

Supplementary Specification to API Specification 6DSS for Subsea Pipeline Valves

Public Review Draft

Revision history

VERSION	DATE	PURPOSE
0.1	November 2019	Issued for Public Review

Acknowledgements

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

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Foreword

This specification was prepared under 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 for projects globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly approved specification, building on recognized industry and/or 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, facilitating improved standardization of major projects across the globe. 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 specification requirements for the procurement of subsea pipeline valves in accordance with API 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 JIP33 standardized procurement 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

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

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

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

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

S-708D: Valve Datasheet for Subsea Pipeline Valves

This document provides project specific requirements where this specification requires the purchaser to define an application specific requirement. It also includes information required by the purchaser for technical evaluation. Additional purchaser supplied documents are also listed in the datasheet, to define scope and technical requirements for enquiry and purchase of the equipment.

S-708L: Information requirements for Subsea Pipeline Valves

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

S-708Q: Quality requirements for Subsea Pipeline Valves

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

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

Unless defined otherwise in the purchase order, 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, IRS, QRS);
- d) this specification;
- e) the parent standard.

1 Scope

Delete "plug" from first paragraph

Add to section

This specification does not define the requirements for plug valves.

2 Normative References

API Standard 6X	Design Calculations for Pressure-containing Equipment
API Specification 6A	Specification for Wellhead and Christmas Tree Equipment
API Specification 17D	Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment
DNVGL-RP-0034	Steel forgings for subsea applications
DNVGL-RP-F112	Duplex stainless steel - design against hydrogen induced stress cracking
DNVGL-RP-B204	Welding of subsea production system equipment

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

4 Valve Types and Configurations

4.1 Valve Types

4.1.2 Gate Valves

Delete NOTE 1

Replace second paragraph with

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

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

4.2 Valve Configurations

4.2.2 Reduced-opening Valves

Add to section

Beyond the limits of Table 1, valves shall be in accordance with the maximum and minimum internal bore dimensions specified in the valve datasheet.

5 Design

5.1 Design Standards and Calculations

Replace second paragraph with

The minimum wall thickness for pressure-containing elements shall be in accordance with ASME B16.34.

Add after second paragraph

The valve design and calculation shall be in accordance with ASME BPVC Section VIII Div.2 and API 6X with consideration as a minimum, for external loading conditions and operating forces.

Add after second paragraph

The external load shall be equivalent to the bending moment calculated using $2/3$ of yield of the interfacing pipe.

Add after second paragraph

The bolting sizing criteria shall be as per ASME BPVC Section VIII Div.1.

Delete first NOTE

Replace third paragraph with

The allowable stress values shall be consistent with the specified design codes.

Replace fourth paragraph with

The design pressure for the body calculation shall be increased such that the hydrostatic test pressure in 10.3 can be applied.

Delete second NOTE

5.2 Pressure and Temperature Rating

Replace third paragraph with

Pressure-temperature ratings for valves made from materials not covered by ASME B16.34 shall be determined from the material properties in accordance with ASME BPVC Section II, Part D.

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.

Add to section

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

5.4 Face-to-face and End-to-end Dimensions

Delete "Unless otherwise agreed" from first sentence

5.5 Valve Operation

Replace "should" with "shall" in first paragraph

Delete "when requested" from second paragraph

5.6 Operator Information

5.6.3 Hydraulic Actuator Data Input

Add new list items

- manual override;
- datasheet of control fluid and compensation fluid (if applicable).

5.6.6 Gearbox Data Input

Add new list item

- maximum input torque.

5.7 Pigging

Add to section

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

5.8 Valve Ends

5.8.1 Flanged Ends

5.8.1.1 General

Add to section

The valve flanged ends shall be integral with the valve body or end closure forging or casting.

Add to section

Welding on flanges shall not be permitted.

Add to section

The back faces of flanges shall be machined flat over the entire back flange area.

Add to section

The nut seating area shall not present a raw surface for the nuts.

5.8.1.2 Offset of Aligned Flange Centrelines - Lateral Alignment

Replace first paragraph with

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

Replace second paragraph with

For valves larger than NPS 2 (DN 50), the maximum lateral misalignment shall be 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 maximum parallelism misalignment shall be 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 in the valve datasheet.

Add to section

The weld preparation shall permit site weld repair or re-preparation of weld ends for re-weld.

5.8.2.2 Parallelism of Aligned Weld Ends—Angular Alignment

Add to section

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

5.9 Valve Cavity Pressure Relief

Add to section

Ball valve and slab gate valve cavity pressure relief shall be achieved by self-relieving seat rings that internally relieve excess pressure from the valve cavity to prevent over-pressurization.

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

Replace last sentence of fourth list item with

Seal test ports shall be provided on all valves.

Delete NOTE 2

Replace second paragraph with

The vent and drain plugs shall be installed and tested as per 10.13 before seal welding.

Add after second paragraph

After testing, vents, drains, body test ports and seal test ports shall be seal welded.

Add after second paragraph

The sealing of the test ports shall be performed by seal welding of metal seated screwed fittings.

Delete NOTE 3

Add to section before third paragraph

Metal seated plugs shall be designed in accordance with API 6A:2011, Figure 19 type II connection.

Add to section

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

5.11 Stem/Seat and Cavity Injection Points

Delete "except by agreement"

Add to section

Cavity injection points shall not be required.

Replace Section 5.12 heading with

5.12 Drain and Vent Valves

Replace section with

Drain and vent valves shall not be required.

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 when the valve is open and transverse when the valve is closed.

5.16 Travel Stops

Add to section

Travel stops shall be designed in accordance with Annex E.

Add to section

Valves with retrievable operators shall be provided with travel stops which are permanently located externally to the valve pressure-containing components.

Delete NOTE

5.18 ROT System

Replace second sentence of first paragraph with

ROT size/class shall be as specified in the valve datasheet.

5.19 Lifting Points and Supports

Replace second paragraph with

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

Delete NOTE 1

Add to section

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

Add to section

Permanent lifting eyes (pad-eyes) shall be designed in accordance with API 17D:2011, Annex K.

5.20 Drive Trains

5.20.1 Design Thrust or Torque

Replace "two times" with "2.5 times" in first paragraph

Add after first paragraph

The calculations shall cover the drive train and lower trunion as applicable.

Add after first paragraph

For swing check valves, the design thrust or torque for drive train safety factor shall be eight times the calculated break away torque.

5.21 Stem Retention

Replace section with

Valves shall be designed to ensure that the stem shall not eject under the following conditions.

- a) any combination of static or dynamic test and operating condition; or
- b) if the packing gland components (see 3.1.37) and/or valve operator mounting components are removed.

Add to section

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

Add 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

Seals shall be designed in accordance with Table 8.

Add new table

Table 8 – Sealing Requirements

Valve Type	Ball	Gate	Check
Pressure Containing Seals			
Body-bonnet	Primary - Bi-directional metal-to-metal ^a	Primary - Bi-directional metal-to-metal ^a Secondary - non-metallic ^a	Primary - Bi-directional metal-to-metal ^a Secondary - non-metallic ^a
Body-closure		NA	NA
Seat-body	Non-metallic ^a	Non-metallic ^a	Metallic / non-metallic ^a
Stem	Primary - metal-to-metal Secondary - non-metallic ^a	Internal metal-to-metal back seat Primary - V-pack Secondary - lip seal ^c	Primary - metal-to-metal ^b Secondary - non-metallic
^a No elastomeric seals (o-rings) shall be used in areas that can be exposed to the produced fluid ^b When applicable (i.e. stem protruding from body) ^c Lip seal design shall consider the effects of reverse pressurization			

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 pressure build-up.

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 markings on the valve.

5.28 Corrosion/Erosion

Replace first paragraph with

When applicable, corrosion-resistant material or overlay shall be applied in accordance with that specified in the valve datasheet.

Delete NOTE 2

Add after second paragraph

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

Delete NOTE 4

Add before third paragraph

The erosion allowance specified in the valve datasheet shall be applied to the flow bore of the valve.

5.29 Design Validation

Replace section with

Design validation shall be in accordance with Annex F.

Add to section

If it can be demonstrated that the existing design validations meet the requirements of this specification, re-validation 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

If hyperbaric testing is specified in the valve datasheet, it shall be carried out in accordance with Annex G.

Add to section

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

Add to section

The valve and actuator may be tested separately in a hyperbaric chamber, if the complete unit does not fit into the hyperbaric chamber.

Add to section

When the actuator assembly is tested separately, the test fixture that simulates the valve opening characteristics shall be attached to the actuator assembly.

Add to section

The manufacturer shall confirm that the existing hyperbaric testing validation conforms to the minimum requirements in 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 in Annex R.

