



Material Data Sheets for Piping and Valve Components

Revision history

VERSION	DATE	AMENDMENTS
2.0	December 2018	Second release
1.1	January 2017	Correction to report reference on page 6 - S572 corrected to S-562
1.0	December 2016	First release

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Foreword

This specification was prepared under a Joint Industry Project 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with support from the World Economic Forum (WEF).

This specification was developed on the basis of NORSOK M-630, 6th edition, which is administered and published by Standards Norway on behalf of the Norwegian petroleum industry. Ten key oil and gas companies from the IOGP membership participated in developing this specification under JIP33 Phase 2 with the objective to leverage and improve industry level standardization for projects globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, based on participating members' company specifications, resulting in a common and jointly approved specification, and building on recognized industry and/or international standards.

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

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil & Gas Community within the World Economic Forum (WEF) have implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industrywide, non-competitive collaboration and standardization. The vision from the CPC industry is to standardize specifications for global procurement for equipment and packages, facilitating improved standardization of major projects across the globe. Whilst individual oil and gas have been improving standardization within their own businesses, this has limited value potential and the industry lags behind other industries and has eroded value by creating bespoke components in projects.

This specification aims to significantly reduce this waste, decrease project costs and improve schedule through pre-competitive collaboration on standardization. This specification defines in the form of material data sheets (MDSs) and element data sheets (EDSs) the supplementary requirements to recognized industry and/or international material standards (the parent standards), which are indispensable for the application of this specification. Unless otherwise specified in the MDSs and EDSs, there are no supplementary requirements or modifications to the remaining clauses of the parent standards.

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

This specification was first issued in December 2016 and re-issued with minor amendments in January 2017. This new revision introduces a number of key changes compared with previous revisions. In particular, the title of this specification has been revised to reflect that the scope has been extended to cover both piping and valves. Material data sheets existing in separate IOGP supplementary specifications for valves and piping have been consolidated into this specification to provide a consistent approach to procurement of materials. A new layout and numbering convention is used for all MDSs and EDSs and each data sheet covers a single product form. The range of applicability of the MDSs and EDSs has been extended by addressing specific minimum requirements for materials exposed to sour environments as defined in ISO 15156 /ANSI NACE MR0175 and ISO 17945 /NACE MR0103.



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Introduction

The purpose of this specification is to define a minimum common set of supplementary requirements for the specification for procurement of the most commonly used materials and to facilitate the manufacture of stock products to reduce cost and increase availability, for application in the petroleum and natural gas industries.

JIP33 standardized procurement specifications follow 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 Requirement

Quality and information requirements for the supply of piping and valve components are specified in the individual material data sheet rather than through separate quality requirements (QRS) and information requirements (IRS) specifications. Quality and information requirements for piping and valve components purchased as part of an equipment item are supplemented by the equipment QRS and IRS.

Unless defined otherwise in the requisition, the order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) user defined requirements (equipment data sheet, IRS, QRS);
- d) this specification;
- e) the parent standard.

This specification is not intended to preclude the use of alternative generic materials or grades within a referenced material standard. Where the use of alternative materials/grades are considered appropriate, the end user is responsible for specifying any additional requirements necessary to meet design and design code or specification.



1 Scope

This specification is a collection of material data sheets (MDSs) and element data sheets (EDSs) for the most commonly used components for piping systems and valves for Normal or Category D fluid service as defined in ASME B31.3.

NOTE The scope of S-563 is code independent and it is not restricted to piping designed to ASME B31.3.

Supplementary material requirements for services defined in ASME B31.3 as Category M fluid service, high pressure fluid service, elevated temperature fluid service, high purity fluid service, severe cyclic conditions, cryogenic service are excluded from the scope.

This specification addresses specific minimum requirements for materials exposed to sour environments as defined in ISO 15156 /NACE MR0175 and ISO 17945 /NACE MR0103. However, this specification does not provide guidelines for material selection and the selection of suitable materials for a specific service including any necessary additional material requirements remains the responsibility of the end (equipment) user.

Line pipe material for pipeline systems is outside the scope of this specification.

