QTR qualification test record/ report
VAR vacuum arc remelting
VIM vacuum induction melting
VOD vacuum oxygen decarburization

4 Valve Types and Configurations

4.1 Valve Types

4.1.1 General

Add to section

The stem shall be constructed from one piece of wrought material.

4.1.2 Gate Valves

Delete NOTE 1

Replace second paragraph with

Gate valves shall have metal-to-metal internal backseat sealing and secondary stem sealing in addition to the primary stem seal.

Add to section

Valve seals shall be in accordance with Table 8.

Add to section

The gate shall be constructed of one piece for slab-gate valves.

Add to section

The gate shall be constructed of two or more pieces for expanding-gate valves.

4.1.3 Lubricated and Nonlubricated Plug Valves

Delete section 4.1.3

4.1.4 Ball Valves

Add to section

The ball shall be constructed of a one-piece solid form ball.

4.1.5 Check Valves

Add to section

For swing check valves without an override, the shaft shall be of a retainerless design where:

— the hinge bracket is internally assembled; or

— the clapper arm is hung from the cover.

Add to section

Check valves with external shaft design shall be prohibited.

4.2 Valve Configurations

4.2.2 Reduced-opening Valves

Add to section

When specified, the valve internal bore dimension shall be in accordance with the valve datasheet.

5 Design

5.1 Design Standards and Calculations

Replace second paragraph with

Design and calculations for pressure-containing elements, including bolted joints and bolt sizing, shall be in accordance with ASME B16.34, ASME *BPVC*, Section VIII, Division 1 or ASME *BPVC*, Section VIII, Division 2, and Table S.1 based on the selected design code.

Add to section after second paragraph

The external load shall be equivalent to the bending moment calculated using $^{2}/_{3}$ of SMYS of the interfacing pipe at design pressure.

Delete first NOTE

Replace third paragraph with

The allowable stress values shall be in accordance with the specified design code.

Replace fourth paragraph with

The design pressure for the body calculation shall be in accordance with the hydrostatic test pressure in 10.3.

Delete second NOTE

Add to section

The valve design shall take account of the allowable design stresses, deformations and integrity of sealing areas.

Add to section

The external load for valves shall take account of the following:

— pressure rating to ASME B16.34 material group at ambient temperature; and

— pressure rating to ASME B16.34 material group at maximum design temperature.

Add to section

Pressure-containing bolted valve joints shall be secured by stud and nut bolting.

Add to section

Bonnet covers and gland plates may be secured by cap screws.

Add to section

Flanges shall be secured using a minimum of four bolts.

Add to section

Bolting shall have a minimum diameter of ⅜ in. (10 mm).

Add to section

Bolting preload torques shall be calculated using API 6A, ASME PCC-1 or EN 1591 with the coefficient of friction based on the bolting material, the bolting coating and the type of lubricant applied.

Add to section

The lubricant used for bolting preload torque calculations shall be identical to the one applied by the manufacturer on the thread and nut faces.

Add to section

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

Add to section

The bolt stress due to preload shall not exceed 70 % of yield at design temperature.

Add to section

Applicable test conditions and supplementary tests shall be taken into account for the design basis of the valve.

5.2 Pressure and Temperature Rating

Delete last paragraph

Add to section

The design of subsea valve components shall account for thermal transient effects between the internal and external parts of the valve, with regards to the sealing capability of:

— metallic gaskets and seals;

— pressure-containing bolting; and

— valve operability/functionality.

NOTE 2 Thermal transient effects consider the ambient and maximum design temperature of the valve.

5.7 Pigging

Add to section

Full bore valves installed in piggable lines, including the transition piece and the pup piece, shall be capable of being pigged, sphered and scraped without damage to the valve.

5.8 Valve Ends

5.8.1 Flanged Ends

5.8.1.1 General

Add to section

For castings, the valve flanged ends shall be integral with the valve body or end closure.

Add to section

For piping connections, the valve end connections shall be designed for heavy series nuts (ASME B18.2.2).

5.8.1.2 Offset of Aligned Flange Centerlines—Lateral Alignment

Replace first paragraph with

For valves of NPS 2 (DN 50), the lateral misalignment shall not exceed 0.06 in. (1.5 mm).

Replace second paragraph with

For valves larger than NPS 2 (DN 50), the lateral misalignment shall not exceed 0.08 in. (2 mm).

5.8.1.3 Parallelism of Aligned Flange Faces—Angular Alignment

Add to section

For valves larger than NPS 24 (DN 600), the parallelism misalignment shall not exceed 0.02 in./ft (1.75 mm/m).

5.8.2 Welding Ends

5.8.2.1 General

Replace section with

Welding ends shall conform to the requirements specified.

Add to section

The weld end length shall permit two full weld repairs or re-preparation of weld ends for re-welding.

5.8.2.2 Parallelism of Aligned Weld Ends—Angular Alignment

Add to section

For valves larger than NPS 24 (DN 600), the parallelism misalignment shall not exceed 0.02 in./ft (1.75 mm/m).

5.9 Valve Cavity Pressure Relief

Add to section

The cavity relief mechanism for valve designs that are not internally self-relieving shall be specified.

5.10 Drains, Vents, Body Test Ports, Seal Test Port, and Body Connections

Replace last sentence of fourth list item with

Production valves shall be designed to accommodate all multi-barrier (primary, secondary and environmental) seal options and seal test port connections (as per the valve on which design validation is performed).

Add to fourth list item

Test ports shall be drilled on production valves if specified.

Replace second paragraph with

Vents, drains, body test ports and seal test ports shall be sealed upon completion of testing by a plug with swivel type design.

Add to section after second paragraph

The primary seal of the plug shall be metal-to-metal and conical.

Add to section after second paragraph

Seal welding of the plugs shall be performed if specified.

Add to section after second paragraph

WPS for seal welding shall be qualified without PWHT.

Delete NOTE 3

Add to section

Drain and vent ports shall be at the lowest and highest possible positions of the cavity respectively.

5.11 Stem/Seat and Cavity Injection Points

Delete "except by agreement"

Add to section

Cavity injection points shall be provided if specified.

5.12 Drain, Sealant, and Vent Valves

Replace section with

Drain and vent valves shall be provided if specified.

Add to section

Sealant valves shall not be provided.

5.15 Position Indicators

Add to first paragraph

Only mechanically attached or integrally machined markings shall be applied.

Replace first sentence of second paragraph with

For direct drive ball valves, the wrench and/or position indicator shall be in line with the pipe if the valve is open and transverse if the valve is closed.

5.16 Travel Stops

Add to section

Travel stops shall be designed in accordance with Annex E.

Add to section

Ball and axial on-off valves with retrievable operators shall be provided with travel stops permanently located external to the valve pressure-containing components.

Delete NOTE

5.18 ROT System

Replace second sentence of first paragraph with

ROT size and class shall be as specified.

5.19 Lifting Points and Supports

Replace first paragraph with

If lifting points are required, the design verification of the lifting points for the valve and the valve-operator assembly shall be provided.

Replace second paragraph with

A lifting procedure with sketches and handling instructions for safe lifting operations of the valve and the valve-operator assembly shall be provided.

Delete NOTE 1

Add to section

Temporary lifting points fitted for the movement of individual items during fabrication shall be removed prior to commencement of testing.

Add to section

Permanent lifting eyes (pad-eyes) shall be designed and tested in accordance with API 17D, Annex K.

5.20 Drive Trains

5.20.1 Design Thrust or Torque

In first paragraph, replace "two times" with

2.5 times

Add to section after first paragraph

The calculations shall cover the drive train and lower trunnion.

Add to section after first paragraph

For swing check valves with an override, the design thrust or torque for drive train safety factor shall be eight times the calculated torque needed to open the valve without any differential pressure.

Add NOTE to section

NOTE For guidance on drive train calculations, refer to IOGP S-562, Annex R.

5.21 Stem Retention

Replace section with

Valve stems shall not be ejected under the following conditions:

a) any internal pressure condition; or

b) if the packing gland components (refer to 3.1.37) and/or valve operator mounting components are removed.

Add to section

The anti-blowout stem retention configuration shall be located internally to the valve ensuring that stem ejection is impossible if external non-body/bonnet fasteners are removed.

Add NOTE to section

NOTE Stem retention can be achieved by:

— an integral stem shoulder on the internal body diameter; or

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

5.22 Body and Stem Seals

Add to section

Sealing arrangements shall be in accordance with Table 8.

Add new table

Table 8—Sealing Requirements

Valve Type→ **Valve Seals↓**	**Ball**	**Gate**	**Check**
Body-bonnet	Primary - bidirectional metal-to-metal Secondary - nonmetallic [ad]	Primary - bidirectional metal-to-metal Secondary - nonmetallic [ad]	Primary - bidirectional metal-to-metal Secondary - nonmetallic [ad]
Body-closure		NA	NA
Seat-obturator	Metallic OR nonelastomeric	Metallic OR nonelastomeric	Metallic OR nonelastomeric
Seat-body	Nonelastomeric	Metallic OR nonelastomeric	Metallic OR nonelastomeric
Stem	Primary - metal-to-metal OR nonelastomeric Secondary - nonelastomeric Environmental seal - nonmetallic	Internal metal to metal backseat [c] Primary - nonelastomeric Secondary - nonelastomeric Environmental seal - nonmetallic	Primary [b] - metal to metal OR nonelastomeric Secondary [b] - nonelastomeric Environmental seal [b] - nonmetallic

[a] Elastomeric seals (o-rings) may be used if compatible with the test, process fluid and design pressure-temperature.
[b] When applicable (i.e. stem protruding from body).
[c] Not applicable for expanding gate valves and non-rising stem gate valves.
[d] Secondary body seal can fulfil dual function of secondary and environmental sealing and is optional.

Add to section

Valves shall be designed to accommodate all sealing options present in Table 8.

Add to section

Lip seals shall only be used on metallic surfaces of corrosion resistant material or with a corrosion resistant overlay.

Add to section

Lip seals shall have an anti-collapse design to prevent crushing against backpressure in the reverse direction.

Add to section

Arrangements involving two face-to-face lip seals with the open ends facing each other (in accordance with Figure 12) shall be prohibited.

Add new figure

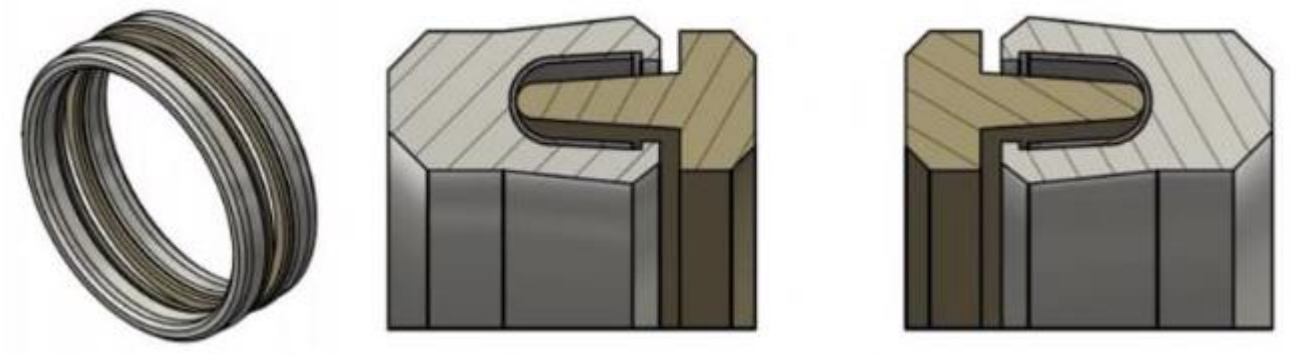


Figure 12—Lip Seals, Face-to-face Configuration

5.24 Overpressure Protection

Replace section with

Valve assemblies with an actuator or gearbox shall be fitted with a pressure relief port between the stem seal and the actuator to prevent valve-bore fluid ingress and malfunction of the actuator or gearbox device.

Add to section

The general arrangement drawing shall detail the set pressure of the relief valves.

Add to section

Relief ports shall be identified by permanent markings on the valve.

5.28 Corrosion/Erosion

Replace first paragraph with

If specified, corrosion-resistant material overlay shall be applied in accordance with element datasheets (EDSs) HF01 and HF02 in Annex R.

Delete NOTE 2

Add to section after second paragraph

The corrosion allowance shall not apply to any areas of CRA overlay and CRA material.

Delete NOTE 4

Add to section before third paragraph

The specified erosion allowance shall apply to the flow bore of the valve.

5.29 Design Validation

Replace section with

Design validation shall be in accordance with Annex F and Annex G.

Add to section

If it can be demonstrated that the existing design validations meet the requirements of this specification, revalidation shall not be required.

5.30 Hyperbaric Performance

Delete "or other means" from first paragraph

Delete NOTE 1

Delete NOTE 2

Delete NOTE 3

Delete NOTE 4

Add to section

Hyperbaric validation testing shall be carried out in accordance with Annex G.

6 Materials

6.1 Material Specification

Add to section before first paragraph

Materials for metallic pressure-containing and pressure-controlling parts shall be in accordance with the material datasheets (MDSs) in Annex R.

Add to section after second paragraph

The material for springs used in energized seals and for energized seats shall be CRA.

6.2 Tensile Test Requirements

In first paragraph, replace "separate or attached block" with

sacrificial part or integral prolongation

Replace first sentence of second paragraph with

Tensile testing shall be performed at room temperature in accordance with the procedures specified in ASTM A370, ASTM E8/E8M or ISO 6892-1.