Replace first sentence of first paragraph with

Specifications for metallic pressure-containing and pressure-controlling parts shall address the following:

6.2 Tensile Test Requirements

Replace "separate or attached block" with "relevant sacrificial or integral part" in first paragraph

Replace first sentence of second paragraph with

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

Replace "yield strength" with "tensile properties" in second paragraph

6.3 Service Compatibility

Replace "when specified by purchaser" with "as specified in the valve datasheet" in first paragraph

Delete "at pressures of Class 600" from third paragraph

6.4 Cast Material

Replace section with

If specified in the valve datasheet that cast material is allowed, API 20A for pressure-containing castings in compliance with casting specification level-3 (CSL-3) shall apply.

6.5 Forged Material

Replace "3:1" with "4.0:1" in first sentence

Add to section

The forgings shall comply with the applicable material datasheets 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 as per the applicable material datasheet in Annex R.

Delete second paragraph

Add to beginning of third paragraph

For $C > 0.12 \%$,

Add to third paragraph

For $C \leq 0.12 \%$, P_{cm} shall be calculated in accordance with the Equation (2a)

$$P_{cm} = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B \quad (2a)$$

Replace fourth paragraph with

The chemical composition for all other parts shall be in accordance with the recognized industry standard, provided that the intended mechanical properties detailed in the material datasheets in Annex R are met.

Delete seventh paragraph

Delete eighth paragraph

Delete ninth paragraph

Delete last paragraph

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 material datasheets in Annex R.

Delete NOTE 1

Delete third paragraph

Replace "separate or attached block" with "relevant sacrificial or integral part" in fourth paragraph

Delete fifth paragraph

Replace "Table 2 and Table 3" with "material datasheets in Annex R" in sixth paragraph

Replace "ASTM A320/320M" with "material datasheets in Annex R" in seventh paragraph

Delete Table 2

Delete Table 3

Replace "Each impact specimen" with "Each re-test impact specimen" in second sentence of eighth paragraph

Delete NOTE 2

Delete last paragraph

Add to section

Sub-size specimens are permitted only if the geometry restricts the extraction of a standard size specimen.

Add to section

API 6A:2018 Table 10 shall be referred to for the adjustment factor, limited to a minimum of a 5 mm wide specimen.

6.8 Bolting

Replace first paragraph with

All pressure boundary bolting and bolting that can compromise the functionality of the valve shall conform to the requirements of the applicable material datasheet and, API 20E or API 20F.

Add after first paragraph

Bolting material shall be in accordance with the material datasheets in Annex R.

Replace "HRC 34 (HBW 319)" with "HRC 32 (HBW 301)" in second paragraph

Delete NOTE 1

Delete third paragraph

Delete NOTE 2

Delete fourth paragraph

Delete fifth paragraph

6.9 Cathodic Protection

Replace first list item of fourth paragraph with

Carbon and low alloy steel material (excluding bolting) shall have a hardness not exceeding 34 HRC.

Add new list items to fourth paragraph

- For bolting, refer to 6.8.
- For components exposed to well bore fluids, refer to 6.10.

Delete NOTE

Add to section

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

7 Welding

Replace section with

Welding requirements are specified as follows:

- a) All welding (girth, clad, buttering) shall conform to the requirements of DNVGL-RP-B204.
- b) Cladding consumables are limited to Alloy 625 (UNS N06625).
- c) Hardfacing by welding shall be in accordance with EDS HF01 in Annex R.

- d) Hardfacing by thermal spraying shall be in accordance with EDS HF02 in Annex R.

8 Quality Control

8.1 Quality Control Procedures

Add to section

The quality requirements of IOGP S-708Q shall also be followed.

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. Refer also to material datasheets in 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 all valve testing equipment shall be retained at the manufacturer's place and available for local inspection by the purchaser's representative.

8.6 NDE of Repairs

Add after second paragraph

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

9 Valve Assembly

Add new list items

- If valves have welded, flanged or studded end connections with a lower rated working pressure than the internals, the entire valve assembly shall be derated to the pressure rating of the end connections.
- Critical components such as seal rings, metallic or non-metallic shall not be re-used if the valve has been dismantled.
- The use of new critical components shall be ensured prior to final assembly of the valves.

- If necessary for assembly, a lubricant with a viscosity not exceeding that of SAE 10W motor oil or equivalent may be used.
- Lubricants and sealants 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 by the purchaser.

10 Factory Acceptance Testing (FAT)

10.1 General

Add to first paragraph

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

Replace second paragraph with

Valves for gas or multiphase service shall be subject to a gas shell and seat test in accordance with 10.9 and 10.11

Replace fourth paragraph with

Testing shall be performed as per the sequence listed in Table 9.

10.3 Hydrostatic Shell Test

10.3.1 General

Delete "If specified by the purchaser" from first paragraph

Add to section

Secondary seals shall be tested independently.

10.4 Operational/Functional Test

10.4.2 Manual Valves

Add to section

All valves shall be torque tested with no differential pressure prior to and post-FAT.

Add to section

The maximum recorded BTO shall not exceed the minimum BTO plus 10 %.

Add to section

If applicable to the valve design, the cavity shall be at atmospheric pressure during the test.

Add to section

For such design, the torque shall be recorded for the valve open to closed with the bore pressurized.

10.4.3 Actuated Valves

Add new section

10.4.3.1

A dedicated actuator shall be used during the standard test.

Add new section

10.4.3.2

The actuator will be subject to a separate test program prior to assembly with the valve.

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Add new table

Table 9 – FAT Sequence

Test	Section number	Description	Medium	Minimum Duration	Acceptance criteria	Additional requirements	Applicability
S1		Drift test	N/A	N/A	PASS / FAIL		when specified in the datasheet
S2	10.3	Hydrostatic shell test	inhibited water	4 hours	No visible leakage		all valves all services
S3	10.2	Stem back seat test	inhibited water	≤ 4": 5 minutes ≥ 6": 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 all services
S4	10.4	Functional test	inhibited water	N/A	Section 10.4	This test includes both torque/thrust test and operational/functional test as defined in 10.4	all valves all services
S5	10.5	Hydrostatic seat test	inhibited water	Section 10.5	Section 10.5		all valves all services
S6	10.6	Cavity relief test	inhibited water / nitrogen	N/A	Section 10.6		all valves
S7	10.11	High pressure gas seat test	nitrogen	1 hour	Section 10.11		valves for gas/multiphase service
S8	10.9	High pressure gas shell test	nitrogen	1 hour	No visible leakage		all valves all services
S9	10.10	High pressure stem seal, Body-bonnet, Body-closure seals test	nitrogen	1 hour	No visible leakage		all valves all services
S10	L.3.4	External static test for stem seal	inhibited water	15 minutes	No visible leakage		when specified in the datasheet
S11	L.3	Test sequence for DIB valves			Section L.3		all DIB valves
S12	10.8	Low pressure gas seat test	nitrogen / air	Section 10.8	Section 10.8		all valves all services
S13	10.13	Testing of body connections	nitrogen / air	20 minutes	No visible leakage	Before seal welding	
S14	10.14	Testing of body connections	nitrogen / air	20 minutes	No visible leakage	After seal welding	all valves all services
S15	L.3.5	Drift test	N/A	N/A	PASS / FAIL		when specified in the datasheet
S16	10.15	Electrical continuity test	N/A	N/A	PASS / FAIL		all valves all services

Add new section

10.4.3.3

The functional test is a verification of the valve and actuator as one unit and shall be carried out for all actuator and valve assemblies, with the purpose to verify that:

- the actuator has been correctly mounted, complete with all auxiliary equipment;
- the open and closed stops are correctly set;
- the limit switches and/or full travel indicators are operating correctly.

Add new section

10.4.3.4

The functional verification shall include the following steps:

- verification of pig passage (drift) for all positions where the remote position signal indicates "open";
- smooth operation of the valve at differential pressure with the actuator supply pressure;
- verification of position indicator device with simultaneous observation of actual obturator position;
- verification of hydraulic system cleanliness level.

Add new section

10.4.3.5

Manual override shall be verified as per 10.4.2.

10.5 Hydrostatic Seat Test

10.5.1 Preparation

Add to section

If necessary for assembly, a lubricant with a viscosity not exceeding that of SAE 10W motor oil or equivalent may be used.

Add to section

Lubricants and sealants shall be removed from seats and obturator sealing surfaces.

Add to section

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

Add to section

All the air shall be purged from the valve during filling.

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 other than check valves, the liquid leakage rate shall not exceed ISO 5208, Rate B.

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 isolated from atmosphere.

10.5.4.2 Bidirectional

Add to second paragraph after first sentence

In this case, the downstream side of the valve shall be isolated from atmosphere.

10.5.4.3 Double Block and Bleed (DBB)

Replace "Rate C" with "Rate B" in fourth paragraph

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

Replace "Rate C" with "Rate B" in second paragraph

Add to section

The test requirements in L.3 shall be followed.