The material data sheets cover the following material types:

- Non-impact tested carbon steel;
- Impact tested carbon steel;
- Ferritic-austenitic stainless steel: types 22Cr duplex and 25Cr duplex;
- High alloy austenitic stainless steel: type 6Mo;
- Austenitic stainless steel: type 316/316L, type 304/304L;
- Copper-Nickel alloys: type 90-10 and aluminium bronze;
- Nickel alloys: type 625;
- Nickel bolting: type 625, 718;
- Precipitation-hardened stainless steel bolting: type 660;
- Titanium grade 2;
- High strength, low alloy steels.

The element data sheets address the following:

- Hard facing by weld overlay;
- Hard facing by thermal spraying;
- Electroless nickel plating;
- Corrosion resistant weld overlay;
- Solid tungsten carbide.



2 Normative references

The following normative references shall apply. For undated references, the latest edition of the document (including any amendments) shall apply.

ANSI/MSS SP-55	Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
API SPEC 5L	Specification for Line Pipe.
API STD 6ACRA	Age-hardened Nickel-based Alloys for Oil and Gas Drilling and Production Equipment
ASME B16.34	Valves - Flanged, Threaded, and Welding End
ASME BPVC Sec. V	Nondestructive Examination
ASME BPVC Sec. VIII Div.1	Rules for Construction of Pressure Vessels
ASME BPVC Sec. IX	Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators
ASME BPVC Code Case 2120-1	Nickel-Iron-Chromium-Molybdenum-Copper Low Carbon Alloy (UNS N08926) for Code Construction Section VIII, Division 1
ASNT SNT-TC-1A	Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing
ASTM E10	Standard Test Method for Brinell Hardness of Metallic Materials
ASTM E18	Standard Test Methods for Rockwell Hardness of Metallic Materials
ASTM A29/A29M	Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A105/A105M	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106/A106M	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A182/A182M	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High- Temperature Service
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A216/A216M	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234/234M	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service



ASTM A240/A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A269/A269M	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276/A276M	Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320/A320M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low- Temperature Service
ASTM A333/A333M	Standard Specification for Seamless and Welded Steel Pipe for Low- Temperature Service and Other Applications with Required Notch Toughness
ASTM A350/A350M	Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A351/A351M	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A352/A352M	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure- Containing Parts, Suitable for Low-Temperature Service
ASTM A358/A358M	Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM E384	Standard Test Method for Microindentation Hardness of Materials
ASTM A403/A403M	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A420/420M	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A453/A453M	Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASTM A453/A453M ASTM A479/A479M	
	Coefficients Comparable to Austenitic Stainless Steels Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers
ASTM A479/A479M	Coefficients Comparable to Austenitic Stainless Steels Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels Standard Practice for Steel Castings, Welding, Qualifications of Procedures and
ASTM A479/A479M ASTM A488/A488M	Coefficients Comparable to Austenitic Stainless Steels Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel
ASTM A479/A479M ASTM A488/A488M ASTM A494/A494M	Coefficients Comparable to Austenitic Stainless Steels Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel Standard Specification for Castings, Nickel and Nickel Alloy Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate-



ASTM A696	Standard Specification for Steel Bars, Carbon, Hot-Wrought or Cold-Finished, Special Quality, for Pressure Piping Components
ASTM A671/A671M	Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures
ASTM A672/672M	Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures
ASTM A703/A703M	Standard Specification for Steel Castings, General Requirements, for Pressure- Containing Parts
ASTM A788/A788M	Standard Specification for Steel Forgings, General Requirements
ASTM A789/A789M	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A790/A790M	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
ASTM A815/815M	Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A928/A928M	Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal
ASTM A960/A960M	Standard Specification for Common Requirements for Wrought Steel Piping Fittings
ASTM A961/A961M	Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications
ASTM A962/A962M	Standard Specification for Common Requirements for Bolting Intended for Use at Any Temperature from Cryogenic to the Creep Range
ASTM A985/A985M	Standard Specification for Steel Investment Castings General Requirements, for Pressure-Containing Parts
ASTM A988/A988M	Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A995/A995M	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM A1014/A1014M	Standard Specification for Precipitation-Hardening Bolting (UNS N07718) for High Temperature Service
ASTM A1058	Standard Test Methods for Mechanical Testing of Steel Products-Metric
ASTM A1082/A1082M	Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications
ASTM B148	Standard Specification for Aluminium-Bronze Sand Castings
ASTM B151/B151M	Standard Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper- Nickel Rod and Bar