In second paragraph, replace "yield strength" with

tensile properties

6.3 Service Compatibility

In first paragraph, replace "when specified by purchaser" with

as specified

In second paragraph, replace "Metallic materials" with

Metallic materials including bearings

Delete "at pressures of Class 600 and above" from third paragraph

Add to section after third paragraph

Elastomers and thermoplastics shall be qualified in accordance with NORSOK M710 or ISO 23936 Parts 1 and 2.

6.4 Cast Material

Replace section with

If specified that cast material is allowed, the casting shall conform to API 20A in accordance with the following casting specification levels (CSL):

— CSL-3 for pressure-containing castings; and

— CSL-2 or higher for pressure-controlling castings.

6.5 Forged Material

In first sentence, replace "3:1" with

4.0:1

Add to section

The forgings shall comply with the applicable MDSs in Annex R.

Delete NOTE 2

6.6 Composition Limits

Replace first paragraph with

The chemical composition of pressure-containing and pressure-controlling parts shall be in accordance with the applicable MDSs in Annex R.

Replace second paragraph including list items with

Carbon equivalent (CE) of carbon steel pressure-containing welding ends shall not exceed 0.43 %.

Replace fourth paragraph with

The chemical composition for other parts shall be in accordance with a recognized industry standard, provided that the required mechanical properties comply with the MDSs in Annex R.

Delete seventh paragraph including list items

Delete eighth paragraph including list items

Delete ninth paragraph including equation

Delete last paragraph

Add NOTE to section

NOTE The requirements from the deleted paragraphs are moved to the MDSs in Annex R.

6.7 Impact Test Requirements

Replace first sentence of first paragraph with

Impact testing shall be performed for all material, excluding austenitic stainless steel, used for pressure-containing and pressure-controlling parts, in accordance with the applicable MDSs in Annex R.

Delete NOTE 1

Delete third paragraph

In fourth paragraph, replace "separate or attached block" with

sacrificial part or integral prolongation

Delete fifth paragraph

In sixth paragraph, replace "Table 2 or Table 3" with

the MDSs in Annex R

Delete Table 2

Delete Table 3

In eighth paragraph, replace "Each impact specimen" with

Each retest impact specimen

Delete NOTE 2

Delete last paragraph

Add NOTE to section

NOTE The requirements from the deleted paragraphs are moved to the MDSs in Annex R.

6.8 Bolting

Replace third paragraph with

Hardness limits for bolting other than carbon and low-alloy bolting materials shall have a hardness not exceeding that specified by NACE.

6.9 Cathodic Protection

Delete NOTE

Add to section

For duplex stainless steel materials exposed to external cathodic protection, the risk of hydrogen induced stress cracking shall be minimized by meeting the requirements in DNVGL-RP-F112.

Replace section 6.12 title with

6.12 Drain, Vent and Other Connections

In first paragraph, replace "Drain" with

Drain, vent and other

Add to section

CRA-clad valves, where drain, vent and other connections breach the CRA layer, shall be fitted with a nickel-based alloy 625 insert and strength welded to ASME *BPVC*, Section VIII, Division 2 using a nickel-based alloy 625 filler.

Add NOTE to section

NOTE Full strength can be achieved with an integral shoulder or a deeper clad pocket.

Add new section

6.14 Hardfacing

Hardfacing materials shall be in accordance with those specified and with the following requirements:

— Hardfacing by welding: EDS HF01 (Table R.12).

— Hardfacing by thermal spraying: EDS HF02 (Table R.13).

7 Welding

Replace section 7 with

7.1 Welding Consumables

Replace section with

Cladding consumables shall be nickel-based alloy 625 (UNS N06625).

7.2 Welding procedure and Welder/Welding Operator Qualifications

Delete section 7.2

7.3 Impact Testing

Delete section 7.3

7.4 Hardness Testing

Delete section 7.4

7.5 Repairs

Delete section 7.5

Add new section

7.6 General

Welding (girth, clad, buttering) shall conform to the requirements of DNVGL-RP-B204 with following exceptions:

— Gas metal arc welding (GMAW) with inert gas shielding (GMAW process, ISO 4063 – 131) may be used for corrosion resistant overlay as a deviation to the permitted processes in DNVGL-RP-B204:2019, Table 4-1.

— Impact testing method in accordance with the requirements specified in 6.7.

— Impact test acceptance criteria for all weld metal and HAZ in accordance with the applicable MDS in Annex R or DNVGL-RP-B204, whichever is more stringent.

Add new section

7.7 Seal Welding

7.7.1

When seal welding is carried out with an integral shoulder, the shoulder size shall be such that:

— seal welding is performed with two passes; and

— the throat thickness is 3 mm minimum.

7.7.2

Welding on the threaded area shall not be permitted.

8 Quality Control

8.2 NDE Requirements

Replace first paragraph with

The extent, method and acceptance criteria of NDE for valve parts shall be in accordance with Annex K and Annex R.

Delete second paragraph

Delete fourth paragraph

8.3 Measuring and Test Equipment

8.3.3 Pressure-measuring Devices

Add new section

8.3.3.4 Calibration Records

Calibration records for measuring and testing equipment shall be retained for inspection.

8.6 NDE of Repairs

Add to section after second paragraph

Major weld repairs on pressure-containing cast parts shall also be examined by RT or UT.

9 Valve Assembly

Add new list items

— Prior to assembly, components shall be visually checked to ensure all parts are free from damage, sharp edges, burrs, rust and swarf, and are thoroughly clean.

— Documented procedures shall be maintained to control the quality, preservation, and assembly of pressure-containing and pressure-controlling parts, including nonmetallic.

— Nonmetallic seals shall not be re-used if the valve is disassembled.

— Lubricant with a viscosity not exceeding that of SAE 10W motor oil or equivalent shall be used on valve internals, if required for assembly.

— Lubricants shall be removed from seats and obturator sealing surfaces prior to testing.

— Lubricants and sealants shall be compatible with the commissioning fluids and service specified.

— Thread compounds shall not be used on seal-welded threaded connections.

10 Factory Acceptance Testing (FAT)

10.1 General

Add to section after first paragraph

Warning—Appropriate safety precautions must be taken for all tests.

Replace second paragraph with

Valves shall be subjected to a gas shell and seat test in accordance with 10.9 and 10.11 respectively.

Replace fourth paragraph with

Testing shall be performed in accordance with the sequence listed in Table 9.

Add to section after fourth paragraph

Alternative optimized FAT sequence programs may be proposed.

Add to section after fourth paragraph

The FAT sequence shall be documented in the FAT procedure.

Delete NOTE 1

Add to fifth paragraph after first sentence

Valves shall be tested with the end caps.

Replace tenth paragraph with

Valves shall be tested with the seating and sealing surfaces free from sealant.

Replace second sentence of fourteenth paragraph with

Once the pressure has stabilized, pressure test minimum durations shall be in accordance with Table 9.

Replace seventeenth paragraph with

A calibrated chart recorder shall be used to provide a record for all tests.

Delete NOTE 3

Add to section

Supplementary tests in Annex L shall be performed if specified or when applicable by valve design (e.g. DIB).

Add new table

Table 9—FAT Sequence

Test	Section number	Description	Medium	Minimum duration	Acceptance criteria	Additional requirements	Applicability
S1	10.15	Electrical continuity test	NA	NA	10.15		all valves
S2	L.5	Drift test	NA	NA	L.5		if specified
S3	10.3	Hydrostatic shell test	inhibited water	4 hours	no visible leakage		all valves
S4	10.2	Stem backseat test	inhibited water	≤ 4 in.: 5 minutes ≥ 6 in.: 10 minutes	no visible leakage	If a test port is not provided for the backseat, this test shall be performed before the shell test by removing or loosening the self-energized packing or seals.	gate valves
S5	10.4	Functional test	inhibited water	NA	10.4	This test includes both torque/thrust test and operational/ functional test as defined in 10.4	all valves
S6	10.5	Hydrostatic seat test	inhibited water	10.5	10.5		all valves
S7	10.6	Cavity relief test	nitrogen	NA	10.6		all valves when applicable
S8	10.9	High pressure gas shell test	nitrogen	1 hour	no visible leakage		all valves
S9	10.11	High pressure gas seat test	nitrogen	1 hour	10.11		all valves
S10	10.5.4.3, 10.5.4.4, 10.5.4.5, L.3 as applicable	Test sequence for DIB/DBB valves			L.3		if specified
S11	10.10	High pressure secondary seals testing (stem, body-bonnet, body-closure)	nitrogen	1 hour	no visible leakage		all valves (when seal test ports are present)
S12	L.4	External static test for stem environmental seal	inhibited water / nitrogen		no visible leakage		if specified
S13	10.8	Low pressure gas seat test	nitrogen	10.8	10.8		all valves

Table 9 *(continued)*

Test	Section number	Description	Medium	Minimum duration	Acceptance criteria	Additional requirements	Applicability
S14	10.13	Testing of body connections	nitrogen	20 minutes	no visible leakage	before seal welding	all valves
S15	10.14	Testing of body connections	nitrogen	20 minutes	no visible leakage	after seal welding	all valves if seal welding is performed
S2	L.5	Drift test	NA	NA	L.5		if specified
S1	10.15	Electrical continuity test	NA	NA	10.15		all valves

10.2 Stem Backseat Test

10.2.1 General

Replace third paragraph with

If a test port is not provided for this test, self-energized packing or seals shall be removed or loosened.

10.3 Hydrostatic Shell Test

10.3.1 General

Delete "If specified by the purchaser" from first paragraph

Add NOTE to section

NOTE This test is intended to verify the primary sealing elements along with the mechanical integrity of the pressure containing envelope.

10.4 Operational/Functional Test

10.4.1 General

Add to section

The torque or thrust measurements and functional testing for ball, gate and axial valves shall be performed with the following conditions:

— without pressure; and

— at the maximum differential pressure.

Add to section

The maximum differential pressure shall be equal to the pressure rating determined in accordance with 5.2 for the material at 100 °F (38 °C).

Add to section

The maximum torque or thrust measurements, and functional testing for ball or gate valves shall be performed for the following valve operations:

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

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

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

d) Open-to-closed with the bore pressurized and the cavity at atmospheric pressure, when applicable to the valve design.

e) Double block and bleed functionality (DBB), when applicable to the valve design - closed-to-open with both sides of the obturator pressurized and the cavity at atmospheric pressure.

NOTE 1 DBB functionality may also be required for DIB valves.

f) Double isolation and bleed functionality (DIB-1 or DIB-2) - bidirectional seat tested as a downstream seat, when applicable to the valve design:

1) DIB-1 (both seats bidirectional):

— Closed-to-open with pressure applied simultaneously to the valve cavity and upstream end, with the downstream side open to atmosphere. Torque or thrust measurements and functional testing performed to each bidirectional seat.

— Closed-to-open with pressure applied to the valve cavity and both ends of the valve with the ends open to atmosphere.

— Open-to-closed with pressure applied to the valve cavity with the bore of the valve open to atmosphere.

NOTE 2 Open-to-closed test is not required when a pressure balance hole is provided between the valve bore and valve cavity.

2) DIB-2 (one seat unidirectional and one seat bidirectional): closed-to-open with pressure applied simultaneously to the valve cavity and upstream end, with the downstream side open to atmosphere.

10.4.2 Manual Valves

Replace first paragraph with

Manual or ROT-operated valves, excluding check valves, shall be operated a minimum of four times for the operating conditions defined in 10.4.1.

Replace second paragraph with

The following valves shall be rejected:

— those requiring input forces exceeding the acceptance criteria defined in 10.4.1;

— those which fail to seal after operation.

Add to section

The input torque of the gearbox shall be measured for the operating conditions specified in 10.4.1.

Add to section

The output torque of the gearbox to operate the valve shall be compared and verified against the measured valve torque.

Add to section

NOTE The output torque of the gearbox is calculated using gearbox mechanical advantage ratio.

10.4.3 Actuated Valves

Replace first paragraph with

Actuated valves, excluding check valves, shall be operated a minimum of four times for the operating conditions defined in 10.4.1.

Replace second paragraph with

The following valves shall be rejected:

— those requiring input forces exceeding the acceptance criteria defined in 10.4.1;

— those which fail to seal after operation.

Add to section

The actuator minimum supply pressure or voltage to operate the valve shall be measured and verified against the measured valve torque or thrust.

Add to section

The measured values shall be recorded.

Add to section

The measured values shall not exceed the manufacturer's documented calculated values.

10.4.4 Check Valves

In first sentence of first paragraph, replace "four times" with

ten times

Add to section

The minimum and maximum measured torque or thrust results shall remain within 10 % of each other.

10.5 Hydrostatic Seat Test

10.5.1 Preparation

Add to section

The air shall be purged from the valve during filling with the test medium.

10.5.3 Acceptance Criteria

Replace first paragraph with

For soft seated valves and metal seated gate valves, the liquid leakage rate shall not exceed ISO 5208, Rate A.

Replace second paragraph with

For other metal seated valves, except check valves, the liquid leakage rate shall not exceed ISO 5208, Rate B.

Replace first sentence of fourth paragraph with

For upstream sealing valves, seat leakage shall be monitored from each seat via the valve body cavity.

Delete second sentence of fourth paragraph

Delete NOTE

10.5.4 Seat Test Procedures for Block Valves

10.5.4.1 Unidirectional

Add to second paragraph after first sentence

In this case, the downstream side of the valve shall be piped to monitor physical leakage.

