

# Supplementary Specification to API Standard 6DSSX Operator and Mounting Kits for Subsea Pipeline Valves

Public Review Draft

## Revision history

VERSION	DATE	PURPOSE
0.1	November 2020	Issued for Public Review

## Acknowledgements

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

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## Foreword

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

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

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

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

## Table of Contents

	Foreword .....	1
	Introduction .....	5
1	Scope .....	7
2	Normative References .....	7
3	Terms, Definitions, Acronyms, Abbreviations, Symbols and Units .....	7
5	Design .....	7
	5.1 Design Input .....	7
	5.3 Design Requirements .....	8
	5.6 Mechanically Loaded Parts .....	8
	5.7 Springs and Spring Modules .....	8
	5.8 Mounting Kit .....	8
	5.10 Design Documents .....	8
	5.11 Sealing .....	8
	5.13 Compensation System .....	9
	5.15 Retrieval Operators .....	9
	5.16 Operator Override .....	9
	5.18 Lifting Arrangements .....	9
	5.23 Environmental and Operational Conditions .....	10
	5.25 Water Depth Performance .....	10
	5.26 Corrosion Resistant Overlay .....	10
	5.29 Hydraulic Connections .....	10
	5.32 Instrumentation and Accessories .....	10
	5.34 Travel Stops .....	11
	5.35 Assembly Practice .....	11
	5.36 Temperature Rating .....	11
6	Materials .....	11
	6.1 Material Specification .....	11
	6.2 Tensile Test Requirements .....	11
	6.3 Service Compatibility .....	12
	6.4 Cast Material .....	12
	6.5 Forged Material .....	12
	6.6 Composition Limits .....	12
	6.7 Impact Test Requirements .....	13
	6.8 Pressure Boundary Bolting .....	13
	6.9 Cathodic Protection .....	14
7	Welding .....	14
	7.2 Welding Procedure and Welder/Welding Operator Qualifications .....	14

7.3	Impact Testing.....	14
7.5	Repairs.....	14
7.8	Other welding requirements.....	14
8	Quality Control.....	15
8.5	Measuring and Test Equipment.....	15
8.8	NDE of Repairs.....	15
9	Sizing Methodology.....	15
9.1	Sizing Method.....	15
9.2	Design and Sizing Output Data.....	16
10	Testing.....	16
10.1	Validation.....	16
10.2	Effect of Changes in Product.....	16
10.3	Factory Acceptance Test.....	16
11	Surface Protection.....	19
13	Preparation for Shipment.....	19
	Annex A (normative) Optional Documentation.....	20
	Annex B (normative) Purchasing Guidelines.....	21
	Annex D (normative) Design Validation—Actuators.....	22
	Annex E (normative) Design Validation—Gearbox.....	27
	Annex F (normative) Hyperbaric Validation Testing.....	30
	Annex G (normative) Requirements for Nondestructive Examination.....	33
	Annex H (informative) Castings and Forgings.....	37
	Annex J (normative) Material Datasheets.....	38

## List of Tables

Table D.1—Design Validation for Actuator.....	24
Table D.2—Endurance Cycles - Typical Example.....	26
Table E.2—Endurance Cycles - Typical Example.....	29
Table G.1—NDE Requirements.....	35
Table G.2—Extent, Method, and Acceptance Criteria of NDE/Item Examination Code.....	36
Table J.1—Material Datasheet No. 22CrB.....	38
Table J.2—Material Datasheet No. 22CrF.....	41
Table J.3—Material Datasheet No. 25CrB.....	43
Table J.4—Material Datasheet No. 25CrF.....	45
Table J.5—Material Datasheet No. 625F.....	47
Table J.6—Material Datasheet No. 625B.....	48
Table J.7—Material Datasheet No. 718F.....	49

**List of Figures**

Figure D.1—Test Procedure for Pressure Temperature Cycle .....25

Public Review Draft

## Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of subsea operators in accordance with API Standard 6DSSX, first edition, [not yet published], Standard for Operator and Mounting Kits for Subsea Pipeline Valves for application in the petroleum and natural gas industries.

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



### JIP33 Specification for Procurement Documents Supplementary Technical Specification

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

#### **IOGP S-731: Supplementary Specification to API Standard 6DSSX Operator and Mounting Kits for Subsea Pipeline Valves**

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to API Standard 6DSSX, following the API Standard 6DSXX section structure. Sections from API Standard 6DSXX not amended by this specification, apply as written to the extent applicable to the scope of supply.

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

#### **IOGP S-731D: Data Sheet for Operator and Mounting Kits for Subsea Pipeline Valves (API Standard 6DSSX)**

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

### **IOGP S-731Q: Quality Requirements for Operator and Mounting Kits for Subsea Pipeline Valves (API Standard 6DSSX)**

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

### **IOGP S-731L: Information Requirements for Operator and Mounting Kits for Subsea Pipeline Valves (API Standard 6DSSX)**

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

The terminology used within this specification and the supporting data sheet, quality and information requirements follows that of the parent standard and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

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

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

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (data sheet, QRS, IRS);
- d) this specification;
- e) API Standard 6DSSX.



## 1 Scope

In first paragraph, replace "subsea pipeline valves that conform to API Specification 6DSS" with

subsea valves, excluding tree valves

## 2 Normative References

Add to section

API Recommended Practice 17A:2017, *Design and Operation of Subsea Production Systems-General Requirements and Recommendations*

API Specification 6A:2018, *Specification for Wellhead and Tree Equipment*

API Specification 20A:2017, *Carbon Steel, Alloy Steel, Stainless Steel, and Nickel Base Alloy Castings for Use in the Petroleum and Natural Gas Industry*

API Specification 20B:2013, *Open Die Shaped Forgings for Use in the Petroleum and Natural Gas Industry*

API Specification 20C:2020, *Closed Die Forgings for Use in the Petroleum and Natural Gas Industry*

ASTM E186, *Standard Reference Radiographs for Heavy-Walled (2 to 4½ in. (50.8 to 114 mm)) Steel Castings*

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

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

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

IOGP S-724, *Supplementary Specification to API Specification 20E Subsea Fasteners (Alloy and Carbon Steel Bolting)*

IOGP S-725, *Supplementary Specification to API Specification 20F Subsea Fasteners (Corrosion-resistant Bolting)*

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

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

### 3.1.27

**pressure, maximum rated**

Delete "as defined by the actuator manufacturer" from definition

## 5 Design

### 5.1 Design Input

#### 5.1.1 General

Delete "(see API 6DSS)" from list item f)

Delete "(see API 6DSS)" from fourth bullet of list item m)

#### 5.1.3 Valve Torque and/or Thrust Data

Delete list item o)

## 5.3 Design Requirements

### 5.3.1 General

Delete "shall be defined by the actuator manufacturer" from list item b)

### 5.3.2 Design Basis

Add to section

Internal chambers that are exposed to potential pressure build up resulting from piston or stem leakage shall be designed to at least 1.1 x relief valve set pressure.