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

Replace second paragraph with

Acceptance criteria shall be per 10.5.3.

Add to section

The test requirements in L.3 shall be followed.

10.6 Cavity Relief Test

10.6.1 General

Add to section

The test medium shall be water with inhibitor except for valves intended for gas or multiphase service.

Add to section

The test medium shall be gas for valves intended for gas or multiphase service.

Add to section

Valve cavity relief pressure shall not exceed the following:

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

10.6.2 Trunnion-mounted Ball Valves with Internal-relieving Seats

10.6.2.1 Procedure 1

Replace list item e) with

- e) Failure to relieve pressure less than the valve pressure ratings mentioned in 10.6.1 shall be cause for rejection.

10.6.2.2 Optional Procedure 2

Replace list item g) with

- g) Failure to relieve pressure less than the valve pressure ratings mentioned in 10.6.1 shall be cause for rejection.

Replace section heading with

10.6.3 Through-conduit Slab Gate Valves with Upstream and Downstream Self-relieving Seats

Replace list item f) with

- f) Failure to relieve pressure less than the valve pressure ratings mentioned in 10.6.1 shall be cause for rejection.

Delete NOTE 2

Add new section heading

10.6.4 Through Conduit Slab Gate Valves with Downstream Self-relieving Seats

Add new section

10.6.4.1

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) Operate the valve in the half-open position, at atmospheric pressure.
- b) Apply the minimum rated working pressure until it stabilizes.
- c) Operate the gate 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 gate in the half-open position and verify that pressure in the valve bore does not increase.
- f) No increase of pressure is allowed in the valve bore.

Add new section

10.6.4.2

The test medium shall be nitrogen.

Add new section

10.6.4.3

For through-conduit gate valves with downstream sealing, a center cavity test port is not 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

Replace first list item with

- Leakage for all soft seated valves and metal seated gate valves shall not exceed ISO 5208 Rate A.

Replace second list item with

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

10.9 High-pressure Gas Shell Test

10.9.1 General

Replace first paragraph with

All valves shall be subject to a gas shell test as follows:

Add after third paragraph

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

Add after third paragraph

If a submerged test is not practically possible, valves shall be tested in a test cell where test ports are piped to a water bucket.

Delete NOTE

Replace Section 10.10 heading with

10.10 High-pressure Stem Seal, Body-Bonnet, Body-end Closure Integrity Testing

10.10.1 General

Replace first paragraph with

High pressure stem seal, body-bonnet, body-closure seals test shall be performed at 1.1 times the design pressure with 100 % nitrogen as the test medium in a fully submerged condition.

Add after first paragraph

If a submerged test is not practically possible, valves shall be tested in a test cell where test ports are piped to a water bucket.

Replace third paragraph with

The test duration shall be a minimum of one hour.

10.11 High-pressure Gas Seat Test

10.11.1

Replace first paragraph with

Valves for gas service and multiphase service shall be subject to a gas seat test as follows.

Add to section

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

10.11.2 Acceptance Criteria

Replace first paragraph with

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

Replace second paragraph with

The acceptable leakage rate for high-pressure gas seat testing shall not exceed ISO 5208, Rate B, for all other metal-seated valves.

10.12 Check Valves

Add to section

The unseating pressure of check valves shall be recorded.

10.13 Installation of Body Connections After Testing

Replace "stem" with "body-stem" in first paragraph

Add after first paragraph

The vent and drain plugs shall be installed and tested as follows before seal welding.

Add after first paragraph

Testing of body connections per 10.9 shall be subject to a gas shell test pressure rating determined in accordance with 5.2 for material at 100 °F (38 °C) based on the valve end connection material.

Add after first paragraph

Test duration shall be 20 minutes minimum after stabilization with no visible leakage allowed.

Delete "when specified by the purchaser" from first sentence of second paragraph

Add to section

Surface NDE (PT) shall be performed in accordance with K.16 as a minimum after each welding pass.

Replace Section 10.15 heading with

10.15 Electrical Continuity Test

Add to first list item

ball seat and body wherever feasible.

Add to third list item

gate seat and body wherever feasible.

Delete fourth list item

11 Coating/Painting

Replace first paragraph with

All valves shall be painted or coated externally in accordance with the purchaser's requirements.

Delete third paragraph

12 Marking

Add to section

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

Add to section

More than one plate may be used when necessary.

Add to section

The nameplate shall be securely fastened to the valve after coating is completed, and located such that it can be read once the valve is installed in its final location.

Add to section

Each side of the valve that contains a single piston effect seat shall be marked with an "SPE" mark.

Add to section

Each side of the valve that contains a double piston effect seat shall be marked with a "DPE" mark.

Add to section

No other names or trademarks shall be allowed on the valve and nameplate except the manufacturer's name (as defined in 15.1).

Table 6 – Valve Marking

Delete "if not shown in Table C.1 to Table C.5 (5.4)" from item 5 in table

13 Preparation for Shipment

Delete "Plug" from fifth paragraph

Add to section

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

Add to section

Valve ends and auxiliary connections shall be protected to give mechanical protection, while preventing the ingress of water and other foreign matter.

Add to section

Prior to packaging and shipment, valve internals shall be thoroughly cleaned and dried with 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) and k)

- k) WPS, PQR.
- l) Qualification.

15 Facility Requirements

Replace Table 7 with

Table 7 – Minimum Facility Requirements

Item	Process Activity	Location
1	Product design	performed on-site, off-site
1b	Product design calculation verification	performed on-site, off-site
1c ^a	Product design validation documentation	performed on-site, off-site
1d ^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	Assembly (Section 3.1.3)	performed on-site
7b	End closure welding of fully welded valves	performed on-site, off-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		

Annex B
(informative)
Valve Configurations

Delete "plug" from first paragraph

Delete Figure B.3

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

Delete "plug" from NOTE

Delete Table C.2

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Replace "informative" with "normative" in Annex E title

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

Replace first paragraph with

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

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Replace Table E.1

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 (1)	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 (2)	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.
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. Stops for open and close in valve.		Stops for open and close in actuator.	Stops for open and close in valve.
Check	With external clapper lift	Stop in body required for open. No stop required for close.	Gearbox stop in open position to avoid overloading valve shaft Stop in valve for open.		Actuator stop in open position to avoid overloading valve shaft.	Stop in valve for open.
<p>NOTES</p> <p>(1) Backseat provides open stop</p> <p>(2) Backseat provides close stop</p>						

Replace "informative" with "normative" in Annex F title

Annex F (normative) Design Validation

F.1 General

Replace first paragraph with

This annex provides design validation test procedures 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, including design changes.

Delete NOTE

Add to section

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

F.2 Effect of Changes in Product

Add new section

F.2.0 General

A change in one of the parameters listed in F.2.1, F.2.2, F.2.3 or F.2.4 shall require a new design validation.

NOTE New design validation is not required if it can be demonstrated that the performance of the product at the intended pressure, temperature and service conditions is maintained.

F.2.1 Design Changes

Replace first sentence with

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

Add new list items to first paragraph

- pressure controlling components;
- size, pressure rating, design temperatures outside of F.12.

Delete third paragraph

F.2.2 Metallic Materials

Replace section with

A change in metallic materials shall require new design validation unless it can be demonstrated that the new material is suitable for the application.

F.2.3 Nonmetallic Seals and Bearings

Replace first paragraph with

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

Add new list item to first paragraph

- 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 as per F.2.0.

Replace first list item of first paragraph with

- hardfacing material characteristics;

Replace third list item of first paragraph with

- design range for contact pressure;

Replace fourth list item of first paragraph with

- specified coating thickness.

Delete second paragraph

F.3 Products for Design Validation

F.3.1

Add to list of second paragraph after first item

- all bearings and thrust washers replaced;
- seat springs replaced;

Replace seventh list item of second paragraph

- FAT performed as per section 10.

F.7 Hydrostatic Testing

Delete section F.7

F.8 Gas Testing

F.8.1 General

Delete "or using the method described as below" from first paragraph

Delete second paragraph

Delete third paragraph

F.8.2 Leak Detection

Replace section with F.8.2.1 and F.8.2.2

Add new section

F.8.2.1

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

Add new section

F.8.2.2

If a submerged test is not practically possible, valves shall be tested in a test cell where the test ports are piped to a water bucket

F.9 Temperature Testing

F.9.1 Location of Temperature Measurement

Replace first sentence with

The temperature shall be measured at the defined location by the following method:

Delete "Method 1:"

Replace third list item of first paragraph with

- The temperature measurement device shall be located internally within 0.5 in. (13 mm) of the seat area.

Delete second paragraph "Method 2" including list items

F.11 Scaling

F.11.1 General

Add to section

Scaling shall only be applied if specified in the valve datasheet.