10.5.4.2 Bidirectional

Add to second paragraph after first sentence

In this case, the downstream side of the valve shall be piped to monitor physical leakage.

10.5.4.3 Double Block and Bleed (DBB)

In fourth paragraph, replace "Rate C" with

Rate B

10.5.4.4 Double Isolation and Bleed DIB-1 (Both Seats Bidirectional)

Replace second paragraph with

Acceptance criteria shall be in accordance with the requirements of 10.5.3.

10.5.4.5 Double Isolation and Bleed DIB-2 (One Seat Unidirectional and One Seat Bidirectional)

Replace second paragraph with

Acceptance criteria shall in accordance with 10.5.3.

10.6 Cavity Relief Test

10.6.1 General

Add to section

Valve cavity relief pressure shall not exceed the following:

— Class 150: 100 psig (6 barg);

— Class 300: 145 psig (10 barg);

— Class 600/900: 220 psig (15 barg);

— Class 1500: 360 psig (25 barg);

— Class 2500: 435 psig (30 barg).

Add to section

Slab gate valves with downstream sealing shall be tested in accordance with 10.6.4

10.6.2 Trunnion-mounted Ball Valves with Internal-relieving Seats

10.6.2.1 Procedure 1

Replace list item e) with

e) The maximum cavity relief pressures shall be in accordance 10.6.1.

10.6.2.2 Optional Procedure 2

Replace list item g) with

g) The maximum cavity relief pressures shall be in accordance with 10.6.1.

10.6.3 Through-conduit Slab Gate Valves with Self-relieving Seats

Replace list item f) with

f) The maximum cavity relief pressures shall be in accordance with 10.6.1.

Delete NOTE 2

Add new section

10.6.4 Through Conduit Slab Gate Valves with Downstream Sealing

10.6.4.1 Procedure

The procedure for cavity-relief testing of through-conduit slab gate valves designed for blocking the flow by the downstream seating surface shall be as follows:

a) Keep the valve in the half-open position at atmospheric pressure.

b) Apply the maximum rated working pressure until it stabilizes.

c) Operate the valve in the closed position, then discharge pressure from both sides of the gate to the atmosphere.

d) Isolate both sides of the gate from atmospheric pressure.

e) Operate the valve in the half-open position and verify that pressure in the valve bore does not increase.

10.6.4.2 Acceptance Criteria

No increase of pressure shall be allowed in the valve bore.

10.6.4.3 Test Medium

The test medium shall be nitrogen.

10.6.4.4 Cavity Test Port

For through-conduit gate valves with downstream sealing, a center cavity test port shall not be allowed.

10.8 Low-pressure Gas Seat Test

10.8.1 Preparation

Replace section with

The valve shall be drained of hydrostatic test fluid and dried with shop air or nitrogen prior to the start of the low-pressure gas seat test.

10.8.3 Acceptance Criteria

Delete "and lubricated plug valves"

Replace second list item with

— Leakage rate for metal seated valves shall not exceed ISO 5208, Rate B.

Replace section 10.9 title with

10.9 High-pressure Gas Shell Test and Primary Seals Integrity Testing

10.9.1 General

Replace first paragraph with

Valves shall be subject to a gas shell test as follows.

Add to section after third paragraph

Applicable seal test ports shall be piped to a water bucket.

Add to section after third paragraph

If specified, the high-pressure gas shell test may be performed in a test cell where test ports are piped to a water bucket.

Add NOTE 2

NOTE 2 This test is intended to verify the primary sealing elements along with the mechanical integrity of the pressure containing envelope.

Replace section 10.10 title with

10.10 High-pressure Secondary Seals Integrity Testing

10.10.1 General

Replace first sentence of first paragraph with

Secondary seals (stem, body-bonnet, body-closure) if applicable, shall be high pressure gas tested at 1.1 times the design pressure using one of the following methods:

10.11 High-pressure Gas Seat Test

10.11.1 General

Replace first paragraph with

Valves shall be subject to a gas seat test.

Add to section

Block valves shall be subject to a high-pressure gas seat test in accordance with the applicable test sequence in 10.5.4.

Add to section

Bidirectional valves shall be tested in both directions.

10.11.2 Acceptance Criteria

Replace first paragraph with

Leakage for soft-seated valves and metal-seated gate valves in high-pressure gas seat testing shall not exceed ISO 5208, Rate A (no visible leakage).

Replace second paragraph with

Leakage for other metal-seated valves shall not exceed ISO 5208, Rate B.

10.12 Check Valves

Add to section

The unseating pressure of check valves shall be recorded.

Add to section

The unseating pressure of non-spring-assisted check valves shall be estimated by calculation if it is not possible to measure the pressure.

Add to section

The re-seat pressure shall be recorded.

Add to section

The re-seat pressure shall be estimated by calculation if it is not possible to measure the pressure.

10.14 Testing of Body Connections

Add to section after second paragraph

The seal test ports shall be tested before and after seal welding.

Replace section 10.15 title with

10.15 Electrical Continuity Test

Delete fourth list item from second paragraph

11 Coating/Painting

Delete "non-corrosion-resistant" from first paragraph

Delete third paragraph

12 Marking

Replace fifth paragraph with

Marking shall be legible for the valve design life.

Add to section

More than one plate may be used to include the required valve marking information.

Add to section

The nameplate shall remain visible when the valve is installed on a structure.

Add to section

For DIB-2 valves, each side of the valve that contains a single piston effect seat shall be marked accordingly.

Add to section

Each side of a valve that contains a double piston effect seat shall be marked accordingly.

Add to section

Only the manufacturer's name, in accordance with 15.1, and trademark shall be allowed on the valve or nameplate.

Table 6—Valve Marking

In Table 6, delete "if not shown in Table C.1 to Table C.5 (5.4)" from item No. 5

13 Preparation for Shipment

Delete "Plug" from fifth paragraph

Add to section

Valves shall be packed in an enclosed vapor-proof barrier material with vapor-phase corrosion inhibitor sachets, ensuring that the inhibitor is not in contact with the paint.

Add to section

Valve ends and auxiliary connections shall be protected against mechanical damage, ingress of water and ingress of other foreign matter.

Add to section

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

14 Documentation

14.2 Documentation Provided with the Valve

Add new list items

j) WPS, PQR.

k) Qualification reports (material qualification, design validation reports).

l) Weight certificate.

15 Facility Requirements

Replace Table 7 with

Table 7—Minimum Facility Requirements

Item	Process Activity	Location
1	Product design	performed on-site, off-site
1a	Product design calculation verification	performed on-site, off-site
1b [a]	Product design validation documentation	performed on-site, off-site
1c [a]	Design validation testing (Annex F and Annex G)	performed on-site, off-site and/or outsourced
2	Material procurement	performed on-site, off-site and/or outsourced
3	Receiving verification	performed on-site
4	Machining	performed on-site, off-site and/or outsourced
5	In-process inspection	performed on-site, off-site and/or outsourced
6	Welding and other processes	performed on-site, off-site and/or outsourced
7 [b]	Assembly (3.1.3)	performed on-site
8	FAT (Section 10)	performed on-site
9	Supplementary test (Annex L)	performed on-site, off-site and/or outsourced
10	Painting/coating (Section 11)	performed on-site, off-site and/or outsourced
11	Marking/tagging/nameplate (Section 12)	performed on-site
12	Preparation for shipment (Section 13)	performed on-site
13	Final inspection/release	performed on-site

[a] Collection and maintenance of documented evidence of validated designs.
[b] Except for closure welding of welded body valves.

Annex B
(informative)
Valve Configurations

Delete "plug" from first paragraph

Delete Figure B.3

Annex C
(normative)
Valve End-to-End and Face-to-Face Dimensions

Delete "plug" from NOTE

Delete Table C.2

Annex E
(normative)
Requirements for Travel Stops by Valve Type

In Annex E heading, replace "informative" with

normative

Replace first paragraph with

Travel stops shall be designed in accordance with Table E.1.

Replace Table E.1 with

Table E.1—Valve Travel Stops

Valve Type	Option/Detail	Travel Stop Requirements in Valve	Manual Gearbox		Actuator	
			Not retrievable	Retrievable	Not retrievable	Retrievable
Ball	All	Stops for open and close (for retrievable operator).	Stops in gearbox for open and close.	Stops in valve for open and close.	Stops in actuator for open and close.	Actuator controls position, not valve stops. Stops in valve for open and close.
Axial-on-off	All	Stops for open and close (for retrievable operator).	Stops in gearbox for open and close.	Stops in valve for open and close.	Stops in actuator for open and close.	Actuator controls position, not valve stops. Stops in valve for open and close.
Gate—slab/parallel through conduit	Conventional (down to close), with backseat	Stop for open. [a]	Stop for open in valve. Backseat provides open stop. Stop for close in valve or gearbox.	Stops in valve for open and close. Backseat provides open stop.	Actuator torque/thrust adjusted or selected to suit backseat in open. Stop for close in valve or actuator.	Stops in valve for open and close. Backseat provides open stop.
Gate—slab/parallel through conduit	Reverse acting (up to close), with backseat	Stop for close. [b]	Stop for close in valve. Backseat provides close stop. Stop for open in valve or gearbox.	Stops in valve for open and close. Backseat provides close stop.	Actuator torque/thrust adjusted or selected to suit backseat in closed position. Stop for open in valve or actuator.	Stops in valve for open and close. Backseat provides close stop.

Table E.1 *(continued)*

Valve Type	Option/Detail	Travel Stop Requirements in Valve	Manual Gearbox		Actuator	
			Not retrievable	Retrievable	Not retrievable	Retrievable
Gate—expanding	Conventional, single expanding with backseat	No stops required. Wedging action provides close stop. Backseat provides open stop.	Stops for open in valve. Backseat provides open stop. Gearbox stop not required.		Actuator torque/thrust adjusted or selected to suit closing load in closed and backseat in open.	
Gate—expanding	Conventional, single expanding without backseat	No stops required in closed. Wedging action provides close stop. Stop in valve required in open.	Stops for open in valve. Gearbox stop not required.		Actuator torque/thrust adjusted or selected to suit closing load in close. Stop for open in valve.	
Gate—expanding	Conventional, double or expanding without backseat	No stops required. Wedging action provides close and open stop.	Gearbox stop not required.		Actuator torque/thrust adjusted or selected to suit closing load in closed and wedging load in open.	
Gate—non-rising stem, multi-turn	Conventional (down to close)	Stops for open and close (for retrievable operator).	Stops for open and close in gearbox or valve.	Stops for open and close in valve.	Stops for open and close in actuator or valve.	Stops for open and close in valve. Actuator may have supplemental stops.
Check	With external clapper disc lift	Stop in body required for open. No stop required for close.	Gearbox stop in open and close positions to avoid overloading valve shaft. Stop in valve for open position (gearbox in disengaged position).		Actuator stop in open and close positions to avoid overloading valve shaft. Stop in valve for open position (actuator in disengaged position).	

[a] Backseat provides open stop.

[b] Backseat provides close stop.

Annex F
(normative)
Design Validation

In Annex F heading, replace "informative" with

normative

F.1 General

Replace first paragraph with

The design validation test procedures in this annex shall be applied for equipment identified in this specification.

Replace second paragraph with

The design validation procedures in this annex shall be applied to the designs of products and design changes.

Delete NOTE

F.2 Effect of Changes in Product

Add new section before F.2.1

F.2.0 General

A change in any of the parameters listed in F.2 shall require a new design validation.

For other changes or existing design validations, a new design validation shall not be required if it is demonstrated (e.g. by FEA) that the performance of the product at the intended pressure, temperature and service conditions is maintained.

A complete gap analysis with justification for the changes shall be provided to demonstrate that the performance of the product at the intended pressure, temperature and service conditions is maintained.

F.2.1 Design Changes

Replace first sentence of first paragraph with

A change in one of the following parameters shall be evaluated and documented in accordance with F.2.0.

Add new list items

— size, pressure rating, design temperatures outside of F.12;

— maximum water depth.

Delete third paragraph

F.2.2 Metallic Materials

Replace section with

A change in metallic materials shall require a new design validation unless demonstrated (e.g. by FEA), that the new material has equivalent properties as a minimum and is suitable for the application and service conditions (see F.2.0).

F.2.3 Nonmetallic Seals and Bearings

Replace first paragraph with

A change in one of the following parameters shall be evaluated and documented in accordance with F.2.0.

Replace first list item with

— type of sealing element (e.g. O-ring, lipseals, chevrons, anti-extrusion rings, back-up rings);

Add new list item

— design of the sealing element.

Delete second paragraph

F.2.4 Hardfacing

Replace first paragraph with

A change in one of the following parameters shall be evaluated and documented in accordance with F.2.0.

Replace first list item with

— hardfacing material characteristics;

Replace third list item with

— design range for contact pressure;

Replace fourth list item with

— specified coating thickness range;

Add new list items

— coating sealant;

— roughness of hardfacing sealing surfaces.

Delete second paragraph

F.3 Products for Design Validation

F.3.1 General

Add to list after first item

— bearings and thrust washers replaced;

Add to list after first item

— seat springs replaced;

Replace last list item with

— FAT performed in accordance with Section 10.

F.3.2 Testing Product

Add to section after first paragraph

Valves shall be tested with end caps or blind flanges fitted.

F.8 Gas Testing

F.8.1 General

Replace section with

Gas shell testing at room temperature shall be in accordance with 10.9.