## 5.6 Mechanically Loaded Parts

Replace first paragraph (including list items) with

Mechanically loaded parts shall be designed to accommodate the maximum anticipated in-service loads including the loads generated at design torque/thrust.

## 5.7 Springs and Spring Modules

In second paragraph, replace "600 times" with

5,000 times

## 5.8 Mounting Kit

In first bullet item, replace "torque/thrust generated at maximum supply pressure" with

"torque/thrust generated at design pressure"

Replace fourth bullet item with

— ROT interface loads.

### 5.8.1 Interface with the Valve

Delete "(see API 6DSS)" from NOTE 1

## 5.10 Design Documents

### 5.10.1 Design File Documentation

Add to second paragraph

Design validation documentation shall identify the person(s) conducting and witnessing the tests as well as the time and place of the testing.

## 5.11 Sealing

### 5.11.1 General

Delete first sentence

Add new list item j)

- j) Interface and cavity seal materials between the operator and the valve, potentially exposed to valve stem seal leakage, shall be suitable for the valve operating fluid(s).

### **5.13 Compensation System**

#### **5.13.6 Sizing of Compensation Tank Volume**

In third paragraph, replace "120 %" with

200 %

#### **5.13.7 Relief System**

##### **5.13.7.1 General**

Add to section

A relief system shall be provided for spring return type actuator to prevent closing (opening) failure by spring (lock in position or velocity reduction) in case of compensation system failure unless otherwise agreed by the purchaser.

### **5.15 Retrieval Operators**

#### **5.15.2 Interfaces for Retrievable Operators**

##### **5.15.2.1 Valve-to-operator Interface**

Add to section

The design shall demonstrate that the valve stem does not move during operator removal/replacement.

### **5.16 Operator Override**

#### **5.16.1 Mechanical Override System for Actuator (ROT)**

Add to section

Opening direction for mechanical overrides shall be designed as per the following requirements:

- a) counter-clockwise as viewed from the override interface for rotational operation;
- b) push on the override for linear operation.

### **5.18 Lifting Arrangements**

#### **5.18.1 General**

Replace fourth paragraph with

Type 1 and Type 3 lifting points shall be designed, tested and marked in accordance with API Recommended Practice 17D.

## 5.23 Environmental and Operational Conditions

### Add to section

Dropped or dragged object protection, when specified by purchaser, should use loads as per Table 1 and Table 2 in API Recommended Practice 17A.

## 5.25 Water Depth Performance

### Replace second paragraph with

The manufacturer shall demonstrate that the operator is suitable for the required water depth by testing in accordance with Annex F.

### Delete "(if requested)" from third paragraph

## 5.26 Corrosion Resistant Overlay

### Add to first paragraph

All other seal areas manufactured from carbon or low alloy steel and exposed to sea water shall be protected with a corrosion resistant overlay.

## 5.29 Hydraulic Connections

### Replace fourth paragraph with

Mechanical connections shall provide leak tight performance for the life of the field and be validated for relevant load cases including vibration from transportation, shock loads, pressure fluctuations and production loadings.

Solutions may be achieved by one of the following:

- a cone and threaded metal-to-metal axially loaded non-rotating seal face fitting with anti-vibration collet;
- 37° cone seal (JIC) fittings conforming to SAE J514 (ISO 8434-2);
- twin ferrule compression fittings.

Rotational back-off preventative measures shall be used at all mechanical fittings.

Tubing runs shall be secured to prevent rotation of the tube and un-threading of the fitting.

Coned and threaded tube anti-vibration collars alone do not meet this requirement. Other anti-vibration methods may be utilized as long as they have been tested and proven to be effective at resisting backing off.

## 5.32 Instrumentation and Accessories

### Delete item c)

### Delete item d)

### In list item e), replace "shall conform" with

shall be in compliance with

Add to section

Any receptacles and position indicators shall be provided with covers retained with plastic or stainless steel braided wire, rope or chain.

## **5.34 Travel Stops**

### **5.34.1 General**

Replace NOTE 2 with

NOTE 2 Refer to IOGP S-708, 5.16 for guidance on travel stops by valve type.

## **5.35 Assembly Practice**

### **5.35.2 Flushing**

Add to section

Flushing shall include a minimum of three full strokes of the actuator.

Add new section

## **5.36 Temperature Rating**

Operators shall be qualified at temperature ratings as defined in this specification.

The temperature rating shall be defined in accordance with the following:

- the minimum rating to be no greater than 14 °F (-10 °C).
- the maximum rating to be no less than 158 °F (70 °C).

## **6 Materials**

### **6.1 Material Specification**

Add new list item e)

- e) reference to applicable international manufacturing standard.

### **6.2 Tensile Test Requirements**

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

sacrificial part or integral prolongation

In first sentence of third paragraph, replace "pressure containing parts" with

all pressure containing, pressure controlling and mechanically loaded parts

In second sentence of third paragraph, replace "yield strength" with

tensile properties

### 6.3 Service Compatibility

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

as specified

In second paragraph, replace "Metallic materials" with

Metallic materials including bearings

### 6.4 Cast Material

Replace section with

Casting material shall conform to API Specification 20A in accordance with the following casting specification levels (CSL):

- CSL-3 for pressure-containing castings; and
- CSL-2 or higher for pressure-controlling castings.

### 6.5 Forged Material

Delete NOTE 2

Add to section

All forged pressure-containing materials shall be formed using a hot-working practice and heat treatment throughout that produces a forged structure with a minimum forge ratio of 4.0:1.