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 is not 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

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

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	Additional requirements	Applicability
Section A	L.3.5	Drift test	N/A	N/A	PASS / FAIL	when specified by purchaser	when specified by purchaser
	F.18.1	Hydrostatic shell test	inhibited water	1 hour	No visible leakage		all valves all services
	10.2	Stem back seat test	inhibited water	≤ 4" 5 minutes ≥ 6": 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 all services
	F.18.2	Hydrostatic seat test ^a	inhibited water	1 hour	Section 10.5		all valves all services
	F.19	Force or torque measurement test	inhibited water				
	10.6	Cavity relief test	inhibited water / nitrogen	N/A	Section 10.6		all valves
	10.11	High pressure gas seat test ^a	nitrogen	15 minutes	Section 10.11		valves for gas/multiphase service
	10.10	High pressure stem seal, Body-bonnet, Body-closure seals test	nitrogen	15 minutes	No visible leakage		All valves all services
	L.3	Test sequence for DIB valves	inhibited water or nitrogen	Section L.3	Section L.3		for DIB valves
10.8	Low pressure gas seat test ^a	nitrogen or air	15 minutes	Section 10.8		all valves all services	
Section B	F.20	Open/close cycling dynamic pressure test at room temperature	inhibited water or nitrogen	160 dynamic cycles			
	F.18.2	Gas seat test ^a	nitrogen	1 hour	Section 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	Item F.16.2 c)		
F.23	Gas seat test at max. temperature ^a	nitrogen	1 hour	Section F.23		
F.24	Low-pressure seat test at max. temperature ^a	nitrogen	1 hour	Section 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	Item F.16.2 c)		
F.23	Gas seat test at min. temperature ^a	nitrogen	1 hour	Section F.23		
F.24	Low-pressure seat test at min. temperature ^a	nitrogen	1 hour	Section F.24		
	<i>Raise the temperature to room temperature</i>					
F.25	Pressure temperature cycling	nitrogen	Section F.25	Section 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	Section F.26		
F.27	Low pressure seat test at room temperature ^a	nitrogen / air	Section 10.8	Section F.27		
F.28	Final force or torque measurement test	nitrogen	N/A			

Section C Hyperbaric testing ^b	G.2.2.1	Hydrostatic test	inhibited water	Section G.2.2.1	Section G.2.2.1		
	G.2.2.2 Step 1	Hyperbaric ingress test	inhibited water	2 hours	G.2.2.2 Step 1		
	G.2.2.2 Step 2	Hydrostatic shell test in hyperbaric conditions	inhibited water	15 minutes	10.3 - G.2.2.2 step 2		applicable to valve only
	G.2.2.2 Step 3	Hydrostatic seat test in hyperbaric conditions ^a	inhibited water	G.2.2.2 Step 3	10.5 - G.2.2.2 Step 3		applicable to valve only
	G.2.2.2 Step 4	Hyperbaric endurance test for Ball valve, Gate valve, Axial ON-OFF valve	inhibited water	200 dynamic cycles	G.2.2.2 Step 4		applicable to valve and actuator as per 5.30
	G.2.2.2 Step 4	Hyperbaric endurance test for check valve	inhibited water	20 dynamic cycles	G.2.2.2 Step 4		applicable to valve and actuator as per 5.30. N/A for check valve without external operator
Section D Hyperbaric testing ^b	F.18.1	Hydrostatic shell test	inhibited water	1 hour	No visible leakage		all valves all services
	10.2	Stem back seat test	inhibited water	≤ 4": 5 minutes ≥ 6": 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 all services
	F.18.2	Hydrostatic seat test ^a	inhibited water	1 hour	Section 10.5		all valves all services
	F.19	Force or torque measurement test	inhibited water				
	10.6	Cavity relief test	inhibited water / nitrogen	N/A	Section 10.6		all valves
	10.11	High pressure gas seat test ^a	nitrogen	15 minutes	Section 10.11		valves for gas/multiphase service
	10.10	High pressure stem seal, Body-bonnet,	nitrogen	15 minutes	No visible leakage		All valves all services

		Body-closure seals test					
	L.3	Test sequence for DIB valves	inhibited water / nitrogen	Section L.3	Section L.3		for DIB valves
	10.8	Low pressure gas seat test ^a	nitrogen/ air	15 minutes	Section 10.8		all valves all services
	L.3.5	Drift test	N/A	N/A	PASS / FAIL	when specified by purchaser	when specified by purchaser
Section E	F.17	Valve disassembly and visual inspection					
^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							

F.16 Acceptance Criteria

F.16.2 Pressure Integrity

Delete list items a) and b)

Delete Table F.2

F.17 Post-test Examination

Add after first paragraph

Dimensional inspection on pressure-containing and pressure-controlling parts shall be performed.

Add after first paragraph

Inspection of sealing surface finishes on pressure-containing and pressure-controlling parts, including sealing elements shall be performed.

Add after first paragraph

For critical parts, the NDE method applied during production of the finished machined components shall be re-applied.

F.19 Force or Torque Measurement

Replace second paragraph with

This is only applicable to check valves provided with an external operator as long as no differential pressure is applied across the obturator.

Delete NOTE

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 heading 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 "or cavity as applicable" to the end of first sentence

Add to section

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

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

Replace third paragraph with

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

F.25 Pressure and Temperature Cycles

F.25.3 Test Procedure

Add to section

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

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.

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.

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Replace "informative" with "normative" in Annex G title

Annex G (normative) **Hyperbaric Validation Testing**

G.1 General

Replace second paragraph with

The type of assembly to be tested shall be as per 5.30.

Replace NOTE with

NOTE Scaling, as defined in G.3 may be used to validate the members of a product family as defined in F.11.2.

Replace fourth paragraph with

When valves or actuators cannot be tested in hyperbaric chambers separately due to size limitations, they may be tested using fixtures or localized testing with prior approval from the purchaser.

G.2 Minimum Design Validation Test Requirements

G.2.1 General

Delete NOTE

Replace "qualification" with "validation" in second paragraph

Delete Table G.1

G.2.2 Hyperbaric Validation Tests

G.2.2.1 Prior to Test

Add to first list item

Refer 5.30 for details.

Replace first sentence of fourth list item with

Perform a hydrostatic test at 1.1 times the rated pressure to check all the connection sealing behaviors.

G.2.2.2 Hyperbaric Testing

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

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

G.2.2.2.5 Step 4—Hyperbaric Endurance Test

Delete third paragraph of list item a)

G.2.2.2.6 Step 5—Hydrostatic Shell at Ambient Condition

Replace section with

Hydrostatic shell testing shall be conducted 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 in the valve datasheet.

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 H
(normative)
Pressure Boundary Bolting

Delete annex

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Annex I
(informative)
Pressure-containing Castings and Forgings

Delete annex

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Annex K (normative) **Requirements for Nondestructive Examination**

K.1 General

Replace section with

The NDE requirements for the components of subsea pipeline valves shall be as per 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 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

Reference standards for acceptance criteria shall be:

- a) up to 50 mm: ASME BPVC Section VIII Div.2:2019 Table 3.9 and ASTM E446;
- b) 50 mm to 305 mm: ASME BPVC Section VIII Div.2:2019 Table 3.10 and ASTM E186.

K.6 Ultrasonic Testing (UT) of Castings

Add after second paragraph

When surface NDT (MT/PT) after final machining is not possible on IDs of hollow/machined castings, UT shall be performed at the rough machining stage to ensure that there are no defects in the zone of final machining.

Add after second paragraph

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

Replace third paragraph with

Acceptance criteria shall be in accordance with ASTM A609/609M, QL-1.

K.7 UT of Forgings and Plate

Add at the beginning of first paragraph

For plates,

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 after second paragraph

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

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 disk 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		
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	Refer EDS in Annex R		
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 shall be conducted.			
^a MT or PT to be performed prior to coating, or overlay.			
^b Requirements for examination of bar material shall be as for forgings.			

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

Replace Extent of Examination RT1 with

Critical sections per ASME BPVC, Section VIII, Division 2, Part 3

Replace Extent of Examination UT1 with

Remaining areas of critical section ASME BPVC, Section VIII, Division 2, Part 3 not covered by RT1

Replace NDE of PT1 with

PT all products

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 forgings shall be in accordance with K.7.

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

Add after first paragraph

Machined surfaces shall be examined using wet fluorescent particles.

Add after first paragraph

When MT 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.7.

Replace second paragraph with

Acceptance criteria shall be in accordance with ASME BPVC, Section VIII, Division 2, part 3.

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 after first paragraph

Machined surfaces shall be examined using wet fluorescent particles.

Add after first paragraph

When MT after final machining is not possible on IDs of hollow/machined forgings, UT shall be performed at 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 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.

Replace second paragraph with

Acceptance criteria shall be in accordance with ASME BPVC, Section VIII, Division 2, Part 3.