F.8.2 Leak Detection

Replace section with

Leak detection shall be in accordance with 10.9.

F.9 Temperature Testing

F.9.1 Location of Temperature Measurement

Replace third list item of Method 1 with

— With the temperature measurement device located within 0.5 in. (13 mm) of the seat area.

F.11 Scaling

F.11.1 General

Add to section

Scaling shall only be applied if specified.

F.12 Limitations of Scaling

F.12.1 Design Validation by Pressure Rating

Replace section with

A class 600 test product shall be used to validate products of the same family having equal or lower pressure ratings.

Add to section

Other scaling by pressure shall not be acceptable.

F.12.2 Design Validation by Size

Replace first paragraph and list items with

Testing of one size of a product family shall validate one nominal size larger and one nominal size smaller than the tested size at the obturator.

Delete NOTE

Add to section

If scaling is applied, additional verification by FEA shall be required.

F.12.3 Design Validation by Temperature

Add to section

New design validations shall be performed for the temperature range -18 °C to +121 °C.

F.15 Design Validation Procedure

Delete NOTE

Add to section

Testing of bidirectional valves with same seat configuration on both sides of the valve shall be conducted in one direction only, provided that the same direction is used for all tests.

Replace Table F.1 with

Table F.1—Design Validation Testing Sequence for Valves

Section number	Description	Medium	Minimum Duration / No. of cycles	Acceptance criteria / Section number	Additional requirements	Applicability
Section A						
10.15	Electrical continuity test	NA	NA	10.15		all valves
L.5	Drift test	NA	NA	L.5		all valves [c]
F.18.1	Hydrostatic shell test	inhibited water	1 hour	no visible leakage		all valves
10.2	Stem back seat test	inhibited water	≤ 4 in.: 5 minutes ≥ 6 in.: 10 minutes	no visible leakage	If a test port is not provided for the back seat, this test shall be performed before the shell test without the self-energized packing or seals in place.	gate valves
F.18.2	Hydrostatic seat test [a]	inhibited water	1 hour	10.5		all valves
F.18.3	Stepwise seat test [a]	inhibited water	3 minutes at each cycle	10.5		all valves
F.19	Force or torque measurement test	inhibited water	4 dynamic cycles	10.4		all valves where applicable
10.6	Cavity relief test	inhibited water / nitrogen	NA	10.6		when applicable by design
10.11	High pressure gas seat test [a]	nitrogen	15 minutes	10.11		all valves
10.10	High pressure secondary seals integrity testing	nitrogen	15 minutes	no visible leakage		all valves
L.3	Test sequence for DIB valves	inhibited water or nitrogen	L.3	L.3		for DIB valves
10.8	Low pressure gas seat test [a]	nitrogen	15 minutes	10.8		all Valves
Section B						
F.29	Shell pressure-cycling test	inhibited water or nitrogen	200 cycles	F.29		

Table F.1 *(continued)*

Section number	Description	Medium	Minimum Duration / No. of cycles	Acceptance criteria / Section number	Additional requirements	Applicability
10.3/10.9	Shell Test	inhibited water or nitrogen	15 minutes	10.3/10.9	Depending on the test medium either hydrostatic or gas body test need to be performed.	
F.20	Open/close cycling dynamic pressure test at room temperature	inhibited water or nitrogen	160 dynamic cycles			
F.19	Force or torque measurement test	inhibited water or nitrogen	4 dynamic cycles			
F.18.2	Gas seat test [a]	nitrogen	1 hour	10.11.2		
F.21	Open/close cycling dynamic pressure gas test at max. temperature	nitrogen	20 dynamic cycles			
F.22	Gas body test at max. temperature	nitrogen	1 hour	F16.2c)		
F.23	Gas seat test at max. temperature [a]	nitrogen	1 hour	F.23		
F.24	Low-pressure seat test at max. temperature [a]	nitrogen	1 hour	F.24		
F.21	Open/close cycling dynamic pressure gas test at min. temperature	nitrogen	20 dynamic cycles			
F.22	Gas body test at min. temperature	nitrogen	1 hour	F16.2c)		
F.23	Gas seat test at min. temperature [a]	nitrogen	1 hour	F.23		
F.24	Low-pressure seat test at min. temperature [a]	nitrogen	1 hour	F.24		
F.25	Pressure temperature cycling	nitrogen	F.25	F.25.3		
F.8.1	Gas body test at room temperature	nitrogen	1 hour	no visible leakage		
F.26	Gas seat test at room temperature [a]	nitrogen	1 hour	F.26		
F.27	Low pressure seat test at room temperature [a]	nitrogen	section 10.8	F.27		

Table F.1 *(continued)*

Section number	Description	Medium	Minimum Duration / No. of cycles	Acceptance criteria / Section number	Additional requirements	Applicability
F.28	Final force or torque measurement test	nitrogen	4 dynamic cycles	10.4		
Section C						
G.2.2.1	Hydrostatic test	inhibited water	G.2.2.1	G.2.2.1		
G.2.2.2.2 Step 1	Hyperbaric ingress test	inhibited water	2 hours	G.2.2.2.2 Step 1		
G.2.2.2.3 Step 2	Hydrostatic shell test in hyperbaric conditions	inhibited water	15 minutes	10.3 - G.2.2.2.3 Step 2		applicable to valve only
G.2.2.2.4 Step 3	Hydrostatic seat test in hyperbaric conditions [a]	inhibited water	G.2.2.2 Step 3	10.5 - G.2.2.2.4 Step 3		applicable to valve only
F.19	Force or torque measurement test	inhibited water	4 dynamic cycles	10.4		
G.2.2.2.5 Step 4	Hyperbaric endurance test for ball valve, gate valve, axial ON-OFF valve	inhibited water	200 dynamic cycles	G.2.2.2.5 Step 4		applicable to valve and actuator in accordance with 5.30
G.2.2.2.5 Step 4	Hyperbaric endurance test for check valve	inhibited water	20 dynamic cycles	G.2.2.2.5 Step 4		applicable to valve and actuator in accordance with 5.30 N/A for check valve without external operator
F.19	Force or torque measurement test	inhibited water	4 dynamic cycles	10.4		
Section D						
F.18.1	Hydrostatic shell test	inhibited water	1 hour	no visible leakage		all valves

Table F.1 *(continued)*

Section number	Description	Medium	Minimum Duration / No. of cycles	Acceptance criteria / Section number	Additional requirements	Applicability
10.2	Stem back seat test	inhibited water	≤ 4 in.: 5 minutes ≥ 6 in.: 10 minutes	no visible leakage	If a test port is not provided for the back seat, this test shall be performed before the shell test without the self-energized packing or seals in place.	gate valves
F.18.2	Hydrostatic seat test [a]	inhibited water	1 hour	10.5		all valves
F.18.3	Stepwise seat test [a]	inhibited water	3 minutes at each cycle	10.5		all valves
F.19	Force or torque measurement test	inhibited water	4 dynamic cycles	10.4		
10.6	Cavity relief test	inhibited water / nitrogen	NA	10.6		all valves
10.11	High pressure gas seat test [a]	nitrogen	15 minutes	10.11		all valves
10.10	High pressure secondary seals integrity testing	nitrogen	15 minutes	no visible leakage		all valves
L.3	Test sequence for DIB valves	inhibited water / nitrogen	L.3	L.3		for DIB valves
10.8	Low pressure gas seat test [a]	nitrogen	15 minutes	10.8		all valves
L.5	Drift test	NA	NA	L.5		all valves [c]
10.15	Electrical continuity test	NA	NA	10.15		all valves
Section E						
F.17	Valve disassembly and visual inspection			F.17		all valves

[a] Bi-directional seats shall be leak tested in both directions.

[b] When only the hyperbaric validation test is applicable, the test sequence shall be Section A,C,D and E.

[c] Drift test shall be performed on all valves as this is design validation (except if the design doesn't allow).

F.16 Acceptance Criteria

F.16.2 Pressure Integrity

Replace second sentence of list item b) with

Leakage rate measured at atmospheric pressure during specified pressure-hold periods shall be in accordance with Table F.1.

Delete Table F.2

Replace section F.17 title with

F.17 Pre- and Post-test Examination

Replace first paragraph with

The tested prototype shall be disassembled and inspected.

Add to section after first paragraph

All critical parts shall be photographed before and after the design validation test.

Add to section after first paragraph

The design validation test procedure shall include traceability ID, critical dimensions, geometrical tolerances and surface finishes for critical components.

Add to section after first paragraph

Critical dimensions, geometrical tolerances and surface finishes for critical components shall be compared pre- and post-test to ensure they are within the design tolerances.

Add to section after first paragraph

The same NDE method used for the finished machined components during production shall be used for the post-test examination.

F.18 Static Pressure Testing at Room Temperature

F.18.1 Hydrostatic Body Pressure Test

Delete first sentence

Add new section

F.18.3 Stepwise Seat Test

A stepwise seat test shall be performed as follows:

— minimum 6 pressure increments from zero to maximum design pressure;

— minimum 3 minute hold period at each step;

— acceptance criteria in accordance with 10.5.

F.19 Force or Torque Measurement

Delete NOTE

Replace fourth paragraph with

The operating forces or torques measurement shall be in accordance with 10.4.

F.20 Dynamic Test at Room Temperature

F.20.1 Speed of Operation

Replace first sentence with

The valve shall be operated at the design speed during design validation.

Replace section F.20.2 title with

F.20.2 Procedure for On-Off Valves (Gate, Ball and Axial-flow)

Add new list item f)

f) Repeat until a minimum of 160 pressure cycles has been carried out.

F.23 Gas Seat Test at Maximum/Minimum Rated Temperature

Add to end of first sentence

or the cavity as applicable

Add to section

In case of bidirectional seats, the pressure shall be applied such that the seats are tested in both directions.

Add to section

Acceptance criteria: the pressure change observed on the pressure-measuring device shall be less than 5 % of the test pressure.

F.24 Low-pressure Seat Test at Maximum/Minimum Rated Temperature

Replace third paragraph with

Acceptance criteria: the pressure change observed on the pressure-measuring device shall be less than 5 % of the test pressure.

F.25 Pressure and Temperature Cycles

F.25.3 Test Procedure

Add to section

Acceptance criteria: the pressure change observed on the pressure-measuring device shall be less than 5 % of the test pressure.

F.26 High-pressure Gas Seat Test at Room Temperature

F.26.2 Acceptance Criteria

Replace section with

The acceptable leakage rate for high-pressure gas seat testing shall be in accordance with 10.11.2.

F.27 Low-pressure Gas Seat Test at Room Temperature

F.27.2 Acceptance Criteria

Replace section with

The acceptable leakage rate for low-pressure gas seat testing shall be in accordance with 10.8.3.

F.28 Final Force or Torque Measurement

Replace third paragraph with

The operating forces or torques measurement shall be in accordance with 10.4.

Add new section

F.29 Shell Pressure-cycling Test

NOTE Pressure-cycling testing is intended to evaluate long-term sealing characteristics of the valve being tested.

Valves shall be subjected to repetitive pressure-cycling tests (hydrostatic or gas as applicable).

Valves shall be alternately pressurized to the full rated working pressure and then fully depressurized for a minimum of 200 pressurization-depressurization cycles.

Pressure shell testing shall be performed in accordance with 10.3 or 10.9 as applicable, before and after the pressure-cycling testing.

Annex G
(normative)
Hyperbaric Validation Testing

In Annex G heading, replace "informative" with

normative

G.1 General

Delete "which shall be applied if specified by the manufacturer or purchaser" from first paragraph

Replace second paragraph with

The valve and actuator assembly shall be validation tested in a hyperbaric chamber as single unit.

Delete NOTE

Replace fourth paragraph with

If localized testing or testing using fixtures is required due to size limitations of testing valves or actuators in a hyperbaric chamber, the design validation procedure shall include the details of the test set-up and execution.

G.2 Minimum Design Validation Test Requirements

G.2.1 General

Delete NOTE

In second paragraph, replace "qualification" with

hyperbaric validation

In fourth paragraph, replace "Table G.1" with

Table F.1

Delete Table G.1

G.2.2 Hyperbaric Validation Tests

G.2.2.2 Hyperbaric Testing

G.2.2.2.1 General

Add to section

See Table F.1.

G.2.2.2.3 Step 2—Hydrostatic Shell Test in Hyperbaric Conditions

Replace "Table G.1" with "Table F.1"

G.2.2.2.4 Step 3—Hydrostatic Seat Test

Replace "Table G.1" with "Table F.1"

G.2.2.2.5 Step 4—Hyperbaric Endurance Test

Replace "Table G.1" with "Table F.1"

G.2.2.2.6 Step 5—Hydrostatic Shell at Ambient Condition

Replace section with

Hydrostatic shell testing shall be conducted after hyperbaric testing in accordance with Table F.1.

G.2.2.2.7 Step 6—Hydrostatic Seat Test at Ambient Condition

Replace section with

Hydrostatic seat testing shall be conducted in accordance with Table F.1.

G.2.2.2.8 Step 7—Valve Disassembly and Visual Inspection

Replace section with

Valve disassembly and visual inspection shall be in accordance with F.17.

G.3 Scaling

Add to first paragraph

Scaling shall only be applied if specified.

Replace second paragraph with

Testing of one size of a product family shall validate one nominal size larger and one nominal size smaller than the tested size at the obturator.