The forging ratio shall be included as part of the material certifications.

The forgings shall comply with the requirements of applicable industry standard.

Open-die forgings shall conform to API Specification 20B in accordance with specification levels FSL-2 or greater for each material group.

Closed-die forgings shall conform to API Specification 20C in accordance with specification levels FSL-2 or greater for each material group.

### 6.6 Composition Limits

#### 6.6.1 General

In first paragraph, replace "carbon and alloy steel pressure-containing parts" with

pressure-containing and pressure-controlling parts

#### 6.6.2 Carbon Steel

Delete "carbon steel" from second paragraph

#### 6.6.4 Duplex and Super Duplex Stainless Steel

Replace section with

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

#### 6.7 Impact Test Requirements

Replace first sentence of first paragraph with

Impact testing shall be performed for all materials excluding austenitic stainless steel, for pressure-containing and pressure-controlling parts, in accordance with MDSs in Annex J if applicable.

Any other material for pressure-containing and pressure-controlling parts shall be tested at minimum design temperature or at 32 °F (0 °C), whichever is less.

Delete NOTE

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

sacrificial part or integral prolongation

Delete sixth paragraph

Replace seventh paragraph with

Impact test results for bolting material shall meet the requirements of IOGP S-724 or IOGP S-725 as applicable.

In eighth paragraph, replace "Each impact specimen" with

Each retest impact specimen

Replace ninth paragraph with

Charpy impact values and test temperatures for other materials (materials other than carbon steel, low alloy steel, duplex or super duplex) shall be by agreement.

#### 6.8 Pressure Boundary Bolting

Replace paragraph with

Pressure boundary bolting shall conform to the requirements of IOGP S-724 or IOGP S-725 as applicable.

##### 6.8.2 Carbon and Alloy Steel Bolting

In first paragraph, replace "API 20E" with

IOGP S-724

##### 6.8.3 CRA Bolting

In first paragraph, replace "API 20F" with

IOGP S-725

Move NOTE to section 6.8.2

## **6.9 Cathodic Protection**

Delete NOTE

Add to section

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

## **7 Welding**

### **7.2 Welding Procedure and Welder/Welding Operator Qualifications**

Add to beginning of seventh paragraph

Overlay welding shall be a minimum of two layers.

### **7.3 Impact Testing**

Replace second paragraph with

Impact testing shall be performed for all materials excluding austenitic stainless steel, for pressure-containing and pressure-controlling parts, in accordance with MDSs in Annex J if applicable.

Any other material for pressure-containing and pressure-controlling parts shall be tested at minimum design temperature or at 32 °F (0 °C), whichever is less.

The absorbed energy shall be in accordance with the appropriate parent material standard or Table 4 and/or Table 5 as applicable, whichever is higher.

Delete NOTE

Delete "at 32 °F (0 °C) or below" from sixth paragraph

### **7.5 Repairs**

Delete "unless otherwise agreed" from third paragraph

Add after fourth paragraph

Weld repair procedures for castings shall be approved by the purchaser.

Add new section

### **7.8 Other welding requirements**

Add new section

#### **7.8.1 Seal Welding**

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

— seal welding is performed with two passes; and



— the throat thickness is 0.12 in. (3 mm) minimum.

### 7.8.2 Welding on threads

Welding on the threaded area shall not be permitted.

## 8 Quality Control

### 8.5 Measuring and Test Equipment

#### 8.5.3 Pressure-measuring Devices

Add new section

##### 8.5.3.4 Calibration Records

Calibration records for measuring and testing equipment shall be available for review if requested.

### 8.8 NDE of Repairs

In third paragraph, replace "Annex I" with

Annex G

In fourth paragraph, replace "8.1" with

8.4

## 9 Sizing Methodology

### 9.1 Sizing Method

#### 9.1.2 Safety Factor

In first paragraph, replace "required thrust/ torque during the entire valve operating cycle:" with

thrust/torque required by valve at the worst case conditions during the entire operating cycle:

Add "unless otherwise specified by purchaser" to list item a)

In list item c), replace "1.0" with

1.1

In list item d), replace "1.5" with

2.0

#### 9.1.3 Hydraulic Actuator

Add NOTE

NOTE For spring return actuators in direct hydraulic systems, sizing should consider a minimum back-pressure of 100 psi plus the difference between the control head pressure and the hydrostatic pressure related to the maximum design water depth is developed in the return line during the entire returning stroke of the actuator.

## **9.2 Design and Sizing Output Data**

### **9.2.1 Hydraulic Actuator**

Add "for ambient and installed conditions" to list item e)

## **10 Testing**

### **10.1 Validation**

Add to section

The manufacturer's written procedures shall conform to the minimum requirements in Annex D, or Annex E and Annex F.

Additional validation tests that correlate intended service life and/or operating conditions in accordance with the purchaser's requirements shall be defined and demonstrated through validation testing.

Replace NOTE with

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

### **10.2 Effect of Changes in Product**

#### **10.2.3 Pressure Caps**

Replace section with

If a pressure cap is provided by actuator supplier, it shall comply with the requirements in API Specification 6DSS, 5.25.

### **10.3 Factory Acceptance Test**

#### **10.3.3 Actuator Testing**

##### **10.3.3.1 General**

Add to the end of first sentence of second paragraph

and compensation system if applicable.

Add to section

After actuator assembly and prior to filling hydraulic oil, the compensated parts shall be low-pressure gas tested as specified by the manufacturer.

The minimum test duration shall be 5 minutes after pressure stabilization has been achieved. No visible leakage shall be allowed.

##### **10.3.3.3 Hold Periods**

###### **10.3.3.3.2 Pressure Stabilization**

Replace second sentence with

The final settling pressure shall not fall below the test pressure before the end of the test hold period.

The initial test pressure shall not be greater than 5 % above the specified test pressure.

#### **10.3.3.3.3 Pressure Maintenance**

Replace paragraph with

Pressure shall remain as per 10.3.3.3.2 during the hold period.

#### **10.3.3.4 Hydraulic Actuator Hydrostatic Shell Test**

Replace section with

##### **10.3.3.4.1 Actuator Cylinder and Piston Shell Test**

Each hydraulic actuator cylinder and piston shall be subjected to a hydrostatic test to demonstrate structural integrity.