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

Add "For forgings" before first sentence

Delete second paragraph

Add to section

Acceptance criteria for forgings shall be in accordance with DNVGL-RP-0034:2015, 3.5.3.5.

Add to section

When 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.

K.17

Replace second paragraph with

Acceptance criteria: no relevant indications on sealing surfaces.

Delete third paragraph

Replace section heading with

K.19 VT of Forgings, Plate and Bolting

Replace first paragraph with

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

Replace second paragraph with

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

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 3 mm of sealing surfaces.

Annex L (informative) **Supplementary Test Requirements**

L.2 Bending Test

Replace first paragraph with

If specified in the valve datasheet, 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

The acceptable leakage rate shall not exceed the leakage rates specified:

- ISO 5208, Rate C, for metal-seated valves in gas service;
- ISO 5208, Rate B, for all other metal-seated valves.

Add new section heading

L.3.4 External Hydrostatic Pressure Test of Stem Seals

Add new section

L.3.4.1

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.

Add list items a) to e)

- a) The hydrostatic test pressure shall be not less than 1.5 times the rated water depth, with pressure applied in the pressure cap, with the valve vented to atmosphere.
- b) Hold periods shall start after pressure stabilization has occurred and the equipment with a pressure measuring/recording device has been isolated from the pressure source.
- c) The valve stem seals shall be monitored for leakage and the pressure monitored for a minimum of 3 minutes.
- d) The test pressure shall be reduced to 0 MPa.

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

Add new section

L.3.4.2

Stem seals shall show no visible leakage while subjected to the test pressure.

Add new section

L.3.4.3

After testing, the pressure shall be reduced to 0 MPa.

Add new section

L.3.5 Drift Test

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

Annex Q (informative) **Purchasing Guidelines**

Q.3 Additional Testing

Delete section

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

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Annex R (normative) Material Selection Tables

Table R.1 - Material Datasheet No. 22CrB

Material Datasheet	MDS No. 22CrB ^a			Rev. 00
<i>TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex</i>				
Page 1 of 3				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bars	ASTM A276	UNS S31803		
	ASTM A276	UNS S32205		
	ASTM A479	UNS S31803		
	ASTM A479	UNS 32205		
	ASTM A182	F51 (UNS S31803)		
	ASTM A182	F60 (UNS S32205)		
Scope	<p>This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.</p> <p>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. For components machined from bar size more than 100 mm or 4 in., bars shall be forged.</p> <p>Product covered by this MDS is limited to a maximum thickness of 300 mm or 12 in. For thickness exceeding 300 mm or 12 in., qualification and specification requirements shall be subject to agreement.</p>			
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 AOD or equivalent method.			
Manufacturing	<p>Bars shall be manufactured to the following requirements:</p> <ul style="list-style-type: none"> - 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. <p>NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted.</p>			
Chemical Composition	<p>UNS S31803: N = 0.14 % - 0.20 %</p> <p>PREN ≥ 34.0</p> <p>A product chemical analysis shall be taken per melt of material.</p>			
Heat Treatment	<p>Bars shall be solution annealed followed by water/liquid quenching.</p> <p>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.</p>			

Material Datasheet	MDS No. 22CrB ^a	Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex		
Page 2 of 3		
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 centreline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370 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 centre 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 centre 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. <u>Valve parts manufactured from bar</u> For bars with outside diameter \geq 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. Acceptance criteria shall comply with this MDS.	
Non-Destructive Testing	<u>Visual Inspection</u> VT shall be carried out on each bar in accordance with the Annexure K. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. <u>Ultrasonic inspection</u> Required on all bars and as per EN 10228-4. Use Annex K for acceptance criteria. <u>Dye Penetrant inspection</u> All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annexure K.	
Repair of Defects	Weld repair is not 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. <u>Hardness testing</u> 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 28HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 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.	

Material Datasheet	MDS No. 22CrB ^a	Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex		
Page 3 of 3		
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.	
Certification	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - The MPS identification or the MCPR/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 NDT 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
Page 1 of 2				
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. For thickness exceeding 300 mm or 12 in., qualification and specification requirements shall be subject to agreement.			
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 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 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 centre 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 centre 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 testing shall be carried out in both longitudinal and transverse directions and sampling locations shall be as per API 6A.			

Material Datasheet	MDS No. 22CrF ^a		Rev. 00
TYPE OF MATERIAL: Austenitic stainless steel type 22Cr duplex			
Page 2 of 2			
Non-Destructive Testing	<p><u>Visual Inspection</u> 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.</p> <p><u>Ultrasonic inspection</u> Required on all forgings and as per EN 10228-4. Use Annex K for acceptance criteria.</p> <p><u>Dye Penetrant inspection</u> All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annexure K.</p>		
Repair of Defects	Weld repair is not permitted.		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	<p>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.</p> <p><u>Hardness testing</u> 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 28HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.</p>		
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	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - The MPS identification or the MCPR/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 NDT 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				
Page 1 of 3				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
	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	<p>This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.</p> <p>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. For components machined from bar size more than 100mm or 4 inches, bars shall be forged.</p> <p>Product covered by this MDS is limited to a maximum thickness of 200 mm or 8 in. For thickness exceeding 200 mm or 8 in., qualification and specification requirements shall be subject to agreement.</p>			
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 AOD or equivalent method.			
Manufacturing	<p>Bars shall be manufactured to the following requirements:</p> <ul style="list-style-type: none"> - 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. <p>NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted.</p>			
Chemical Composition	<p>PREN \geq 40.0</p> <p>A product chemical analysis shall be taken per melt of material.</p>			
Heat Treatment	<p>Bars shall be solution annealed followed by water/liquid quenching.</p> <p>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.</p>			
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 centreline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370 Annex A1.			
Impact Testing/ Toughness testing	<p>Except as modified in the MDS, sampling and acceptance criteria shall comply with ISO 17781 QL II.</p> <p>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.</p>			

Material Datasheet	MDS No. 25CrB ^a	Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 25Cr duplex		
Page 2 of 3		
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 centre 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 centre 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	<p>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.</p> <p>Valve parts manufactured from bar :</p> <p>For bars with outside diameter \geq 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. Acceptance criteria shall comply with this MDS.</p>	
Non-Destructive Testing	<p><u>Visual Inspection</u></p> <p>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.</p> <p><u>Ultrasonic inspection</u></p> <p>Required on all bars and as per EN 10228-4. Use Annex K for acceptance criteria.</p> <p><u>Dye Penetrant inspection</u></p> <p>All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annexure K.</p>	
Repair of Defects	Weld repair is not permitted.	
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	<p>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.</p> <p><u>Hardness testing</u></p> <p>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 32HRC from three readings taken in close proximity.</p> <p>The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.</p>	
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.	

Material Datasheet	MDS No. 25CrB ^a	Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 25Cr duplex		
Page 3 of 3		
Certification	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - The MPS identification or the MCPR/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 NDT carried out stating which standards material complies with. 	
<p>^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.</p>		

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				
Page 1 of 2				
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. For thickness exceeding 200 mm or 8 in., qualification and specification requirements shall be subject to agreement.			
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 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 \geq 40.0 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 centre 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 centre 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 testing shall be carried out in both longitudinal and transverse directions and sampling locations shall be as per API 6A.			

Material Datasheet	MDS No. 25CrF ^a		Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 25Cr duplex			
Page 2 of 2			
Non-Destructive Testing	<p><u>Visual Inspection</u> 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.</p> <p><u>Ultrasonic inspection</u> Required on all forgings and as per EN 10228-4. Use Annex K for acceptance criteria.</p> <p><u>Dye Penetrant inspection</u> All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K</p>		
Repair of Defects	Weld repair is not permitted.		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	<p>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.</p> <p><u>Hardness testing</u> 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 32HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.</p>		
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	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - The MPS identification or the MCPR/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 NDT 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				
Page 1 of 1				
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 < 0.450% or Pcm < 0.220%. 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. Any re-heat treatment shall be approved by purchaser.			
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 is not 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					
Page 1 of 1					
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 < 0.450% or Pcm < 0.220%. 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. Any re-heat treatment shall be approved by purchaser.				
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 is not 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				
Page 1 of 1				
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 tempering temperature with holding time equal to two 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. Any re-heat treatment shall be approved by purchaser.			
Tensile Testing	SMYS ≥ 65ksi			
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			
Extent of Testing	No additional requirement			
Non-Destructive Testing	No additional requirement			
Repair of Defects	Weld repair is not 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. FLAS