Annex I
(informative)
Pressure-containing Castings and Forgings

Delete Annex I

Annex K
(normative)
Requirements for Nondestructive Examination

K.1 General

Replace section with

The NDE requirements for valve components shall be in accordance with quality level 2 (QL-2).

K.2 Specification of QLs

Delete "QL-1 and" from first sentence

K.3 RT of Castings

Replace second paragraph with

Acceptance criteria shall be in accordance with the applicable design code as follows:

— ASME B16.34, Appendix I;

— ASME *BPVC*, Section VIII, Division 1:

  — UW-51 for linear indications;

  — Appendix 4 for rounded indications.

— ASME *BPVC*, Section VIII, Division 2, Part 3.

K.4 RT on Weldments

Replace section with

Examination and acceptance criteria shall be in accordance with DNVGL-RP-B204.

K.5 RT of Welding Ends After Machining of Castings

Add to section

The acceptance criteria shall be in accordance with:

— Up to 50 mm: ASME *BPVC*, Section VIII, Division 2, Table 3.9 and ASTM E446.

— 50 mm to 305 mm: ASME *BPVC*, Section VIII, Division 2, Table 3.10 and ASTM E186.

Replace Table K.1 with

Table K.1—NDE Requirements

Part	QL-2		
	Cast	Forged	Plate
Body or closures and end connections or bonnet or cover or gland housing	VT1 and RT3 and UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Welding ends	VT1 and RT4 or UT5 and MT1 or PT1	VT2 and UT5 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Stem or shaft [a b]	N/A	VT2 and UT2 and MT1 or PT1	N/A
Trunnion [b] or trunnion/ bearing plates	VT1 and UT1 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Bolting (pressure-containing)	N/A	VT2 and UT2 and MT1 or PT1	N/A
Ball or gate [a]	VT1 and RT3 and UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Plug or clapper disc [a b]	VT1 and RT3 and UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Clapper disc arm	VT1 and RT3 and UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Seat rings [b]	VT1 and RT3 and UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Corrosion-resistant overlay	VT3 and UT3 and PT1		
Seal gaskets	VT4		
Seat springs	VT4		
Pressure-containing welds	VT3 and RT2 and UT3 and MT1 or PT1		
Reinforcement and stiffening welds	VT3		

Table K.1 *(continued)*

Part	QL-2		
	Cast	Forged	Plate
Fillet and attachment welds to pressure-containing parts	VT3 and MT1 or PT1		
Pipe pup to valve welds or pipe pups	VT3 and RT2 and UT3 and MT1 or PT1		
Plating	VT4		
Hardfacing	VT4 and PT1 and VT5		
Sealing surfaces	VT2 and MT2 or PT2		
NOTE 1 See Table K.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 product form or forms to be performed.			
[a] MT or PT to be performed prior to coating or overlay. [b] Requirements for examination of bar material shall be as for forgings.			

K.6 Ultrasonic Testing (UT) of Castings

Add to section after second paragraph

UT shall be performed with a normal beam probe (with 0.06 in. (1.6 mm) flat bottom hole) in addition to the volumetric NDE for the critical sections of the casting.

Add to section after second paragraph

A UT scan plan shall be prepared prior to the examination.

K.7 UT of Forgings and Plate

Replace first paragraph with

Plate examination shall be carried out in accordance with ASME *BPVC*, Section V, Article 5.

Replace second paragraph with

UT examination and acceptance criteria for carbon steel and low alloy steel forgings shall be in accordance with DNVGL-RP-0034.

Add to section after second paragraph

UT examination and acceptance criteria for forgings in austenitic stainless steel, austenitic-ferritic stainless steel and nickel alloy shall be in accordance with BS EN 10228-4, quality class 3.

Add to section after second paragraph

A UT scan plan shall be prepared prior to the examination.

Table K.2—Extent, Method, and Acceptance Criteria of NDE/Item Examination Code

In Table K.2, replace item RT1 with

Examination	NDE	Extent	Method	Acceptance
RT1	RT casting	Critical sections per ASME *BPVC*, Section VIII, Division 2, Part 3	K.3	K.3

In Table K.2, replace item UT1 with

Examination	NDE	Extent	Method	Acceptance
UT1	UT casting	Remaining areas of critical section not covered by RT1	K.6	K.6

In Table K.2, replace item PT1 with

Examination	NDE	Extent	Method	Acceptance
PT1	PT all products	Remaining areas of critical section not covered by RT1	K.15, K.16	K.15, K.16

K.8 UT of Full Penetration Welds

Replace section with

Examination and acceptance criteria shall be in accordance with DNVGL-RP-B204.

K.9 UT of Weld Overlay

Replace section with

Examination and acceptance criteria shall be in accordance with DNVGL-RP-B204.

K.11 UT of Welding Ends of Forgings

Replace section with

Examination and acceptance criteria of welding ends of forgings shall be in accordance with K.7.

K.12 MT of Castings on 100 % of Surface Area

Add to section after first paragraph

Machined surfaces shall be examined using wet fluorescent particles.

Add to section after first paragraph

When MT after final machining is not possible on the internal diameters of hollow/machined castings, UT shall be performed at the rough machining stage in accordance with K.6.

Replace second paragraph with

Acceptance criteria shall be in accordance with the applicable design code as follows:

— ASME *BPVC*, Section VIII, Division 1, Appendix 7;

— ASME *BPVC*, Section VIII, Division 2, Part 3;

— ASME B16.34, Appendix II.

Add to section

An MT scan plan shall be prepared prior to the examination.

K.13 MT of Forgings, Weldments, and Bolting

Replace first paragraph with

MT examination and acceptance criteria of forgings shall be in accordance with DNVGL-RP-0034.

Add to section after first paragraph

Machined surfaces shall be examined using wet fluorescent particles.

Add to section after first paragraph

When MT after final machining is not possible on the internal diameters of hollow/machined forgings, UT shall be performed at the rough machining stage in accordance with K.7.

Replace second paragraph with

MT examination and acceptance criteria of weldments shall be in accordance with DNVGL-RP-B204.

Add to section

MT examination and acceptance criteria of bolting shall be in accordance with API 20E.

K.14 MT on Sealing (Including Seating) Surfaces

Replace section with

MT examination and acceptance criteria of sealing surfaces prior to overlay welding shall be in accordance with DNVGL-RP-0034.

K.15 PT of Castings

Add to section after first paragraph

When PT after final machining is not possible on IDs of hollow/machined castings, UT shall be performed at the rough machining stage in accordance with K.6.

Add to section after first paragraph

For hardfaced surfaces, penetrant testing shall include substrate areas 0.5 in. (12.5 mm) beyond the coating.

Replace second paragraph with

Acceptance criteria shall be in accordance with the applicable design code as follows:

— ASME *BPVC* Section VIII, Division 1, Appendix 7;

— ASME *BPVC,* Section VIII, Division 2, Part 3;

— ASME B16.34, Appendix III.

Add to section

MT acceptance criteria shall be applied if PT on ferrous materials is required.

K.16 PT of Forgings, Weldments, Weld Overlay, Bolting, and Seal Welds

Replace first paragraph with

Forgings examination shall be carried out in accordance with ASME *BPVC,* Section V, Article 6.

Replace second paragraph with

For stainless steel or higher grade material, the acceptance criteria shall be in accordance with ASME *BPVC*, Section VIII, Division 1, Appendix 8, with the following modification: no relevant rounded indication with a major dimension equal to or greater than $^{1}/_{8}$ in. (3 mm).

Add to section

Acceptance criteria for carbon and low alloy steel forgings shall be in accordance with DNVGL-RP-0034:2015, 3.5.3.5.

Add to section

PT for carbon steel and low-alloy steel forgings shall be carried out only when it is not possible to access the surface to be magnetized for MT.

Add to section

If PT after final machining is not possible on IDs of hollow/machined forgings, UT shall be performed at the rough machining stage in accordance with K.7.

Add to section

PT examination and acceptance criteria of weldments, weld overlay and seal welds shall be in accordance with DNVGL-RP-B204.

Add to section

PT examination and acceptance criteria of bolting shall be in accordance with API 20F.

Add to section

PT on threaded bolts shall be performed using water washable penetrant material.

Add to section

For hardfaced surfaces, penetrant testing shall include substrate areas 0.5 in. (12.5 mm) beyond the coating.

K.17 PT of Sealing (Including Seating) Surfaces

Replace second paragraph with

Acceptance criteria shall be no relevant indications permitted on sealing or seating surfaces.

Delete third paragraph

Replace section K.19 title with

K.19 VT of Forgings, Plate and Bolting

Replace first paragraph with

Forgings and plate in the final condition shall be visually examined on all accessible surfaces.

Add to section after first paragraph

The light intensity at the examination surface shall be a minimum of 1000 lx.

Replace second paragraph with

Forgings and plate shall be free from cracks, seams, laps, folds, pipe, segregation, underfills, scale and other imperfections.

Add to section

VT examination and acceptance criteria of bolting shall be in accordance with API 20E and API 20F, as applicable.

K.20 VT of Weldments

Replace section with

VT examination and acceptance criteria of weldments shall be in accordance with DNVGL-RP-B204.

K.22 Visual Examination (VT) of Sealing Surfaces

Replace first paragraph with

Examination shall be carried out in accordance with ASME *BPVC*, Section V, Article 9 or ISO 17637.

Replace second paragraph with

No surface indications shall be permitted on or within 0.125 in. (3 mm) of sealing surfaces.

Annex L
(informative)
Supplementary Test Requirements

L.2 Bending Test

Add to first paragraph

If specified, a bending test shall be performed.

L.3 Test Sequence for Valves Required for DIB Operations

L.3.2 Test Medium

Replace section with

Test fluid shall be fresh water for hydrostatic testing and nitrogen for gas testing in accordance with Section 10.

L.3.3 Acceptance

Replace second paragraph with

Leakage for all metal-seated valves shall not exceed ISO 5208, Rate B.

Add new section

L.4 External Hydrostatic Pressure Test of Environmental Stem Seals

The valve shall be equipped with a temporary stem cap fixed on the top of the valve to enclose the driving stem and simulate an external pressure as follows.

a) The hydrostatic test pressure shall be not less than 1.1 times the rated water depth, with pressure applied in the pressure cap and the valve vented to atmosphere.

b) Hold periods shall start once the pressure has stabilized and the valve, with the pressure measuring device, has been isolated from the pressure source.

c) The valve stem seals shall be monitored for leakage for a minimum of three minutes, while ensuring that the pressure remains stabilized for the duration.

d) Pressure shall be reduced to the ambient condition.

e) Steps a) through d) shall be repeated for a secondary hold period of 15 minutes as a minimum.

Stem seals shall show no visible leakage.

Add new section

L.5 Drift Test

A drift mandrel shall be passed through the bore of the valve at the start and at the end of the FAT.

Table L.1 provides guidance on drift mandrel diameters.

Drift mandrel length should be derived from face-to-face dimensions in accordance with Annex C.

Add new table

Table L.1—Drift Mandrel Diameters

NPS	Class 150 - 600		Class 900		Class 1500		Class 2500		FACTOR (Drift/Bore)
	Minimum Bore Dimension	Minimum Drift Diameter	Minimum Bore Dimension	Minimum Drift Diameter	Minimum Bore Dimension	Minimum Drift Diameter	Minimum Bore Dimension	Minimum Drift Diameter	
0.50	13	12.77	13	12.77	13	12.77	13	12.77	98.26 %
0.75	19	18.67	19	18.67	19	18.67	19	18.67	
1.00	25	24.57	25	24.57	25	24.57	25	24.57	
1.25	32	31.44	32	31.44	32	31.44	32	31.44	
1.50	38	37.34	38	37.34	38	37.34	38	37.34	
2.00	49	48.49	49	48.49	49	48.49	42	41.56	98.96 %
2.50	62	61.35	62	61.35	62	61.35	52	51.46	
3.00	74	73.23	74	73.23	74	73.23	62	61.35	
4.00	100	99.50	100	99.50	100	99.50	87	86.57	99.50 %
6.00	150	149.25	150	149.25	144	143.28	131	130.35	
8.00	201	200.69	201	200.69	192	191.70	179	178.72	99.84 %
10.00	252	251.61	252	251.61	239	238.63	223	222.65	
12.00	303	302.53	303	302.53	287	286.55	265	264.59	
14.00	334	333.48	322	321.50	315	314.51	292	291.55	
16.00	385	384.40	373	372.42	360	359.44	333	332.48	
18.00	436	435.32	423	422.34	406	405.37	374	373.42	
20.00	487	486.24	471	470.27	454	453.29	419	418.35	
22.00	538	537.16	522	521.19	500	499.22	-	-	
24.00	589	588.08	570	569.11	546	545.15	-	-	
26.00	633	632.02	617	616.04	594	593.08	-	-	
28.00	684	682.94	665	663.97	641	640.00	-	-	
30.00	735	733.86	712	710.89	686	684.93	-	-	
32.00	779	777.79	760	758.82	730	728.86	-	-	
34.00	830	828.71	808	806.74	775	773.79	-	-	
36.00	874	872.64	855	853.67	819	817.73	-	-	
38.00	925	923.56	904	902.59	-	-	-	-	
40.00	976	974.48	956	954.51	-	-	-	-	
42.00	1020	1018.41	1006	1004.43	-	-	-	-	
48.00	1166	1164.19	1149	1147.21	-	-	-	-	
54.00	1312	1309.96	-	-	-	-	-	-	
56.00	1360	1357.88	-	-	-	-	-	-	
60.00	1458	1455.73	-	-	-	-	-	-	

Add new section

L.6 Additional Life-cycle/Endurance Testing – Design Validation

NOTE 1 Life-cycle/endurance testing is intended to evaluate long-term wear characteristics (e.g. obturator parts, stem seals) and performance of the valve being tested.