The test pressure shall be a minimum of 1.5 X the design pressure rating of the actuator.

As per API Specification 17D, the test shall consist of three parts:

- primary pressure-holding period;
- reduction of the pressure to zero;
- secondary pressure-holding period.

The first pressure-holding period shall not be less than 3 minutes.

The second pressure-holding period shall not be less than 1 hour.

The test period shall not begin until the test pressure has been reached and has stabilized, the equipment and the pressure-monitoring device have been isolated from the pressure source.

The external surfaces of the parts shall be thoroughly dried.

No visible leakage shall be allowed.

##### **10.3.3.4.2 Compensated or non-compensated parts shell test**

Each hydraulic compensated or non-compensated parts shall be subjected to a hydrostatic test to demonstrate structural integrity.

The test pressure shall be a minimum of 1.5 X the relief valve set pressure or a pressure determined by the manufacturer, the higher values shall apply.

As per API specification 17D, the test shall consist of three parts:

- primary pressure-holding period;
- reduction of the pressure to zero;
- secondary pressure-holding period.

The first pressure-holding period shall not be less than 3 minutes.

The second pressure-holding periods shall not be less than 1 hour.

The test period shall not begin until the test pressure has been reached and has stabilized, the equipment and the pressure-monitoring device have been isolated from the pressure source.

The external surfaces of the parts shall be thoroughly dried.

No visible leakage shall be allowed.

#### **10.3.3.6 Hydraulic Actuator Compensation Circuit Test**

In first sentence of first paragraph, replace "compensation chamber" with

compensation chamber and circuit

Delete "housing" from second paragraph

#### **10.3.3.7 Actuator Operational Test**

##### **10.3.3.7.3 Force Measurement**

Replace fourth paragraph with

The output shall be measured at the design, minimum and maximum rated pressure, and minimum and maximum supply pressure/input torques during the full stroke of the actuator.

#### **10.3.4 Gearbox Testing**

Add to section

After gearbox assembly, the compensated and non-compensated parts shall be low-pressure gas tested as per the manufacturer's specifications.

The minimum test duration shall be 5 minutes after pressure stabilization has been achieved.

No visible leakage shall be allowed.

##### **10.3.4.1 Gearbox Housing and Compensation Chamber Seal Test**

Add before first paragraph

Each compensated or non-compensated gearbox housing shall be subjected to a hydrostatic test to demonstrate structural integrity.

The test pressure shall be a minimum of 1.5 X the relief valve set pressure or a pressure determined by the manufacturer, whichever is higher.

As per API Specification 17D, the test shall consist of three parts:

- primary pressure-holding period;
- reduction of the pressure to zero;
- secondary pressure-holding period.

The first pressure-holding period shall not be less than 3 minutes.

The second pressure-holding period shall not be less than 1 hour.

The test period shall not begin until the test pressure has been reached and has stabilized, and the equipment and the pressure-monitoring device have been isolated from the pressure source.

The external surfaces of the parts shall be thoroughly dried.

The gearbox housing shall show no visible leakage while subjected to test pressure.

### **10.3.7 Testing of Valve and Operator Assembly**

In first sentence of first paragraph, replace "API 6DSS" with

IOGP S-708

In NOTE 1, Replace "API 6DSS" with

IOGP S-708

## **11 Surface Protection**

Delete "non-corrosion-resistant" from first paragraph

## **13 Preparation for Shipment**

Add to section

Any blanked off supply ports that prevent the ROT override from being used due to hydraulic lock shall be clearly identified with a temporary warning label on the ROV override interface.

## **Annex A** **(normative)** **Optional Documentation**

*In Annex A heading, replace "informative" with "normative"*

*Replace Annex A with*

Refer to IOGP S-731L for documentation requirements.

## **Annex B (normative) Purchasing Guidelines**

Replace Annex B with

Refer to IOGP S-731D for purchasing guidelines.

## **Annex D**

### **(normative)**

## **Design Validation—Actuators**

In Annex D heading, replace "informative" with "normative"

### **D.1 General**

Delete first paragraph

Delete NOTE

### **D.2 Products for Validation**

#### **D.2.1 General**

Add to section after first paragraph

As per API Specification 17D 5.1.7.2, prototype equipment (or first article) and fixtures used to qualify designs using these validation procedures shall be representative of production models in terms of design, production dimensions/tolerances, intended manufacturing processes, deflections and materials.

The actual dimensions of equipment subjected to validation test shall be within the allowable range for dimensions specified for normal production equipment.

Equipment should be qualified with the minimal lubricants required for assembly unless the lubricants can be replenished when the equipment is in service or is provided for service in a sealed chamber.

#### **D.2.2 Testing Product**

Add to section

For redundant seal designs (refer to 5.11.4), the seal mechanisms shall be independently validated unless the primary and secondary seal mechanisms are identical.

### **D.4 Test Orientation**

Replace first paragraph with

The orientation of the actuator during validation testing shall be per installed orientation as specified in the valve datasheet unless otherwise agreed.

### **D.8 Temperature Stabilization**

Add to first paragraph

As per API Specification 6A, the temperature shall remain at or beyond the extreme during the hold period but should not go beyond the upper and lower temperatures by more than 11 °C (20 °F).



## **D.9      Scaling**

### **D.9.1      General**

Add to section

Scaling shall only be applied if agreed by the purchaser.

### **D.9.3      Validation by Output Torque/Thrust**

Replace section with

Validation of an actuator with a nominal output torque/thrust "X" shall qualify all operators having nominal output torque/thrust between 75 % X and 125 % X that are of the same design, safety factors, manufactured under the same process, same material and the operator meets equal or shallower water depth rating requirements.

### **D.9.4      Validation by Hydraulic Design Pressure**

Replace section with

Scaling by hydraulic design pressure shall not be accepted.

## **D.10      Documentation**

### **D.10.2      Contents of Validation Files**

Add list item i)

i) person(s) conducting and witnessing the tests,

Add list item j)

j) place of the testing.

## **D.11      Validation Procedure**

### **D.11.1      General**

Replace first sentence of first paragraph with

Validation of actuators shall be performed by:

- a) following the procedure listed in Table D.1; and
- b) by completing endurance cycles as identified in D.14.