Material Datasheet	MDS No. FLAS ^a			Rev. 00
TYPE OF MATERIAL: Low alloyed steel fasteners				
Page 1 of 2				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bolting	ASTM A320	L7, L7M, L43		-
	ASTM A194	7 or 7M		ASTM A194 S3, S4, S5
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification..			
Manufacturing	<p>Threading of studs and bolts may be done by machining or rolling. Thread rolling shall be done after heat treatment.</p> <p>Threads in nuts shall be machined.</p> <p>All pressure boundary bolting and bolting that can compromise the functionality of the valve shall conform to the requirements of API 20E BSL2 or API 20F BSL 2.</p> <p>Purchaser shall specify if the bolting will be under insulation and in such cases sour service requirements as stated in this MDS shall apply. When bolting size is equal or greater than 2 ½" (M64), L43 shall be used.</p>			
Tensile Testing	Axial testing shall be carried out in addition to wedge testing in case of headed bolting. Maximum actual yield strength allowed is 930MPa and the yield to tensile strength ratio shall be maximum 0.88.			
Impact Testing/ Toughness testing	<p>Nuts to A194: S3 shall apply.</p> <p>For bolt, screw or stud lengths too short to extract a 55mm long test specimen from, a bolt(s), screw(s) or stud(s) of sufficient longer length shall be manufactured solely for CVN impact testing.</p>			
Proof Load Testing	Nuts to A194: S4 shall apply.			
Hardness Testing	In case of L7, L43 and 7 grades, hardness limit of 32HRC applies			
Extent of Testing	<p>Bolting shall be subjected to full size product mechanical and/or metallurgical testing/examination on a per manufactured lot basis.</p> <p>For mechanical testing, i.e. tensile/tension (axial or wedge) or proof load, no fewer than two (2) tests shall be performed per manufactured lot or the number of tests as specified in the base case standard/specification, whichever is the more stringent.</p>			
Decarburization Test	<p>Decarburization testing shall be performed on LAS bolting in accordance with ASTM A962/A962M in the following cases:</p> <ul style="list-style-type: none"> - When the LAS raw material OD, prior to the machining of any threads, is within 1,5 mm (0,06") in diameter of the (finished) bolting d; or - Any LAS bolting subjected to quality heat treatment after hot forming and/or thread rolling. <p>One (1) test shall be performed per manufactured lot.</p>			
Metallurgical Test	<p>One sample per manufacturing lot shall be tested for metallurgical properties.</p> <p>One microstructure examination for phases observed and grain size shall be carried out</p> <p>One macrostructure examination shall be carried out.</p> <p>Acceptance criteria shall be as per API 20E.</p>			

Material Datasheet	MDS No. FLAS ^a		Rev. 00
TYPE OF MATERIAL: Low alloyed steel fasteners			
Page 2 of 2			
Non-Destructive Testing	<p><u>Visual Inspection</u> VT Examination and acceptance criteria of bolting shall be in accordance with API 20E.</p> <p><u>Ultrasonic testing</u> All bolting shall be ultrasonically tested as per requirements of API 20E BSL-2, prior to threading or machining.</p> <p><u>Magnetic particle testing</u> 5 % of manufactured lot or minimum 2 of finished bolting shall be tested as per requirements of API 20E BSL-2 for surface defects.</p>		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	<p>When sour service is specified by the purchaser, only Grade L7M/7M is acceptable and hardness limit of 22HRC applies. 100% of bolting shall be tested for hardness.</p> <p>The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2 section 9 and this MDS.</p>		
Surface Treatment and Finish	<p>All bolting shall be protected from atmospheric corrosion. Hot dip galvanizing, Electrolytic Zinc and cadmium plating is not allowed. Any other electrolytic plating shall be baked for hydrogen removal as per API 20E.</p> <p>In case, PTFE coating is used, electrical continuity with the CP system shall be proven.</p>		
Dimensional Tolerances	Dimension control shall be as per sample size specified in API 20E table 3.		
Certification	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>All production testing shall be carried out at ISO 17025 certified lab or as agreed with purchaser.</p> <p>S5 shall apply for nuts to ASTM A194.</p> <p>The inspection documents shall be issued in accordance with ISO 16228 F3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - Steel manufacturer of starting material and original test certificate to ISO 10474 /EN 10204 Type 3.1; - Heat treatment condition; - Head / nut forming (hot forming / machining) method; - Thread forming (rolling or machining) method. 		
<p>^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.</p>			

Table R.9 - Material Datasheet No. 625F

Material Datasheet		MDS No.625F ^a			Rev. 00
TYPE OF MATERIAL: Nickel alloy type 625					
Page 1 of 1					
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 AOD or 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 which are heat treated in same batch. For hollow forgings, sampling shall be at half thickness For solid forgings, sampling shall be at T/2 for thickness less than 50 mm and at T/2 and T/4 for thickness more than 50 mm. Test sampling plan shall be approved by purchaser.				
Non-Destructive Testing	All NDE shall be carried out in accordance with Annex K				
Repair of Defects	Weld repair is not 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 section 7.2 and this MDS.				
Surface Treatment and Finish	Finished components shall be pickled. Machined surfaces do not require pickling.				
Marking	The component shall be marked to ensure full traceability to heat and heat treatment lot.				
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. 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. 625B

Material Datasheet	MDS No. 625B ^a			Rev. 00
TYPE OF MATERIAL: Annealed nickel alloy				
Page 1 of 1				
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 AOD or 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 is not 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 section 7.2 and this MDS.			
Surface Treatment and Finish	Finished bars shall be white pickled. Machined surfaces do not require pickling			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. 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.11 - Material Datasheet No. 718F

Material Datasheet	MDS No. 718 ^a			Rev. 00
TYPE OF MATERIAL: Nickel alloys				
Page 1 of 1				
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.			
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.			
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 API6ACRA shall apply.			
Hardness	Maximum hardness 40HRC.			
Macro Etch/ Micrographic Examination	Forging or bar shall be examined in accordance with API6ACRA 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 is not 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 section 7.2 and this MDS.			
Surface Treatment and Finish	White pickled. Finish machined surfaces may not be pickled.			
Marking	Each forging / bar shall be marked to ensure full traceability to melt and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 or EN 10204Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: <ul style="list-style-type: none"> – The MPS identification or the MCPR/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.12 - Material Datasheet No. 725F

Material Datasheet	MDS No. 725F ^a			Rev. 00
TYPE OF MATERIAL: Nickel alloys				
Page 1 of 1				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Forging / Forged bar / rolled bar	API STD 6ACRA	UNS N07725	120K	ASTM A962 S56
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
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			
Manufacturing	Manufacturing shall be according to written MPS under the qualification as required by this MDS.			
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 API6ACRA shall apply.			
Hardness	Maximum hardness 43HRC			
Macro Etch/ Micrographic Examination	Forgings / bars shall be examined in accordance with API6ACRA and the acceptance criteria shall be agreed with purchaser.			
Extent of Testing	No additional requirements.			
Non-Destructive Testing	All NDE shall be carried out in accordance in Annex K.			
Repair of Defects	Weld repair is not 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 section 7.2 and this MDS.			
Surface Treatment and Finish	White pickled. Finishes machined surfaces may not be pickled.			
Marking	Each forging / bar shall be marked to ensure full traceability to melt and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. 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: – The MPS identification or the MCPR/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.13 - Material Datasheet No. F718

Material Datasheet	MDS No. F718 ^a			Rev. 00
TYPE OF MATERIAL: Nickel alloy type 718				
Page 1 of 2				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bolting	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.			
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.			
Manufacturing	<p>Threading of studs and bolts may be done by machining. If thread rolling is carried out, it shall be performed after age hardening.</p> <p>Hot forming of heads or nuts is allowed only if heat treatment post hot forming is specifically qualified as per the requirements of ISO 17782 or NORSOK M-650. Otherwise heads and nuts shall be machined from bar (starting material) which is originally heat treated by the mill.</p> <p>Threads in nuts shall be machined.</p> <p>All bolting shall comply to API 20F BSL-3.</p>			
Heat Treatment	Solution annealing and ageing heat treatment shall be carried out after the final hot forming operation, provided it is specifically qualified for this grade. Otherwise, raw material shall be purchased with quality heat treatment already performed by the mill and test results meeting this MDS. Quenching media is restricted to the qualified manufacturing route.			
Impact Testing/ Toughness testing	The impact testing requirements of API6ACRA shall apply.			
Hardness	100 % bolting. Maximum hardness 40HRC. Hardness shall not be tested in the threaded area.			
Macro Etch/ Micrographic Examination	Bolting shall be examined in accordance with API6ACRA and meet the required acceptance criteria.			
Proof Load Testing	Proof load testing shall be carried out on nuts in accordance with ASTM A194 and the acceptance criteria shall comply with the requirements for Grade 7.			
Extent of Testing	<p>Testing shall be carried out on finished fastener. In case finished fastener is not of sufficient length, an additional fastener with sufficient length may be produced specifically for testing purpose, but shall have undergone the same process as the production lot (including same heat and heat treatment).</p> <p>For mechanical testing, i.e. tensile/tension (axial or wedge) or proof load, no fewer than two (2) tests shall be performed per manufactured lot or the number of tests as specified in the base case standard/specification, whichever is the more stringent.</p>			
Non-Destructive Testing	All NDE shall be in accordance with API 20F BSL-3.			
Repair of Defects	Weld repair is not permitted.			