Valves shall be subjected to extended life-cycle/endurance testing (hydrostatic or gas) to simulate valve operation for long-term field service.

Valves shall be subjected to operational cycles for a minimum of 200 open-and-close cycles.

NOTE 2 The additional life-cycle/endurance testing may be performed during hyperbaric testing.

Life-cycle/endurance testing shall be performed at the maximum differential pressure (equal to the pressure rating determined in accordance with 5.2 for the material at 100 °F (38 °C)).

Operational/functional and seat testing shall be performed in accordance with 10.4, 10.5, 10.8 and 10.11 as applicable, before and after the life-cycle/endurance testing.

Add new section

L.7 Slam Shut Testing of Check Valves - Design Validation

A slam shut event at maximum pipeline pressure downstream and atmospheric pressure upstream shall be demonstrated by testing or by analytical means.

The acceptable leakage rate shall be in accordance with Section 10 after three slam shut closure cycles.

Slam shut testing shall be conducted on an identical prototype of each valve design.

Analytical verification shall use tools demonstrating comparable results between analysis and test from previously designed and slam-tested valves.

Annex Q
(informative)
Purchasing Guidelines

Q.3 Additional Testing

Delete section Q.3

Q.4 Valve Datasheet

Replace section with

IOGP S-708D (valve datasheet) contains the information necessary for the description and design of subsea pipeline valves.

Delete Table Q.1

Annex R
(normative)
Material Datasheets

Add new annex

Table R.1—Material Datasheet No. 22CrB

Material Datasheet	**MDS No. 22CrB [a]**			**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 22Cr Duplex				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A276	UNS S31803		
	ASTM A276	UNS S32205		
	ASTM A479	UNS S31803		
	ASTM A479	UNS S32205		
	ASTM A182	F51 (UNS S31803)		
	ASTM A182	F60 (UNS S32205)		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 or NPS 4 and under manufactured from bars. Valve parts having holes / bores may be machined from bar provided the axis of the bore is in the same direction as axis of the bar. Product covered by this MDS is limited to a maximum thickness of 300 mm or 12 in.			
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.			
Metal Making	The melt shall be refined by argon oxygen decarburization (AOD) or equivalent method.			
Manufacturing	Bars shall be manufactured to the following requirements: – bar forgings as defined in ASTM A788 and certified to ASTM A182; or – hot or cold finished cylindrical shaped bar manufactured to ASTM A276 or A479 with maximum diameter of 300 mm or 12 in. Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination). Cold drawing or cold forming is not permitted.			
Chemical Composition	UNS S31803: N = 0.14 % - 0.20 % PREN ≥ 34.0 (where PREN = Cr% + 3.3 * (Mo% + 0.5*W%) + 16* N%) A product chemical analysis shall be taken per melt of material.			
Heat Treatment	Bars shall be solution annealed followed by water/liquid quenching. Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including quenching.			
Tensile Testing	Tensile test shall be carried out at minimum T/4 from external surface. Where tensile testing in both directions is required by this MDS, all tensile tests shall meet the specified properties of the referenced standard specification in both directions. The centerline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370-19e1, Annex A1.			

Table R.1 *(continued)*

Material Datasheet	**MDS No. 22CrB [a]**	**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 22Cr Duplex		
Impact Testing/ Toughness testing	Except as modified in the MDS, sampling and acceptance criteria shall comply with ISO 17781 QL II. Where impact testing in the tangential direction is required by this MDS, the acceptance criteria shall be 45 J (33 ft lbf) average, 35 J (26 ft lbf) minimum single.	
Corrosion Testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar.	
Micrographic Examination	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar and sample an area of 10 mm or 0.4 in. by 10 mm or 0.4 in. minimum.	
Extent of Testing	Tensile, impact tests and corrosion tests, and micrographic examination including ferrite measurements shall be carried out for each lot as defined in ASTM A484.	
Test Sampling	The mid-length of axial (longitudinal) and tangential (transverse) specimens shall be located at a distance of minimum 100 mm from the end of the bar. *Valve parts manufactured from bar* For bars with outside diameter ≥ 100 mm or 4 in. intended for machining of valve parts, in addition to tensile testing and impact testing in the longitudinal direction, one tensile test specimen and one set of three impact test specimens shall be taken in the tangential direction. Tangential specimen shall be located at the same location as longitudinal sample. Acceptance criteria shall comply with this MDS.	
Non-Destructive Testing	*Visual Inspection* VT shall be carried out on each bar in accordance with the Annex K. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. *Ultrasonic inspection* Required on all bars and as per EN 10228-4. Use Annex K for acceptance criteria. *Dye Penetrant inspection* All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K.	
Repair of Defects	Weld repair shall not be permitted	
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified, the material shall conform to the requirements of ISO 15156/NACE MR0175 and the following additional requirements to the MDS. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 28 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.	
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.	
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.	

Table R.1 *(continued)*

Material Datasheet	**MDS No. 22CrB** [a]	**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 22Cr Duplex		
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be prepared in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Material process specification (MPS) identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer of starting material and steelmaking practice. – Solution annealing temperature, holding time and quenching medium shall be stated. – Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly. – All NDE carried out stating which standards material complies with.	

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.2—Material Datasheet No. 22CrF

Material Datasheet	**MDS No. 22CrF [a]**			**Rev. 00**
TYPE OF MATERIAL: Austenitic Stainless Steel Type 22Cr Duplex				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F51 (UNS S31803)		
	ASTM A182	F60 (UNS S32205)		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. Product covered by this MDS is limited to a maximum thickness of 300 mm or 12 in. Material process specification (MPS) and MPQ shall be prepared prior to production.			
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.			
Metal Making	The melt shall be refined by argon oxygen decarburization (AOD) or equivalent method.			
Manufacturing	Forgings shall have minimum reduction ratio / forging ratio of 4:1. Reduction ratio shall be calculated as defined in API 20B.			
Chemical Composition	UNS S31803: N = 0.14 % - 0.20 % PREN ≥ 34 (where PREN = Cr% + 3.3 * (Mo% + 0.5*W%) + 16* N%) A product chemical analysis shall be taken per melt of material.			
Heat Treatment	Forgings shall be solution annealed followed by water/liquid quenching. Forgings shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including quenching.			
Tensile Testing	Tensile testing shall be carried out in both longitudinal and transverse directions and sampling locations shall be as per API 6A.			
Impact Testing/ Toughness testing	Sampling and acceptance criteria shall comply with ISO 17781 QL II.			
Corrosion Testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the forging.			
Extent of Testing	Tensile, impact tests and corrosion tests, and micrographic examination including ferrite measurements shall be carried out for each heat – heat treatment lot as defined below: The testing shall be carried out on the forging with heaviest wall thickness within the heat treatment load. A test lot shall not exceed: – 2 000 kg (4 400 lb) for forgings with as forged weight up to 50 kg (110 lb); and – 5 000 kg (11 000 lb) for forgings with as forged weight > 50 kg (110 lb).			
Micrographic Examination	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the forging and sample an area of 10 mm or 0.4 in. by 10 mm or 0.4 in. minimum.			
Test Sampling	Test sampling shall be carried out on prolongation or a sacrificial as per ISO 17781. Prolongation shall be integral part of the main forging until last heat treatment is carried out. Tensile test samples shall be taken at same location and in transverse direction, when size permits, as Charpy V-notch (CVN) test samples.			

Table R.2 *(continued)*

Material Datasheet	**MDS No. 22CrF** [a]	**Rev. 00**
TYPE OF MATERIAL: Austenitic Stainless Steel Type 22Cr Duplex		
Non-Destructive Testing	*Visual Inspection* VT shall be carried out on each bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. *Ultrasonic inspection* Required on all forgings and as per EN 10228-4. Use Annex K for acceptance criteria. Scan plan shall be included in pre-production documents. *Dye Penetrant inspection* All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K.	
Repair of Defects	Weld repair shall not be permitted.	
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 and the following additional requirements to the MDS. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two forgings per lot. The maximum hardness shall be 28 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.	
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.	
Marking	The forgings shall be marked to ensure full traceability to heat and heat treatment lot.	
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – MPS identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer of starting material and steelmaking practice. – Solution annealing temperature, holding time and quenching medium shall be stated. – Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly. – All NDE carried out stating which standards material complies with.	

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.3—Material Datasheet No. 25CrB

Material Datasheet	**MDS No. 25CrB [a]**			**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 25Cr Duplex				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A276	UNS S32750		
	ASTM A276	UNS S32760		
	ASTM A479	UNS S32750		
	ASTM A479	UNS S32760		
	ASTM A182	F53 (UNS S32750)		
	ASTM A182	F55 (UNS S32760)		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 or NPS 4 and under manufactured from bars. Valve parts having holes / bores may be machined from bar provided the axis of the bore is in the same direction as axis of the bar. Product covered by this MDS is limited to a maximum thickness of 200 mm or 8 in.			
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.			
Metal Making	The melt shall be refined by argon oxygen decarburization (AOD) or equivalent method.			
Manufacturing	Bars shall be manufactured to the following requirements: – bar forgings as defined in ASTM A788 and certified to ASTM A182; or – hot or cold finished cylindrical shaped bar manufactured to ASTM A276 or A479 with maximum diameter of 200 mm or 8 in. NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination). Cold drawing or cold forming is not permitted.			
Chemical Composition	PREN ≥ 40.0 (where PREN = Cr% + 3.3 * (Mo% + 0.5*W%) + 16* N%) A product chemical analysis shall be taken per melt of material.			
Heat Treatment	Bars shall be solution annealed followed by water/liquid quenching. Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including quenching.			
Tensile Testing	Tensile test shall be carried out at minimum T/4 from external surface. Where tensile testing in both directions is required by this MDS, all tensile tests shall meet the specified properties of the referenced standard specification in both directions. The centerline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370-19e1, Annex A1.			
Impact Testing/ Toughness testing	Except as modified in the MDS, sampling and acceptance criteria shall comply with ISO 17781 QL II. Where impact testing in the tangential direction is required by this MDS, the acceptance criteria shall be 45 J (33 ft lbf) average, 35 J (26 ft lbf) minimum single.			
Corrosion Testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar.			

Table R.3 *(continued)*

Material Datasheet	**MDS No. 25CrB [a]**	**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 25Cr Duplex		
Micrographic Examination	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar and sample an area of 10 mm or 0.4 in. by 10 mm or 0.4 in. minimum.	
Extent of Testing	Tensile, impact tests and corrosion tests, and micrographic examination including ferrite measurements shall be carried out for each lot as defined in ASTM A484.	
Test Sampling	The mid-length of axial (longitudinal) and tangential (transverse) specimens shall be located at a distance of minimum 100 mm from the end of the bar. Valve parts manufactured from bar: For bars with outside diameter ≥ 100 mm or 4 in. intended for machining of valve parts, in addition to tensile testing and impact testing in the longitudinal direction, one tensile test specimen and one set of three impact test specimens shall be taken in the tangential direction. Tangential specimen shall be located at the same location as Longitudinal sample. Acceptance criteria shall comply with this MDS.	
Non-Destructive Testing	*Visual Inspection* VT shall be carried out on each bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. *Ultrasonic inspection* Required on all bars and as per EN 10228-4. Use Annex K for acceptance criteria. *Dye Penetrant inspection* All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K.	
Repair of Defects	Weld repair shall not be permitted.	
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 and the following additional requirements to the MDS. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 32 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.	
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.	
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.	
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification.	

Table R.3 *(continued)*

Material Datasheet	**MDS No. 25CrB [a]**	**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 25Cr Duplex		
Certification *(continued)*	The inspection documents shall include the following information: – Material process specification (MPS) identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer of starting material and steelmaking practice. – Solution annealing temperature, holding time and quenching medium shall be stated. – Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly. – All NDE carried out stating which standards material complies with.	

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.4—Material Datasheet No. 25CrF

Material Datasheet	**MDS No. 25CrF [a]**			**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 25Cr Duplex				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F53 (UNS S32750)		
	ASTM A182	F55 (UNS S32760)		
	ASTM A182	F61 (UNS S32550)		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. Product covered by this MDS is limited to a maximum thickness of 200 mm or 8 in. Material process specification (MPS) and MPQ shall be prepared prior to production.			
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.			
Metal Making	The melt shall be refined by argon oxygen decarburization (AOD) or equivalent method.			
Manufacturing	Forgings shall have minimum reduction ratio / forging ratio of 4:1. Reduction ratio shall be calculated as defined in API 20B.			
Chemical Composition	PREN ≥ 40.0 (where PREN = Cr% + 3.3 * (Mo% + 0.5*W%) + 16* N%) A product chemical analysis shall be taken per melt of material.			
Heat Treatment	Forgings shall be solution annealed followed by water/liquid quenching. Forgings shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including quenching.			
Tensile Testing	Tensile testing shall be carried out in both longitudinal and transverse directions and sampling locations shall be as per API 6A.			
Impact Testing/ Toughness testing	Sampling and acceptance criteria shall comply with ISO 17781 QL II.			
Corrosion Testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the forging.			
Micrographic Examination	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the forging and sample an area of 10 mm or 0.4 in. by 10 mm or 0.4 in. minimum.			
Extent of Testing	Tensile, impact tests and corrosion tests, and micrographic examination including ferrite measurements shall be carried out for each heat – heat treatment lot as defined below: The testing shall be carried out on the forging with heaviest wall thickness within the heat treatment load. A test lot shall not exceed: – 2 000 kg (4 400 lb) for forgings with as forged weight up to 50 kg (110 lb); and – 5 000 kg (11 000 lb) for forgings with as forged weight > 50 kg (110 lb).			
Test Sampling	Test sampling shall be carried out on prolongation or a sacrificial as per ISO 17781. Prolongation shall be integral part of the main forging until last heat treatment is carried out. Tensile test samples shall be taken at same location and in transverse direction, when size permits, as Charpy V-notch (CVN) test samples.			