Add to paragraph

For retrievable actuators, additional testing as per D.13 shall be performed.

In second paragraph, replace "appropriate" with

full

**Table D.1—Design Validation for Actuator**

*Add new row before "fluid cleanliness check D.11.2"*

Design Validation Tests	Reference Section
Make/Break testing for Retrievable Actuators (if applicable)	D.13

*Add new row after "Static operating torque/thrust output measurement (fixture only) D.11.8"*

Design Validation Tests	Reference Section
Testing of Valve and Operator Assembly (when qualified with Valve)	D.11.18

*Add new row after "Actuator Operational Test (repeat) D.11.15"*

Design Validation Tests	Reference Section
Testing of Valve and Operator Assembly (when qualified with Valve) (repeat)	D.11.18

### **D.11.3 Hydraulic cylinder shell test**

*Add "except that the holding period shall be at least 1 hour." at end of sentence*

### **D.11.5 Hydraulic Actuator Piston Seal Test**

*Replace paragraph with*

Actuator seal test as per 10.3.3.5 shall be repeated three times. During third time, the minimum hold period shall not be less than 1 hour, when 1 X the hydraulic design pressure is applied.

### **D.11.7 Actuator Operational Test**

*Add to section*

The actuator shall be tested in accordance with 10.3.3.7.

### **D.11.9 Dynamic open/close cycling test at ambient temperature (fixture or valve)**

#### **D.11.9.2 Procedure**

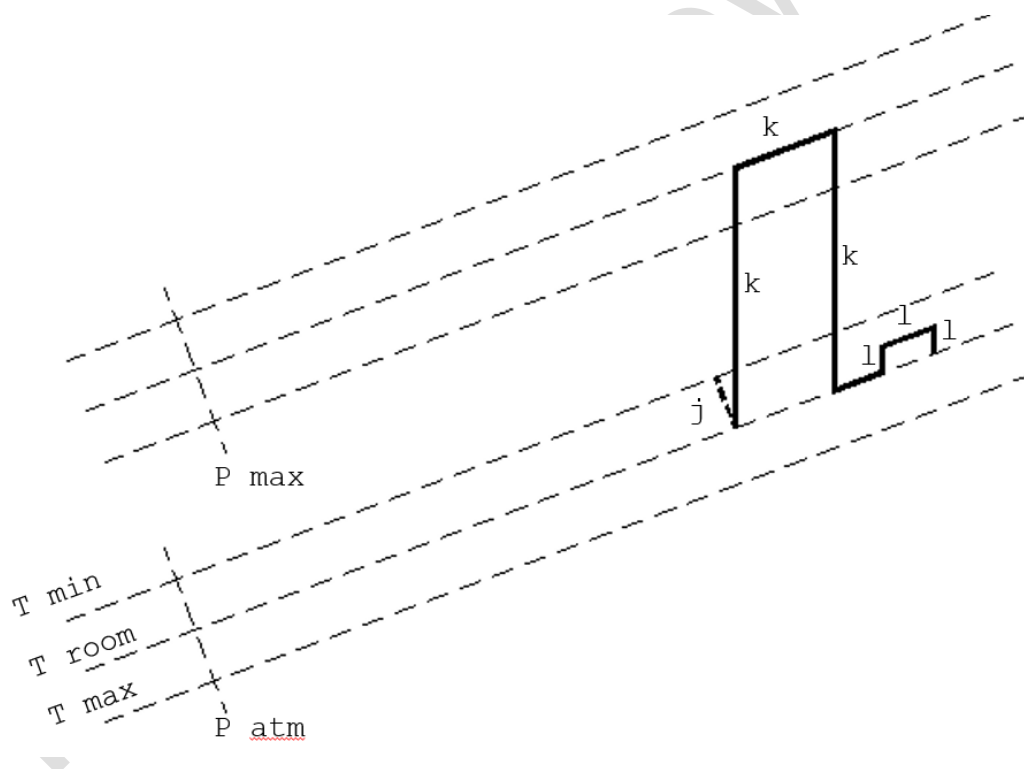
*In first sentence of fourth paragraph, replace "measured and recorded on cycles 1, 40, 80, 120 and 160" with*

measured and recorded for each cycle

### **D.11.10 Dynamic Test at Minimum/Maximum Rated Temperature**

*In first sentence of second paragraph, replace "measured and recorded on cycles 1, 40, 80, 120 and 160" with*

measured and recorded for each cycle



For hold periods at room temperature, pressure maintenance shall be per 10.3.3.3.3.

No visible leakage shall be allowed.

Add new section

#### **D.11.18 Testing of Valve and Operator Assembly**

Actuator shall be tested in accordance with 10.3.7.

Add new section

#### **D.13 Make/Break Testing for Retrievable Actuators**

Connection/connector make-break between the retrievable actuator/mounting spool and pressure cap shall be simulated for a minimum of three times.

Add new section

#### **D.14 Endurance Cycle Testing**

As per API Specification 17D, actuator shall be subjected to lifecycle/endurance testing to simulate long-term field service conditions by completing 600 cycles.

NOTE This section is to provide guidance on achieving the 600 endurance cycles. Cycles performed with manual override shall not be included.

- 1) Completing the testing per Table D.1 in Annex D satisfies 200 of the 600 endurance cycles.
- 2) Completing the 200 Hyperbaric cycles performed in accordance with Annex F satisfies 200 of the 600 endurance cycles.
- 3) Additional endurance cycles shall be performed in accordance with F.2.2.2.4 Step 3 or D.11.9 except the total number of cycles shall be minimum required to meet a total of 600 endurance cycles in addition to the cycles performed in 1) and 2).

**Table D.2—Endurance Cycles - Typical Example**

(1) Minimum number of endurance cycles completed	200
(2) Minimum number of endurance cycles completed	200
Total endurance cycles performed in (1) + (2)	400
(3) Additional endurance cycles to be performed (600 - 400)	200

- 4) After completion of total of 600 cycles following actuator functional tests shall be performed.
  - a) Static operating force output measurement as per D.11.8.
  - b) Hydraulic actuator seal test as per 10.3.3.5.
  - c) When compensation chamber is provided, compensation chamber seal test as per 10.3.3.6.
- 5) Post-test examination shall be performed as per D.12.