Material Datasheet	MDS No. F718 ^a		Rev. 00
TYPE OF MATERIAL: Nickel alloy type 718			
Page 2 of 2			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	<p>The material shall conform to the requirements of ISO 15156 /NACE MR0175 , and this MDS.</p> <p>The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.</p>		
Surface Treatment and Finish	White pickled.		
Marking	Each bolting shall be marked to ensure full traceability to melt and heat treatment lot.		
Certification	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>All production testing shall be carried out at ISO 17025 certified lab or as agreed with purchaser.</p> <p>The inspection documents shall be issued in accordance with ISO 16228 Type F3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - The MPS identification or the MCPR/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.; - Head forming method shall be stated; - Thread forming method shall be stated; - Original steel mill certificate (EN 10204 / ISO 10474 type 3.1) shall be attached as annexure. 		
^a The supplementary suffix "S" designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service			

Table R.14 - Material Datasheet No. 660D

Material Datasheet	MDS No. 660D ^a			Rev. 00
TYPE OF MATERIAL: Precipitation-Hardened Stainless Steel				
Page 1 of 2				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bolting	ASTM A453	Grade 660 (UNS S66286)	Class D	-
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Threading of studs and bolts may be done by machining. Hot forming of heads and nuts is only acceptable if heat treatment post hot forming is specifically qualified for this grade on bolt/screws and nuts. Otherwise heads and nuts shall be machined from bar (starting material) which is originally heat treated by the mill Threads in nuts shall be machined. All bolting shall comply to API 20F BSL-3 as a minimum and this MDS.			
Heat Treatment	Heat treatment shall be carried out after the final hot forming operation provided it is specifically qualified for this grade. Otherwise, raw material shall be purchased with quality heat treatment already performed by the mill and test results meeting this MDS.			
Impact Testing/ Toughness testing	Impact testing shall be carried out at minus 101 °C (-150 °F). The minimum absorbed energy shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single, the lateral expansion shall be 0.38 mm (0.015 in).			
Proof Load Testing	Proof load testing shall be according to ASTM A962 and the load shall comply with ASTM A194 Grade 7.			
Extent of Testing	Testing shall be carried out on finished fastener. In case finished fastener is not of sufficient length, an additional fastener with sufficient length may be produced specifically for testing purpose, but shall have undergone the same process as the production lot (including same heat and heat treatment). For mechanical testing, i.e. tensile/tension (axial or wedge) or proof load, no fewer than two (2) tests shall be performed per manufactured lot or the number of tests as specified in the base case standard/specification, whichever is the more stringent.			
Non-Destructive Testing	All NDE shall be in accordance with API 20F BSL-3.			
Hardness Testing	All fasteners shall be hardness tested in accordance with ASTM F606/F606M and shall not exceed 35HRC.			
Repair of Defects	Weld repair is not permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) a	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. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.			
Marking	Each bolt and nut shall be marked on the end/head to ensure full traceability to heat and heat treatment lot.			

Material Datasheet	MDS No. 660D ^a	Rev. 00
TYPE OF MATERIAL: <i>Precipitation-Hardened Stainless Steel</i>		
Page 2 of 2		
Certification	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>All production testing shall be carried out at ISO 17025 certified lab or as agreed with purchaser.</p> <p>The inspection documents shall be issued in accordance with ISO 16228 Type F3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> – Steel manufacturer, melting and refining practice; – Heat treatment condition. Solution annealing temperature, quenching medium, ageing temperature and holding time shall be stated; – Head forming method shall be stated; – Thread forming method shall be stated; – Original steel mill certificate (EN 10204 / ISO 10474 type 3.1) shall be attached as annexure. 	
^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.15 - Material Datasheet No. F625

Material Datasheet	MDS No. F625 ^a			Rev. 00
TYPE OF MATERIAL: Nickel alloy type 625				
Page 1 of 2				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bolting	ASTM F468	UNS N06625	-	-
	ASTM F467	UNS N06625	Grade 2	-
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 AOD or 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			
Manufacturing	Threading of studs, bolts and screws may be done by machining or rolling. Thread rolling shall be done after heat treatment. Threads in nuts shall be machined.			
Heat Treatment	No additional requirements.			
Tensile Testing	For sizes above 37.5 mm (1½ in) in diameter the strength properties shall be agreed.			
Proof Load Testing	For sizes above 37.5 mm (1½ in) in diameter the strength properties shall be agreed.			
Extent of Testing	Testing shall be carried out on finished fastener. In case finished fastener is not of sufficient length, an additional fastener with sufficient length may be produced specifically for testing purpose, but shall have undergone the same process as the production lot (including same heat and heat treatment). For mechanical testing, i.e. tensile/tension(axial or wedge), torsional strength (torque breaking) or proof load, no fewer than two (2) tests shall be performed per manufactured lot or the number of tests as specified in the base case standard/specification, whichever is the more stringent. CVN impact testing shall consist of minimum one (1) set of three (3) test specimens.			
Test Sampling	<u>Visual Inspection</u> All products shall be 100 % visually examined in all areas of threads, shanks and heads. Discontinuities shall comply with requirements specified in ASTM F788 for bolts/studs and ASTM F812 for nuts. <u>Liquid Penetrant Testing</u> Liquid penetrant testing shall be according to ASTM A962. Supplementary requirement S56 shall apply to 10 % of the bolting. <u>Ultrasonic testing</u> All bolting diameter greater than 25mm shall be ultrasonically tested as per requirements of ASTM A745.			
Repair of Defects	Weld repair is not 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 section 7.2 and this MDS.			
Marking	Each bolt and nut shall be marked on the end/head to ensure full traceability to heat and heat treatment lot.			

Material Datasheet	MDS No. F625 ^a	Rev. 00
TYPE OF MATERIAL: Nickel alloy type 625		
Page 2 of 2		
Certification	<p>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.</p> <p>The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> – Heat treatment conditions (annealing temperature and time shall be stated); – Original inspection documents of the bar material shall be included in the documentation. 	
^a The supplementary suffix "S" designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.		

Table R.16 - Material Datasheet No. LCC

Material Datasheet	MDS No. LCC ^a			Rev. 00
TYPE OF MATERIAL: Impact tested carbon steel				
Page 1 of 2				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S23 ASTM A703 S8, S14, S20
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	All castings shall be manufactured in accordance with API 20A CSL-3.			
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 a minimum temperature of -46 °C (-50 °F). Acceptance criteria shall be 27 J (20 ft lbf) average, 20 J (15 ft lbf) single.			
Extent of Testing	ASTM A703 supplementary requirement S14 shall apply.			
Test Sampling	<p>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.</p> <p>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.</p> <p>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.</p>			
<p>The diagram illustrates two types of test blocks: an Integrated Test Block and a Gated Test Block. Both are shown in cross-section relative to a central circular casting. The Integrated Test Block is attached to the side of the casting, with a thickness of T and a width of T/2. A hatched area of width X is shown within it. The Gated Test Block is attached to the top of the casting, with a thickness of T and a width of T/4. A hatched area of width X is shown within it. The distance from the end of the hatched area to the end of the test block is labeled as T/4. The total thickness of the casting is labeled as T, and the total height of the gated block assembly is labeled as T+x.</p>				

Material Datasheet	MDS No. LCC ^a	Rev. 00
TYPE OF MATERIAL: Impact tested carbon steel		
Page 2 of 2		
Non-Destructive Testing	All NDE shall be carried out in accordance with Annex K.	
Repair of Defects	ASTM A703 supplementary requirement S20 shall apply with the following additional requirements: <ul style="list-style-type: none"> - Repairs as described in ASTM A352 sections 9.3 and 9.4 shall be considered major repairs and shall be documented in accordance with A703 S20.2 and approved by the purchaser. - 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 by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 , and the following additional requirements to the MDS. <p><u>Hardness testing</u></p> <ul style="list-style-type: none"> - 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 22HRC 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 section 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 section 9 and this MDS.	
Marking	The castings shall be marked to ensure full traceability to melt and heat treatment lot.	
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. <p>The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.</p> <p>The inspection documents shall include the following information:</p> <ul style="list-style-type: none"> - 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.17 - Element Datasheet No. HF01