Table R.4 *(continued)*

Material Datasheet	**MDS No. 25CrF** [a]	**Rev. 00**
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 25Cr Duplex		
Non-Destructive Testing	*Visual Inspection* VT shall be carried out on each bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. *Ultrasonic inspection* Required on all forgings and as per EN 10228-4. Use Annex K for acceptance criteria. Scan plan shall be included in pre-production documents. *Dye Penetrant inspection* All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K	
Repair of Defects	Weld repair shall not be permitted.	
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 and the following additional requirements to the MDS. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two forgings per lot. The maximum hardness shall be 32 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.	
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.	
Marking	The forgings shall be marked to ensure full traceability to heat and heat treatment lot.	
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – MPS identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer of starting material and steelmaking practice. – Solution annealing temperature, holding time and quenching medium shall be stated. – Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly. – All NDE carried out stating which standards material complies with.	

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.5—Material Datasheet No. F60

Material Datasheet	**MDS No. F60** [a]			**Rev. 00**
TYPE OF MATERIAL: Carbon Steel				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A694	F60		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification and DNVGL-RP-0034.			
Metal Making	No additional requirement			
Manufacturing	Manufacturing and qualification of forgings shall be in accordance with DNVGL-RP-0034 SFC2.			
Chemical Composition	CE < 0.430 %. All trace elements shall be reported.			
Heat Treatment	Forgings shall be delivered in quenched and tempered condition. A normalizing treatment may be used prior to quality heat treatment. If re-heat treatment is required, it shall be justified, prior to carrying out the activity.			
Tensile Testing	No additional requirement.			
Impact Testing/ Toughness testing	Test temperature shall be equal or lower than minimum design temperature of a valve but not more than -18°C.			
Micrographic Examination	No additional requirement.			
Extent of Testing	No additional requirement.			
Non-Destructive Testing	No additional requirement.			
Repair of Defects	Weld repair shall not be permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	No additional requirement.			
Marking	No additional requirement.			
Certification	The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification.			

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.6—Material Datasheet No. F65

Material Datasheet	**MDS No. F65** [a]			**Rev. 00**
TYPE OF MATERIAL: Carbon Steel				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A694	F65		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification and DNVGL-RP-0034.			
Metal Making	No additional requirement.			
Manufacturing	Manufacturing and qualification of forgings shall be in accordance with DNVGL-RP-0034 SFC2.			
Chemical Composition	CE < 0.430 %. All trace elements shall be reported.			
Heat Treatment	Forgings shall be delivered in quenched and tempered condition. A normalizing treatment may be used prior to quality heat treatment. If re-heat treatment is required, it shall be justified, prior to carrying out the activity.			
Tensile Testing	No additional requirement.			
Impact Testing/ Toughness testing	Test temperature shall be equal or lower than minimum design temperature of a valve but not more than -18 °C.			
Micrographic Examination	No additional requirement.			
Extent of Testing	No additional requirement.			
Non-Destructive Testing	No additional requirement.			
Repair of Defects	Weld repair shall not be permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	No additional requirement.			
Marking	No additional requirement.			
Certification	The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification.			

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.7—Material Datasheet No. F22 Mod.

Material Datasheet	**MDS No. F22 Mod. [a]**			**Rev. 00**
TYPE OF MATERIAL: Low Alloy Steel				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F22 Mod.		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification and DNVGL-RP-0034.			
Metal Making	No additional requirement.			
Manufacturing	Manufacturing and qualification of forgings shall be in accordance with DNVGL-RP-0034 SFC2. A simulated PWHT shall be carried out at temperature 20°C lower than the specified tempering temperature with holding time equal to two or greater times PWHT cycle.			
Chemical Composition	All trace elements shall be reported.			
Heat Treatment	Forgings shall be delivered in quenched and tempered condition. A normalizing treatment may be used prior to quality heat treatment. If re-heat treatment is required, it shall be justified, prior to carrying out the activity.			
Tensile Testing	SMYS ≥ 65 ksi			
Impact Testing/ Toughness testing	Test temperature shall be equal or lower than minimum design temperature of a valve but not more than -46 °C.			
Micrographic Examination	No additional requirement than DNVGL-RP-0034.			
Extent of Testing	No additional requirement than DNVGL-RP-0034.			
Non-Destructive Testing	No additional requirement than DNVGL-RP-0034.			
Repair of Defects	Weld repair shall not be permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	No additional requirement.			
Marking	No additional requirement.			
Certification	The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification.			

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.8—Material Datasheet No. 625F

Material Datasheet	**MDS No.625F [a]**			**Rev. 00**
TYPE OF MATERIAL: Nickel alloy type 625				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM B564	UNS N06625		ASTM B564 S5.3
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal Marking	Basic electric furnace (EF) melt shall be refined by argon oxygen decarburization (AOD) or vacuum oxygen decarburization (VOD) followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.			
Heat Treatment	Forgings or forged bars shall be supplied in annealed condition. Forgings shall be placed in such a way as to ensure free circulation of heating and cooling media around each component during the heat treatment process including any rapid cooling/quenching.			
Extent of Testing	A lot shall consist of all forgings of the same type, size, and wall thickness, manufactured from one heat of material and which are heat treated in same batch. A test sampling plan shall be prepared as part of the manufacturing procedure specification.			
Non-Destructive Testing	All NDE shall be carried out in accordance with Annex K			
Repair of Defects	Weld repair shall not be permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.			
Surface Treatment and Finish	Finished components shall be pickled. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.			
Marking	The component shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Heat treatment condition (annealing temperature shall be stated).			

[a] The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.9—Material Datasheet No. 625B

Material Datasheet	**MDS No. 625B** [a]			**Rev. 00**
TYPE OF MATERIAL: Annealed nickel alloy				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM B446	UNS N06625 Grade 1		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal Making	Basic electric furnace (EF) melt shall be refined by argon oxygen decarburization (AOD) or vacuum oxygen decarburization (VOD) followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.			
Heat Treatment	Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including any rapid cooling/quenching.			
Non-Destructive Testing	All NDE shall be carried out in accordance with Annex K.			
Repair of Defects	Weld repair shall not be permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	The material shall conform to the requirements of ISO 15156/NACE MR0175 and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.			
Surface Treatment and Finish	Finished bars shall be white pickled. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Heat treatment condition (annealing temperature shall be stated).			

[a] The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.10—Material Datasheet No. 718F

Material Datasheet	**MDS No. 718 [a]**			**Rev. 00**
TYPE OF MATERIAL: Nickel alloys				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forging / Forged bar / rolled bar	API STD 6ACRA	UNS N07718	120K	ASTM A962 S56
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat Treatment	Solution annealing and ageing heat treatment shall be carried out after the final hot forming operation. Quenching media is restricted to the qualified manufacturing route.			
Impact Testing/ Toughness testing	The impact testing requirements of API 6A CRA shall apply.			
Hardness	Maximum hardness 40 HRC.			
Macro Etch/ Micrographic Examination	Forging or bar shall be examined in accordance with API 6A CRA and meet the required acceptance criteria.			
Extent of Testing				
Non-Destructive Testing	All NDE shall be carried out in accordance with Annex K.			
Repair of Defects	Weld repair shall not be permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	The material shall conform to the requirements of ISO 15156/NACE MR0175 and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3:2015, 7.2 and this MDS.			
Surface Treatment and Finish	White pickled. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.			
Marking	Each forging / bar shall be marked to ensure full traceability to melt and heat treatment lot.			
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474 or EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Material process specification (MPS) identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer, melting and refining practice. – Heat treatment condition. Solution annealing temperature, quenching medium, ageing temperature and holding time shall be stated. – Legible photo micrographs stating phases detected, topographical duplex grains, intermetallic phases or precipitates, etc.			

[a] The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.11—Material Datasheet No. LCC

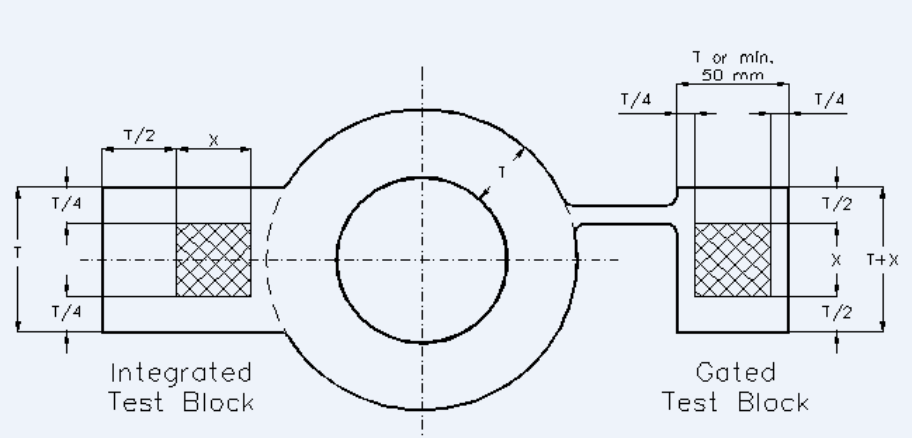
Material Datasheet	**MDS No. LCC [a]**			**Rev. 00**
TYPE OF MATERIAL: Impact tested carbon steel				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S53 ASTM A703 S8, S14, S20
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Pressure-containing castings shall conform to API 20A casting specification level-3 (CSL-3 and pressure controlling castings shall conform to API 20A casting specification level-2 (CSL-2) or greater			
Chemical Composition	Supplementary requirement S23 applies with the following restrictions: C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 % Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.			
Heat Treatment	During the heat treatment process, castings shall be placed in such a way as to ensure free circulation around each casting including possible quenching operation. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F).			
Impact Testing/ Toughness testing	ASTM A703 Supplementary requirement S8 shall apply. Impact testing shall be performed at temperature of -46 °C (-50 °F). Acceptance criteria shall be 28 J (21 ft lbf) average, 21 J (16 ft lbf) single.			
Extent of Testing	No additional requirement than API 20A.			
Test Sampling	Test blocks shall be integrally cast or gated onto the casting and shall accompany the castings through all heat treatment operations including any post weld stress relieving. Thickness of the test block shall be equal to the thickest part of the casting represented up to a maximum thickness of 100 mm (4 in). For flanged components, the largest flange thickness is the ruling section. Dimensions of test blocks and location of test specimens within the test blocks are shown in the figure below for integral and gated test block. The test specimens shall be taken within the cross hatched area. Distance from end of test specimen to end of test block shall minimum be T/4. 			
Non-Destructive Testing	All NDE shall be carried out in accordance with Annex K.			

Table R.11 *(continued)*

Material Datasheet	MDS No. LCC [a]	Rev. 00
TYPE OF MATERIAL: Impact tested carbon steel		
Repair of Defects	Production casting weld repair limitations as per table 8 of API 20A shall apply. ASTM A703 supplementary requirement S20 shall apply with the following additional requirements: – Repairs as described in ASTM A352:2018, 9.3 and 9.4 shall be considered major repairs and shall be documented in accordance with ASTM A703 S20.2. – The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this datasheet using a cast plate. – Weld repairs are not acceptable for castings that leak during pressure testing. – Examination of major repair welds on pressure containing parts shall also include RT.	
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified, the material shall conform to the requirements of ISO 15156/NACE MR0175, and the following additional requirements to the MDS. *Hardness testing* – Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 22 HRC from three readings taken in close proximity. – Welding procedure qualification testing for all repair welding shall meet the requirements of NACE MR0175-2/ISO 15156-2:2015, 7.3.3, using Vickers method, with a maximum hardness of 250HV. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2:2015, Section 9 and this MDS.	
Marking	The castings shall be marked to ensure full traceability to melt and heat treatment lot.	
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474/EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Heat treatment condition. For tempered condition, tempering temperature shall be stated.	