## **Annex E** **(normative)** **Design Validation—Gearbox**

In Annex E heading, replace "informative" with "normative"

### **E.1 General**

Replace first paragraph with

The design validation test procedures in this annex shall be applied for gearboxes.

Delete NOTE

Delete "By agreement" from second sentence of third paragraph

### **E.2 Products for Validation**

#### **E.2.1 General**

Add to section after first paragraph

As per API specification 17D, 5.1.7.2, prototype equipment (or first article) and fixtures used to qualify designs using these validation procedures shall be representative of production models in terms of design, production dimensions/tolerances, intended manufacturing processes, deflections and materials.

The actual dimensions of equipment subjected to validation test shall be within the allowable range for dimensions specified for normal production equipment.

Equipment should be qualified with the minimal lubricants required for assembly unless the lubricants can be replenished when the equipment is in service or is provided for service in a sealed chamber.

#### **E.2.2 Testing Product**

Add to section

For redundant seal designs (refer to 5.11.4), the seal mechanisms shall be independently validated unless the primary and secondary seal mechanisms are identical.

### **E.4 Test Orientation**

Replace first paragraph with

Orientation of gearbox during validation testing shall be as per the installed orientation as specified in the valve datasheet unless otherwise agreed.

### **E.8 Scaling**

#### **E.8.3 Validation by Output Torque/Thrust**

Replace "50 %X [X/2] and 150 % X [1.5X] that are of the same design" with

75 % X and 125 % X that are of the same design, safety factors

## **E.9 Documentation**

### **E.9.2 Contents of Validation Files**

Add new list item i)

- i) person(s) conducting and witnessing the tests,

Add new list item j)

- j) place of the testing.

## **E.10 Validation Procedure**

### **E.10.1 General**

Replace first sentence of first paragraph with

Validation of gearbox shall be performed by:

- a) following the procedure listed in Table E.1; and
- b) completing a total of 600 endurance cycles as identified in E.12.

In second paragraph, replace “appropriate” with

full

### **E.10.7 Temperature Cycle Test**

#### **E.10.7.2 Test Temperature**

Replace section with

Test temperature extremes shall be in accordance with 5.36.

Add new section

## **E.12 Endurance cycle testing**

As per API Specification 17D, gearboxes shall be subjected to lifecycle/endurance testing to simulate long-term field service conditions by completing 600 cycles.

NOTE This section is to provide guidance on achieving the 600 endurance cycles.

- 1) Completing the testing per Table E.1 in Annex E satisfies 200 of the 600 endurance cycles.
- 2) Completing the 200 Hyperbaric cycles performed in accordance with Annex F satisfies 200 of the 600 endurance cycles.
- 3) Additional endurance cycles shall be performed in accordance with E.10.6 except the total number of cycles shall be minimum required to meet a total of 600 endurance cycles in addition to the cycles performed in (1) and (2).

Add new Table E.2

**Table E.2—Endurance Cycles - Typical Example**

(1) Minimum number of endurance cycles completed	200
(2) Minimum number of endurance cycles completed	200
Total endurance cycles performed in (1) + (2)	400
(3) Additional endurance cycles to be performed (600 - 400)	200

- 4) After completion of total of 600 cycles following gearbox functional tests shall be performed:
- gearbox operational test as per 10.3.4,
  - when compensation chamber is provided, gearbox housing and compensation chamber seal test as per 10.3.4.1,
  - static operating force output measurement as per E.10.5.

## Annex F (normative) Hyperbaric Validation Testing

In Annex F title, replace "informative" with

normative

### F.1 General

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

Replace second paragraph with

The operator shall be tested either on a valve or on a test fixture simulating the opening/closing dynamic force profile of a valve against full differential pressure during cycles.

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

Delete NOTE

### F.2 Minimum Design Validation Test Requirements

#### F.2.2 Hyperbaric Validation Tests

##### F.2.2.2 Hyperbaric Testing

Replace section F.2.2.2.3 title with

##### F.2.2.2.3 Step-2—Hydrostatic Shell Test and Pressure cycling Test in Hyperbaric Conditions

Add new section before first paragraph

##### F.2.2.2.3.1 Step-2.1—Hydrostatic Shell Test in Hyperbaric Conditions

###### a) Requirements

Replace first paragraph with

Perform a hydrostatic shell test (see Table F.1), with external hyperbaric pressure equal to 1.1 X the design water depth applied.

The test pressure in the hydraulic actuator cylinder shall be environmental pressure plus at least 1.1 X the design pressure of the actuator.

As per API Specification 17D, the test shall consist of three parts:

- primary pressure-holding period;
- reduction of the pressure to zero;
- secondary pressure-holding period.



The first pressure-holding period shall not be less than 3 minutes.

The second pressure-holding period shall not be less than 1 hour.

The test period shall not begin until the test pressure has been reached, has stabilized, and the equipment and pressure-monitoring device have been isolated from the pressure source.

Internal pressure shall be monitored.

Add new section

#### **F.2.2.2.3.2 Step 2.2—Pressure-cycling Test in Hyperbaric Conditions**

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

Hydraulic actuator shall be subjected to repetitive pressure-cycling tests that occurs in long-term service considering a static working condition.

The hydraulic actuator cylinder and piston shall be alternately pressurized and depressurized in a static condition with the external hyperbaric pressure equal to 1.1 X the design water depth applied, as follows.

##### **Double acting actuator:**

The hydraulic actuator cylinder and piston seals shall be alternately pressurized to the environmental pressure plus the design pressure and then fully depressurized for a minimum of 200 pressurization-depressurization cycles.

##### **Single acting actuator:**

The hydraulic actuator cylinder and piston seals shall be alternately pressurized to the environmental pressure plus the design pressure and then depressurized at the minimum holding pressure, as defined by the actuator manufacturer, for a minimum of 200 pressurization-depressurization cycles.

#### **F.2.2.2.4 Step 3—Hyperbaric Endurance Test**

In first paragraph of list item a), replace "design pressure specified in paragraph 5.4" with

environmental pressure plus maximum rated pressure

Add new section

#### **F.2.2.2.5 Step 4—Actuator Seal Test**

The hydraulic actuator piston seal test shall be performed as per 10.3.3.5 to verify the integrity of actuator seals.