Element Datasheet	EDS No. HF01		Rev. 00
Type of Special process: Hard facing by overlay welding			
Page 1 of 2			
Scope	This EDS specifies requirements for hard facing by overlay welding of valve parts.		
Welding	<p><u>Welding process</u></p> <p>The hard facing 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).</p> <p><u>Welding Consumable</u></p> <p>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) should be considered subject to purchaser approval. For seawater service, the consumable shall be subject to agreement with the purchaser.</p>		
Procedure Qualification Testing	<p><u>General</u></p> <p>The hard facing shall be carried out using welding procedures qualified in accordance with ASME IX or ISO 15614-7 modified as follows:</p> <ul style="list-style-type: none"> - 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. <p>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.</p> <p>The temperature of the components shall be checked during welding. The interpass temperature during hard facing of duplex stainless steels shall not exceed 150 °C (302 °F).</p> <p>The thickness of the hard facing shall be measured and be minimum 1.6 mm (0.06 in) after final machining.</p> <p><u>Hardness testing</u></p> <p>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. The hardness for HAZ and unaffected base material shall not exceed the maximum values specified in ISO 15156 /MR0175 and for type 22Cr and 25Cr duplex base materials the hardness shall not exceed 310HV average, 320HV individual single value.</p> <p><u>Metallographic examination</u></p> <p>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 %.</p>		

Element Datasheet	EDS No. HF01		Rev. 00
Type of Special process: Hard facing by overlay welding			
Page 2 of 2			
	<p><u>Corrosion testing</u></p> <p>Corrosion testing shall be carried out for 25Cr duplex, Alloy 625 and Alloy 718 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 hard facing may be removed, but any buffer layer and heat affected zone in the base material shall be exposed in the corrosion test</p> <p><u>Macro section</u></p> <p>The macro section for the qualification shall show no cracking and complete fusion between base material and the hard facing layer.</p>		
Procedure Qualification Testing	<p><u>Impact testing</u></p> <p>The qualification testing shall include Charpy V-notch 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 hard facing and base material. The notch shall be perpendicular to the hard faced surface.</p>		
Heat Treatment	<p>Heat treatment after hard facing 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.</p> <p>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).</p>		
Non-Destructive Testing	<p><u>Visual Inspection</u></p> <p>VT shall be carried out on each 100 % of the weld overlay according to ASME BPVC Sec. 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.</p> <p><u>Liquid penetrant testing</u></p> <p>All deposited surfaces shall, after final machining, be penetrant tested in accordance with ASME V Article 6 with acceptance criteria according to ASME VIII, Div. 1, Appendix 8, except on sealing surfaces where no indication is acceptable (actual sealing surface areas to be defined by purchaser).</p>		
Repair of Defects	<p>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.</p> <p>All excavations shall be dye penetrant inspected prior to the start of repair welding in order to confirm the complete removal of defects.</p> <p>Repair by re-welding shall be performed in accordance with a written procedure. The following information must be given in these procedures:</p> <ul style="list-style-type: none"> - 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.18 - Element Datasheet No. HF02

Element Datasheet	EDS No. HF02	Rev. 00
Type of Special Process: Hard facing by thermal spraying of tungsten carbide		
Page 1 of 2		
Scope	This EDS specifies requirements for hard facing by thermal spraying of tungsten carbide of valve parts.	
Process	<p><u>General</u> The hard facing shall be carried out using high velocity oxygen fuel (HVOF) or equivalent process.</p> <p><u>Coating composition</u> 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.</p> <p><u>Coating thickness</u> 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, unless specified otherwise by the purchaser.</p> <p><u>Surface preparation</u> 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 min to 320 min) 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.</p> <p><u>Thermal spraying</u> 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 fulfill 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.</p> <p><u>Sealing</u> All coated surfaces shall be sealed when carbon or low alloy steel is the base material. If sealer is used, the type of sealer and testing requirements shall be agreed with the purchaser and be specified in the procedure.</p> <p><u>Finishing</u> All coated parts shall be ground and lapped to a mirror like finish and maximum roughness of Ra = 0.15 µm (6 min).</p>	

Element Datasheet	EDS No. HF02		Rev. 00
Type of Special Process: Hard facing by thermal spraying of tungsten carbide			
Page 2 of 2			
Procedure Qualification Testing	<p><u>General</u></p> <p>The thermal spray procedure shall be supported by a qualification test and the following essential variables shall apply to each procedure:</p> <ul style="list-style-type: none"> - the type of equipment used; - nozzle length; - fuel and gas flow rate, $\pm 5\%$; - spray distance, $\pm 5\%$; - spray rate, $\pm 5\%$; - grade of powder; - powder supplier; - sealer type (if used). <p>The procedure shall be re-qualified if any of the above is changed outside given allowable range.</p> <p>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.</p>		
Procedure Qualification Testing	<p><u>Bonding test</u></p> <p>The bonding strength shall be tested in accordance with ASTM C633 or ISO 4624. Not less than 3 specimens of a type shall be tested.</p> <p>Acceptance criteria: minimum bond strength shall be 60 MPa (8.7 ksi).</p> <p><u>Bending test</u></p> <p>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).</p> <p>Acceptance criteria: no spalling is acceptable. However, cracking in the coating and chipping on the edge of the test specimen is acceptable.</p> <p><u>Hardness test</u></p> <p>A minimum of 3 indentations shall be made on a cross section for metallographic examination.</p> <p>Acceptance criteria: The average hardness shall be minimum 1000HV0.3 with minimum single value not lower than 900HV0.3.</p> <p><u>Porosity test</u></p> <p>One piece shall be prepared for cross section metallographic examination. An area of minimum 1.0 mm² shall be examined.</p> <p>Acceptance criteria: the porosity shall be less than 1 % by area.</p> <p><u>Surface finish test</u></p> <p>The surface roughness of the finished component shall be tested.</p> <p>Acceptance criteria: The roughness value shall be $R_a \leq 0.15 \mu\text{m}$ (6 min).</p>		
Production Testing	<p>Finished polished hard facing thickness and surface roughness of all parts shall be tested and shall fulfill the requirements specified above.</p> <p>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.</p>		

Table R.19 - Element Datasheet No. CRO01

Element Datasheet	EDS No. CRO01	Rev. 00
Type of Special process: Alloy 625 corrosion resistant overlay welding		
Page 1 of 2		
Scope	This EDS specifies requirements for corrosion resistant overlay welding for valve parts.	
Welding	<p><u>Welding process</u> Slag-forming welding processes are not permitted for overlay welding of valve component surfaces. A minimum of two layers of weld metal shall be deposited for all processes. Thickness of the overlay deposit for corrosion protection after final machining shall be minimum 3.0 mm or as required on applicable design drawing.</p> <p><u>Welding Consumable</u> The welding consumable for the weld overlay shall comply with UNS N06625.</p> <p><u>Welders, operators qualification</u> The welder or welding operators shall be qualified to ASME IX, ISO 9606 or ISO 14732.</p>	
Procedure Qualification Testing	<p><u>General</u> The welding procedures shall be qualified in accordance with ASME IX or ISO 15614-7, modified as follows. The weld qualification test shall be carried out on base material of same grade as to be used in production. Qualification testing shall be carried out according to ASME IX or ISO 15614-7 and the following additional requirements.</p> <p><u>Chemical composition</u> The weld overlay deposit shall comply with UNS N06625 with a maximum iron content of 10 % by mass measured at the minimum qualified thickness, unless a lower value of 5 % iron by mass is specified by the purchaser.</p> <p><u>Hardness testing</u> 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. Testing of HAZ shall be carried out with maximum 0.5 mm (0.02 in) distance between the indentations from fusion line, through HAZ into unaffected base material. The hardness for HAZ and unaffected base material shall not exceed 350 HV. When sour service is specified by the purchaser, the hardness of the weld overlay, HAZ and unaffected base material shall not exceed the maximum values specified in ISO 15156 /NACE MR0175 . The hardness of finished machined overlay surface shall not exceed 35 HRC for Alloy 625.</p>	
Heat Treatment	Heat treatment after overlay welding shall be carried out, as necessary, to meet specified properties.	

Element Datasheet	EDS No. CRO01		Rev. 00
Type of Special process: Alloy 625 corrosion resistant overlay welding			
Page 2 of 2			
Non-Destructive Testing	<p><u>Visual Inspection</u> VT shall be carried out on each 100 % of the weld overlay according to Annex K</p> <p><u>Liquid penetrant testing</u> All deposited surfaces shall, after final machining, be penetrant tested in accordance with Annex K</p> <p><u>UT Bond INtegrity testing</u> All deposited surfaces shall, after final machining, be penetrant tested in accordance with Annex K</p> <p><u>Thickness of weld overlay</u> The weld overlay thickness shall be measured at minimum three locations for each component. For components with complicated geometry the manufacturer shall establish a procedure for this purpose.</p>		
Repair of Defects	<p>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.</p> <p>All excavations shall be dye penetrant inspected prior to the start of repair welding in order to confirm the complete removal of defects.</p> <p>Repair by re-welding shall be performed in accordance with a written procedure. The following information must be given in these procedures:</p> <ul style="list-style-type: none"> - 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. 		

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