ASTM B171/B171M	Standard Specification for Copper-Alloy Plate and Sheet for Pressure Vessels, Condensers, and Heat Exchangers
ASTM B265	Standard Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate
ASTM B338	Standard Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers
ASTM B348	Standard Specification for Titanium and Titanium Alloy Bars and Billets
ASTM B363	Standard Specification for Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings
ASTM B366/B366M	Standard Specification for Factory-Made Wrought Nickel and Nickel Alloy Fittings
ASTM B367	Standard Specification for Titanium and Titanium Alloy Castings
ASTM B381	Standard Specification for Titanium and Titanium Alloy Forgings
ASTM B443	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip
ASTM B444	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625 and UNS N06852) and Nickel-Chromium- Molybdenum-Silicon Alloy (UNS N06219) Pipe and Tube
ASTM B446	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar
ASTM A462	Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service
ASTM B466/B466M	Standard Specification for Seamless Copper-Nickel Pipe and Tube
ASTM B467	Standard Specification for Welded Copper-Nickel Pipe
ASTM B499	Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B564	Standard Specification for Nickel Alloy Forgings
ASTM B571	Standard Practice for Qualitative Adhesion Testing of Metallic Coatings
ASTM B578	Standard Test Method for Microhardness of Electroplated Coatings
ASTM B602	Standard Test Method for Attribute Sampling of Metallic and Inorganic Coatings
ASTM B705	Standard Specification for Nickel-Alloy (UNS N06625, N06219 and N08825) Welded Pipe



ASTM B733	Standard Specification for Autocatalytic (Electroless) Nickel-Phosphorus Coatings on Metal
ASTM B834	Standard Specification for Pressure Consolidated Powder Metallurgy Iron- Nickel- Chromium-Molybdenum (UNS N08367), Nickel-Chromium- Molybdenum-Columbium (Nb) (UNS N06625), Nickel- Chromium-Iron Alloys (UNS N06600 and N06690), and Nickel-Chromium-Iron-Columbium- Molybdenum (UNS N07718) Alloy Pipe Flanges, Fittings, Valves, and Parts
ASTM B861	Standard Specification for Titanium and Titanium Alloy Seamless Pipe
ASTM B862	Standard Specification for Titanium and Titanium Alloy Welded Pipe
ASTM C633	Standard Test Method for Adhesion or Cohesion Strength of Thermal Spray Coatings
ASTM E165/E165M	Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM F2329	Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F467	Standard Specification for Nonferrous Nuts for General Use
ASTM F468	Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
ASTM F788	Standard Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
ASTM F812	Standard Specification for Surface Discontinuities of Nuts, Inch and Metric Series
ASTM G48	Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution.
EEMUA Pub. 234	90/10 Copper Nickel Alloy Piping for Offshore Applications Specification
EN 10204	Metallic products — Types of inspection documents
ISO 148-1	Metallic materials - Charpy pendulum impact test - Part 1: Test method
ISO 3452 (all parts)	Non-destructive testing - Penetrant testing
ISO 3878	Hardmetals - Vickers hardness test.
ISO 4624	Paints and varnishes - Pull-off test for adhesion
ISO 4499 (all parts)	Hardmetals — Metallographic determination of microstructure
ISO 6506-1	Metallic materials - Brinell hardness test - Part 1: Test method
ISO 6507-1	Metallic materials - Vickers hardness test - Part 1: Test method