However, the minimum hold time shall be 1 hour for the second step at 1 X the hydraulic design pressure.

The test pressures shall be environmental pressure plus at least 0.2 X the hydraulic cylinder design pressure and 1.0 X the hydraulic design pressure of the actuator as applicable. The external hyperbaric pressure shall be 1.1 X the design water depth applied.

No visible leakage shall be allowed during the hold periods.

When compensation chamber is provided, compensation chamber seal test shall be performed as per 10.3.3.6.

Add new section

**F.2.2.2.6 Step 5—Hyperbaric Ingress Test (Repeat)**

Repeat hyperbaric ingress test as per F.2.2.2.2.

**F.3 Scaling**

In second paragraph, replace "50 %X [X/2] and 150 %X [1.5X]" with

75 % X and 125 % X

## **Annex G** **(normative)** **Requirements for Nondestructive Examination**

### **G.1 General**

Replace paragraph with

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

### **G.2 Specification of Quality Levels**

Delete "QL-1 and" from first sentence

### **G.5 Ultrasonic Testing (UT) of Castings**

Add to section after second paragraph

For critical sections, UT shall be performed with a normal beam probe with 0.06 in. (1.6 mm) flat bottom hole in addition to the regular volumetric NDE practices.

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

### **G.6 UT of Forgings and Plate**

Add to section

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

### **G.9 Magnetic Particle Testing (MT) of Castings on 100 % of Surface Area**

Add to section after first paragraph

Machined surfaces shall be examined using wet fluorescent particles.

When MT after final machining is not possible on the internal diameters of hollow/machined castings, UT shall be performed at the rough machining stage in accordance with G.5.

Add to section

The magnetization scan plan shall be prepared and approved prior to examination.

### **G.10 MT of Forgings, Weldments, and Bolting**

Add to section after first paragraph

Machined surfaces shall be examined using wet fluorescent particles.

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

Add to section

MT examination and acceptance criteria of bolting shall be in accordance with IOGP S-724 or IOGP S-725 as applicable.

## **G.12 Penetrant Testing (PT) of Castings**

Add to section after first paragraph

When PT after final machining is not possible on IDs of hollow/machined castings, UT shall be performed at the rough machining stage in accordance with G.5

## **G.13 PT of Forgings, Weldments, Weld Overlay, Bolting, and Seal Welds**

Replace second paragraph with

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

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

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

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

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

Replace section G.16 title with

## **G.16 VT of Forgings, Plate and Bolting**

Replace first paragraph with

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

Add to section after first paragraph

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

Replace second paragraph with

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

Add to section

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

## G.19 Visual Examination (VT) of Sealing Surfaces

Replace first paragraph with

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

Replace second paragraph with

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

Replace Table G.1 with

**Table G.1—NDE Requirements**

Part	QL-2		
	Cast	Forged	Plate
Pressure containing parts	VT1 and RT3 and UT4 and MT1 or PT1	VT2 and UT2 and MT1 or PT1	VT2 and UT2 and MT1 or PT1
Stem or shaft or rod <sup>a, b</sup>	N/A	VT2 and UT2 and MT1 or PT1	N/A
Bolting (pressure-containing)	N/A	VT2 and UT2 and MT1 or PT1	N/A
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		
Plating	VT4		
Hardfacing	VT4 and PT1 and VT5		
Sealing surfaces	VT2 and MT2 or PT2		
NOTE 1 See Table G.2 for specification of the examinations referred to in this table.			
NOTE 2 N/A means that the manufacturer is not allowed to use this material form for that specific part.			
NOTE 3 All the NDE activities listed above for a specific product form or forms to be performed.			
<sup>a</sup> MT or PT to be performed prior to coating or overlay.			
<sup>b</sup> Requirements for examination of bar material shall be as for forgings.			

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

*Replace RT1 row with*

Examination	NDE	Extent	Method	Acceptance
RT1	RT casting	Critical sections per ASME <i>BPVC</i> , Section VIII, Division 2, Part 3	G.3	G.3

*Replace UT1 row with*

Examination	NDE	Extent	Method	Acceptance
UT1	UT casting	Remaining areas of critical section not covered by RT1	G.5	G.5

*Replace PT1 row with*

Examination	NDE	Extent	Method	Acceptance
PT1	PT all products	Remaining areas of critical section not covered by RT1	G.12, G.13	G.12, G.13

## **Annex H** **(informative)** **Castings and Forgings**

Delete Annex H

Public Review Draft

Add new Annex J

## Annex J (normative) Material Datasheets

**Table J.1—Material Datasheet No. 22CrB**

Material Datasheet		MDS No. 22CrB <sup>a</sup>		Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 22Cr Duplex				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bars	ASTM A276	UNS S31803		
	ASTM A276	UNS S32205		
	ASTM A479	UNS S31803		
	ASTM A479	UNS 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.</p> <p>Product covered by this MDS is limited to a maximum thickness of 300 mm or 12 in.</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 argon oxygen decarburization (AOD) or equivalent method.			
Manufacturing	<p>Bars shall be manufactured to the following requirements:</p> <ul style="list-style-type: none"><li>– bar forgings as defined in ASTM A788 and certified to ASTM A182; or</li><li>– hot or cold finished cylindrical shaped bar manufactured to ASTM A276 or A479 with maximum diameter of 300 mm or 12 in.</li></ul> <p>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 (where PREN = Cr% + 3.3 * (Mo% + 0.5*W%) + 16* N%)</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	<p>Tensile test shall be carried out at minimum T/4 from external surface. Where tensile testing in both directions is required by this MDS, all tensile tests shall meet the specified properties of the referenced standard specification in both directions. The centerline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370-19e1, Annex A1.</p>			



Material Datasheet		MDS No. 22CrB <sup>a</sup> (continued)	Rev. 00
Impact Testing/ Toughness testing	Except as modified in the MDS, sampling and acceptance criteria shall comply with ISO 17781 QL II. Where impact testing in the tangential direction is required by this MDS, the acceptance criteria shall be 45 J (33 ft lbf) average, 35 J (26 ft lbf) minimum single.		
Corrosion Testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar.		
Micrographic Examination	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar and sample an area of 10 mm or 0.4 in. by 10 mm or 0.4 in. minimum.		
Extent of Testing	Tensile, impact tests and corrosion tests, and micrographic examination including ferrite measurements shall be carried out for each lot as defined in ASTM A484.		
Test Sampling	The mid-length of axial (longitudinal) and tangential (transverse) specimens shall be located at a distance of minimum 100 mm from the end of the bar. <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. Tangential specimen shall be located at the same location as longitudinal sample. 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 Annex 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 Annex K.		
Repair of Defects	Weld repair shall not be permitted		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified, the material shall conform to the requirements of ISO 15156 /NACE MR0175 and the following additional requirements to the MDS. <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 28 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3:2015, 7.2 and this MDS.		
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.		
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.		
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be prepared in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.		