[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table R.12—Element Datasheet No. HF01

Element Datasheet	EDS No. HF01	Rev. 00
Type of Special process: Hardfacing by overlay welding		
Scope	This EDS specifies requirements for hardfacing by overlay welding of valve parts.	
Welding	*Welding process* The hardfacing shall be made by a suitable weld overlay process such as PTAW (plasma transferred arc welding), GTAW (gas tungsten inert gas welding) or LBW/EBW (laser/electron beam welding). *Welding Consumable* For general and hydrocarbon service the welding consumables shall be of type E/ERCoCr-A (UNS R30006) e.g. Stellite 6 or equivalent, or type 13Cr (ER410). For other services, except for seawater service the use of E/ERCoCr-B (UNS R30012) or E/ERCoCr-E (UNS R30021) may be proposed.	
Procedure Qualification Testing	*General* The hardfacing shall be carried out using welding procedures qualified in accordance with ASME IX or ISO 15614-7 modified as follows: – The test plate dimensions shall be the minimum required by the welding standard sufficient to allow all required tests to be carried out. The minimum qualified parent material thickness shall be the thickness of the test plate. – The qualification shall be carried out on base material of same specification and grade as used in production. – The testing shall be carried out according to ASME IX or ISO 15614-7 and the requirements in this EDS. A stringer bead technique is recommended. If weaving is used, the width shall be within the qualified range taking into consideration the risk of overheating of the material and cracking. The temperature of the components shall be checked during welding. The interpass temperature during hardfacing of duplex stainless steels shall not exceed 150 °C (302 °F). The thickness of the hardfacing shall be measured and be minimum 1.6 mm (0.06 in.) after final machining. *Hardness testing* Hardness testing shall be carried out on base material, heat affected zone and weld metal. Vickers hardness HV5 or HV10 shall be used. The examination of the HAZ shall be carried out with maximum 0.5 mm (0.02 in.) distance between the indentations from fusion line, through HAZ into the unaffected base material. Where ISO 15156/NACE MR0175 is specified, the hardness for HAZ and unaffected base material shall not exceed the maximum values specified in ISO 15156/NACE MR0175 and for type 22Cr and 25Cr duplex base materials the hardness shall not exceed 310HV average, 320HV individual single value. *Metallographic examination* Metallographic examination shall be carried out for the following materials: 22Cr and 25Cr duplex, Alloy 625, and Alloy 718. For type 22Cr and 25Cr duplex the ferrite content in the heat affected zone shall be determined in accordance with ASTM E562 and shall be in the range of 30 % to 70 %. *Corrosion testing* Corrosion testing shall be carried out for 25Cr duplex and Alloy 625 substrates. The testing shall be carried out according to ASTM G48, method A, and for 24 h exposure time at 40 °C (104 °F). The acceptance criteria shall be no pitting at 20x magnification and maximum weight loss shall be 4 g/m2. The sample shall include the cross section from the overlay surface into the unaffected base material. The hardfacing may be removed, but any buffer layer and heat affected zone in the base material shall be exposed in the corrosion test. *Macro section* The macro section for the qualification shall show no cracking and complete fusion between base material and the hardfacing layer.	

Table R.12 *(continued)*

Element Datasheet	**EDS No. HF01**	**Rev. 00**
Type of Special process: Hardfacing by overlay welding		
Procedure Qualification Testing *(continued)*	*Impact testing* The qualification testing shall include Charpy V-notch (CVN) impact testing for materials that require impact testing by the applicable ASTM standard or MDS. The test conditions and acceptance criteria shall be as stated in the ASTM standard or MDS (the MDS requirements prevail). One set of impact testing shall be carried out with specimens located in the base material 2 mm (0.08 in) below the fusion line between the hardfacing and base material. The notch shall be perpendicular to the hardfaced surface.	
Heat Treatment	Heat treatment after hardfacing shall be carried out, as necessary, to meet specified properties. Components to be exposed to H2S containing environment shall be heat treated as required in ISO 15156/NACE MR0175, as applicable. Overlaying low alloy steels (ASTM A182 F22) shall be followed by stress relieving at a minimum temperature of 620 °C (1148 °F). Such stress relieving is not required, if hardfacing is applied over an overlaid low alloy steel (with Alloy 625 for corrosion resistance).	
Non-Destructive Testing	*Visual Inspection* VT shall be carried out on each 100 % of the weld overlay according to ASME *BPVC,* Section V, Article 9 or ISO 17637. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. Porosity, slag inclusions are not permitted on and within 50 mm (2 in.) of sealing surfaces. *Liquid penetrant testing* All deposited surfaces shall, after final machining, be penetrant tested in accordance with ASME V, Article 6 with acceptance criteria according to ASME *BPVC*, Section VIII, Division 1, Appendix 8, except on sealing surfaces where no indication is acceptable.	
Repair of Defects	Repairs may be local or total when non-conforming conditions are found. Defects in excess of acceptance standard shall be removed by reducing weld overlay thickness and shall be repaired by re-welding. All excavations shall be dye penetrant inspected prior to the start of repair welding in order to confirm the complete removal of defects. Repair by re-welding shall be performed in accordance with a written procedure. The following information must be given in these procedures: – Method of removing defects. – Requirements related to the shape of the excavation. – Inspection of repair prior to re-welding. – Applicable welding procedure and qualification tests. – Inspection after welding.	

Table R.13—Element Datasheet No. HF02

Element Datasheet	EDS No. HF02	Rev. 00
Type of Special Process: Hardfacing by thermal spraying of tungsten carbide		
Scope	This EDS specifies requirements for hardfacing by thermal spraying of tungsten carbide of valve parts.	
Process	*General* The hardfacing shall be carried out using high velocity oxygen fuel (HVOF) or equivalent process. Hardfacing shall only be applied on corrosion resistant substrates. *Coating composition* The coating shall be of cermet type based on tungsten carbide (WC) and a metallic binder. The binder shall be based on Co and/or Ni which shall be alloyed with Cr or Cr and Mo. Pure Co or Ni binders are not accepted. *Coating thickness* The coating thickness shall be in the range 0.15 mm to 0.25 mm (0.006 in. to 0.01 in.) after grinding and lapping. *Surface preparation* The components shall be cleaned for removal of oil by a cleaning agent (acetone or similar) before grit blasting with aluminium oxide. The surface roughness before spraying shall be within the range 4 µm to 8 µm (160 µin to 320 µin) Ra. All edges shall be chamfered or rounded. Balls shall be spherical within 0.05 mm (0.002 in.). The components shall be at a temperature minimum 10 °C (50 °F) above dew point and be immediately grit blasted in warm condition. Any oil, dust or particles shall be removed by suitable means before spraying. *Thermal spraying* The component shall be coated immediately after grit blasting, while the component still is at a temperature above the dew point. All thermal spraying shall be carried out under optimal conditions and accordance with established and qualified procedures to ensure that the coating on all areas fulfil the specified requirements. For valves all seating area shall be coated. For ball valves the complete spherical part of the ball shall be coated. For gate valves all surfaces sliding against the seats during valve opening and closing shall be coated. *Sealing* All coated surfaces shall be sealed. The type of sealer and testing requirements shall be specified in the procedure. *Finishing* All coated parts shall be ground and lapped to a mirror like finish and maximum roughness of Ra = 0.15 µm (6 µin).	
Procedure Qualification Testing	*General* The thermal spray procedure shall be supported by a qualification test and the following essential variables shall apply to each procedure: – the type of equipment used; – nozzle length; – fuel and gas flow rate, ±5 %; – spray distance, ±5 %; – spray rate, ±5 %; – grade of powder; – powder supplier; – sealer type (if used). The procedure shall be re-qualified if any of the above is changed outside given allowable range.	

Table R.13 *(continued)*

Element Datasheet	**EDS No. HF02**	**Rev. 00**
Type of Special Process: Hardfacing by thermal spraying of tungsten carbide		
Procedure Qualification Testing *(continued)*	The qualification test shall be made at test samples of sufficient size for extraction the required test specimens. Each procedure qualification shall be tested as specified in the following sections.	
Procedure Qualification Testing	*Bonding test* The bonding strength shall be tested in accordance with ASTM C633 or ISO 4624. Not less than three specimens of a type shall be tested. Acceptance criteria: minimum bond strength shall be 60 MPa (8.7 ksi). *Bending test* Three coupons, with size 20 mm x 100 mm x minimum 1.5 mm shall be tested. The coupons shall be bent 90° over a mandrel with diameter 25 mm (1.0 in.). Acceptance criteria: no spalling is acceptable. However, cracking in the coating and chipping on the edge of the test specimen is acceptable. *Hardness test* A minimum of three indentations shall be made on a cross section for metallographic examination. Acceptance criteria: The average hardness shall be minimum 1000HV0.3 with minimum single value not lower than 900HV0.3. *Porosity test* One piece shall be prepared for cross section metallographic examination. An area of minimum 1.0 mm^2 shall be examined. Acceptance criteria: the porosity shall be less than 1 % by area. *Surface finish test* The surface roughness of the finished component shall be tested. Acceptance criteria: The roughness value shall be Ra ≤ 0.15 µm (6 µin).	
Production Testing	Finished polished hardfacing thickness and surface roughness of all parts shall be tested and shall fulfil the requirements specified above. Production testing shall be carried out on regular basis as minimum twice per week and on every new batch of powder or on changing grade of powder. The test shall be similar to a procedure qualification test and the applicable testing shall consist of hardness and porosity test according to the requirements stated above in the EDS.	

Add new annex

Annex S
(normative)
Design Criteria for Pressure Containing Elements

This annex details the design criteria requirements based on the selected design code.

Requirements of this annex shall be followed in addition to the selected design code requirements.

Table S.1—Design Criteria for Pressure-containing Elements

Design Code Criteria	**ASME B16.34**	**ASME *BPVC*, Section VIII, Division 1 or Division 2**
Wall Thickness Criteria	Minimum wall thickness of valve body, including flow passage wall section, thickness of central core section and transition sections in accordance with ASME B16.34, Section 6.	Minimum wall thickness of valve body designed in accordance with ASME *BPVC*, Section VIII, Division 1 or by finite element analysis in accordance with ASME *BPVC*, Section VIII, Division 2. The minimum body thickness at the flow passage wall section including seat housing areas in accordance with ASME B16.34 based on the inside diameter of the flow passage in ASME B16.34, 6.1.2. Body buttwelding ends associated to transition sections remain in accordance with ASME *BPVC*, Section VIII and/or the applicable pipeline standards.
Ligament Section Criteria	Minimum thickness of ligament section about axial holes in the central core section of a two- or three-piece split body calculated in accordance with ASME B16.34. Inside diameter not less than the minimum values defined in ASME B16.34, 6.1.2 (a) and $^{2}/_{3}d'$ (where *d'* is the inside diameter of the central core section). Ligament thickness distributed in compliance with ASME B16.34, 6.1.3 (d). Where a corrosion allowance has been specified, the thickness of the inner ligament to be the minimum thickness as defined above, plus the corrosion allowance.	Minimum thickness of ligament section about axial holes in the central core section of a two- or three-piece split body does not need to be in compliance with ASME B16.34. Ligament section thickness calculated in accordance with ASME *BPVC*, Section VIII, Division 1 or Division 2. Additional thickness may be required to compensate for material removed by the axial holes. [a] Where a corrosion allowance has been specified, the thickness of the inner ligament to be the minimum thickness as defined above, plus the corrosion allowance.
Corrosion Allowance	Where a corrosion allowance of 3 mm or less has been specified, the actual wall thickness to be not less than that defined by the wall thickness criteria and ligament section criteria above. No additional wall thickness is required. Where a corrosion allowance of greater than 3 mm has been specified, the wall thickness to include additional thickness for every mm of corrosion allowance greater than 3 mm. Where a valve body section design does not undergo an increase in wall thickness at the transition from the flow passage to the central core section (e.g. cast top entry body designs, or some two-piece cast body designs) the specified corrosion allowance to be added to the minimum wall thickness defined by the wall thickness criteria above. [b]	
Bolting Criteria	Bolting to comply with ASME B16.34.	Bolting to comply with ASME *BPVC*, Section VIII, Division 1 or Division 2 as applicable. – designed to include bending and axial loads; and – designed to include gasket factors.

Table S.1 *(continued)*

Design Code Criteria	**ASME B16.34**	**ASME *BPVC*, Section VIII, Division 1 or Division 2**
Others pressure-containing elements	Pressure-containing elements not covered by ASME B16.34 to be designed in accordance with ASME *BPVC*, Section VIII, Division 1 or Division 2.	Other pressure-containing elements to comply with ASME *BPVC*, Section VIII, Division 1 or Division 2 as applicable.
Piping Loads	The piping load to be equivalent to the bending moment calculated using $^{2}/_{3}$ of SMYS of the interfacing pipe including design pressure. To be verified by FEA.	

[a] The inner ligament (between axial hole and the inside diameter of the central core section) should have sufficient thickness to prevent any plastic deformation or loss of pressure containment due to body dilation.

[b] There shall be no loss of structural integrity as a result of loss of material due to the corrosion allowance specified.

Add new annex

Annex T
(normative)
Check Valves—Additional Requirements

T.1 General

This annex provides requirements specific to check valves.

T.2 Clapper Disc

The valve clapper disc shall ensure free movement (without getting stuck) to respond without delay to zero flow or reverse flow.

T.3 Materials

The clapper disc, clapper disc arm, clapper disc hinge and seat materials shall be selected to prevent erosion, scoring, galling or damage, including impact from the passage of pigs or fatigue from two phase gas and condensate flow.

T.4 Design

Check valves shall not allow deposition of sand or debris that could restrict free movement and sealing ability of the clapper.

T.5 Orientation

Any limitation of the installation orientation of the check valve shall be defined.

T.6 Information

The following attributes and information shall be defined:

— flow velocity required to achieve full opening;

— position of the clapper disc under normal flow conditions (maximum or minimum);

— measures taken to ensure long life of the bearings, if it does not result in a fully open valve under normal and fluctuating flow conditions;

— flow rate at onset of valve chatter;

— verification that the valve will not be damaged following pig impact on a closed clapper disc in the flow direction.

T.7 Characteristics

Analysis techniques (e.g. FEA) shall be used to determine the following:

— clapper disc position for a full range of flow rates;

- pressure losses across the clapper disc;
- resonant frequency of the clapper disc;
- slam shut behavior; and
- propensity for valve “chatter".

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