Material Datasheet		MDS No. 22CrB <sup>a</sup> (continued)	Rev. 00
Certification (continued)	The inspection documents shall include the following information:		
	<ul style="list-style-type: none"><li>– Material process specification (MPS) identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used.</li><li>– Steel manufacturer of starting material and steelmaking practice.</li><li>– Solution annealing temperature, holding time and quenching medium shall be stated.</li><li>– Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly.</li><li>– All NDE carried out stating which standards material complies with.</li></ul>		
<sup>a</sup> 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 J.2—Material Datasheet No. 22CrF**

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

Material Datasheet		MDS No. 22CrF <sup>a</sup> (continued)	Rev. 00
Non-Destructive Testing	<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. <u>Ultrasonic inspection</u> Required on all forgings and as per EN 10228-4. Use Annex K for acceptance criteria. Scan plan shall be included in pre-production documents. <u>Dye Penetrant inspection</u> All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K.		
Repair of Defects	Weld repair shall not be permitted.		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 and the following additional requirements to the MDS. <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 28 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3:2015, 7.2 and this MDS.		
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.		
Marking	The forgings shall be marked to ensure full traceability to heat and heat treatment lot.		
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – MPS identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer of starting material and steelmaking practice. – Solution annealing temperature, holding time and quenching medium shall be stated. – Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly. – All NDE carried out stating which standards material complies with.		
<sup>a</sup> 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 J.3—Material Datasheet No. 25CrB**

Material Datasheet		MDS No. 25CrB <sup>a</sup>		Rev. 00
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel Type 25Cr Duplex				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bars	ASTM A276	UNS S32750		
	ASTM A276	UNS S32760		
	ASTM A479	UNS S32750		
	ASTM A479	UNS S32760		
	ASTM A182	F53 (UNS S32750)		
	ASTM A182	F55 (UNS S32760)		
Scope	<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.</p> <p>Product covered by this MDS is limited to a maximum thickness of 200 mm or 8 in.</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 argon oxygen decarburization (AOD) or equivalent method.			
Manufacturing	<p>Bars shall be manufactured to the following requirements:</p> <ul style="list-style-type: none"><li>– bar forgings as defined in ASTM A788 and certified to ASTM A182; or</li><li>– hot or cold finished cylindrical shaped bar manufactured to ASTM A276 or A479 with maximum diameter of 200 mm or 8 in.</li></ul> <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><math>PREN \geq 40.0</math> (where <math>PREN = Cr\% + 3.3 * (Mo\% + 0.5*W\%) + 16* N\%</math>)</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	<p>Tensile test shall be carried out at minimum T/4 from external surface. Where tensile testing in both directions is required by this MDS, all tensile tests shall meet the specified properties of the referenced standard specification in both directions. The centerline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370-19e1, Annex A1.</p>			
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>			
Corrosion Testing	<p>The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar.</p>			
Micrographic Examination	<p>The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the center of the bar and sample an area of 10 mm or 0.4 in. by 10 mm or 0.4 in. minimum.</p>			

Material Datasheet		MDS No. 25CrB <sup>a</sup> (continued)	Rev. 00
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 ≥ 100 mm or 4 in. intended for machining of valve parts, in addition to tensile testing and impact testing in the longitudinal direction, one tensile test specimen and one set of three impact test specimens shall be taken in the tangential direction. Tangential specimen shall be located at the same location as Longitudinal sample. Acceptance criteria shall comply with this MDS.</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 Annex K.</p>		
Repair of Defects	Weld repair shall not be 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 32 HRC from three readings taken in close proximity.</p> <p>The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3:2015, 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.		
Certification	<p>The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard.</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"><li>– Material process specification (MPS) identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used.</li><li>– Steel manufacturer of starting material and steelmaking practice.</li><li>– Solution annealing temperature, holding time and quenching medium shall be stated.</li><li>– Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly.</li><li>– All NDE carried out stating which standards material complies with.</li></ul>		
<sup>a</sup> 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 J.4—Material Datasheet No. 25CrF**

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

Material Datasheet		MDS No. 25CrF <sup>a</sup> (continued)	Rev. 00
Non-Destructive Testing	<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. <u>Ultrasonic inspection</u> Required on all forgings and as per EN 10228-4. Use Annex K for acceptance criteria. Scan plan shall be included in pre-production documents. <u>Dye Penetrant inspection</u> All components after final machining shall be inspected as per ASTM E165 with acceptance criteria as per Annex K		
Repair of Defects	Weld repair shall not be permitted.		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 and the following additional requirements to the MDS. <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 32 HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3:2015, 7.2 and this MDS.		
Surface Treatment and Finish	Finished product shall be white pickled and passivated. Machined surfaces do not require pickling provided proper handling and storage procedures are implemented avoiding any contamination.		
Marking	The forgings shall be marked to ensure full traceability to heat and heat treatment lot.		
Certification	The manufacturer shall demonstrate that the quality management arrangements established for the supply of products and services conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – MPS identification or the manufacturing process qualification record (MPQR)/ qualification test record/ report (QTR) number used. – Steel manufacturer of starting material and steelmaking practice. – Solution annealing temperature, holding time and quenching medium shall be stated. – Microstructure (original digital) photographs describing exact location of sampling, magnification and detailing the findings clearly. – All NDE carried out stating which standards material complies with.		
<sup>a</sup> 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 J.5—Material Datasheet No. 625F**

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

**Table J.6—Material Datasheet No. 625B**

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

<sup>a</sup> The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

**Table J.7—Material Datasheet No. 718F**

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

<sup>a</sup> The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

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