ISO 6508-1	Metallic materials - Rockwell hardness test - Part 1: Test method
ISO 6892-1	Metallic materials Tensile testing Part 1: Method of test at room temperature
ISO 9001	Quality management systems — Requirements
ISO 9606 (all parts)	Qualification testing of welders - Fusion welding
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
ISO 10474	Metallic products — Inspection documents
ISO 11970	Specification and qualification of welding procedures for production welding of steel castings
ISO 14732	Welding personnel - Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials
ISO 15156-1 /NACE MR0175-1	Petroleum and natural gas industries - Materials for use in H2S-containing environments in oil and gas production - Part 1: General principles for selection of cracking-resistant materials
ISO 15156-2 /NACE MR0175-2	Petroleum and natural gas industries - Materials for use in H2S-containing environments in oil and gas production - Part 2: Cracking-resistant carbon and low-alloy steels, and the use of cast irons
ISO 15156-3 /NACE MR0175-3	Petroleum and natural gas industries - Materials for use in H2S-containing environments in oil and gas production - Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys
ISO 17637	Non-destructive testing of welds - Visual testing of fusion-welded joints.
ISO 17781	Petroleum, petrochemical and natural gas industries - Test methods for quality control of microstructure of austenitic/ferritic (duplex) stainless steels
ISO 17782	Petroleum, petrochemical and natural gas industries Scheme for conformity assessment of manufacturers of special materials
ISO 17945 /NACE MR0103	Petroleum, petrochemical and natural gas industries — Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments
ISO 28079	Hardmetals — Palmqvist toughness test
MSS SP-147	Quality Standard for Steel Castings Used in Standard Class Steel Valves - Sampling Method for Evaluating Casting Quality
NACE TM0284	Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen- Induced Cracking
NORSOK M-650	Qualification of Manufactures of Special Materials



3 Terms, definitions, acronyms and abbreviations

3.1 Terms and definitions

3.1.1 Shall

Verbal form used to indicate requirements strictly to be followed in order to conform to this specification and from which no deviation is permitted, unless accepted by the end (equipment) user.

3.1.2 May

Verbal form used to indicate a course of action permissible within the limits of this specification.

3.1.3 Carbon steel

Alloy of carbon and iron containing up to 2 % mass fraction carbon and up to 1.65 % mass fraction manganese and residual quantities of other elements, except those intentionally added in specific quantities for deoxidation (usually silicon and/or aluminium).

3.1.4 Low-alloy steel

Steel containing a total alloying element content of less than 5 % mass fraction, or steels with less than 10.5 % mass fraction chromium, but more than that specified for carbon steel.

3.1.5 Stainless steel

Steel containing \geq 10.5 % Cr (by mass), possibly with other elements added to secure special properties.

3.1.6 Austenitic stainless steel

Stainless steel whose microstructure at room temperature consists predominantly of austenite.

3.1.7 Stainless steel types 304 and 316

Austenitic stainless steel certified to meet both 304/304L or 316/316L properties.

3.1.8 Stainless steel type 6Mo

Austenitic stainless steel alloys with 6 % Mo and PREN \geq 40.0.

3.1.9 Stainless steel type 22Cr duplex

Ferritic-austenitic stainless steel alloys with $30.0 \le PREN < 40.0$ and $Cr \ge 19$ % (by mass).

3.1.10 Stainless steel type 25Cr duplex

Ferritic-austenitic stainless steel alloys with $40.0 \le PREN < 48.0$, often referred to as "super duplex".

3.1.11 Martensitic stainless steel

Stainless steel whose microstructure at room temperature consists predominantly of martensite.

3.1.12 Stainless steel type 13Cr

Martensitic stainless steel alloys with nominal 13 % Cr (by mass).



3.1.13 Precipitation-hardened stainless steel

Stainless steel with a high strength resulting from the precipitation of intermetallic compounds by a final heat treatment.

3.1.14 Nickel alloys

Metallic material in which nickel is the major element.

3.1.15 Pilot casting

Casting made and tested as part of the initiation and development of the production method such as the first casting from a new or modified pattern produced using identical foundry practices as the production castings it is intended to represent.

3.1.16 Nominal pipe size

Numerical designation of size in inches which is common to components in piping systems.

3.1.17 End (equipment) user

Company or organization (normally an oil company) that is responsible for the operation of an installation/facility and its component (e.g. piping, valve, etc.).

3.1.18 Purchaser

Party which purchases a product from a manufacturer. In the context of this specification, an oil company, the contractor or the buyer are purchasers.

3.1.19 Manufacturer (material)

Party, including subcontractors, which carries out operations (e.g. forming, heat treatment, welding, etc.) that affect the material properties of the finished product.

3.1.20 Quality specification level (QSL)

Level defining the extent of control activities, typically including verification, inspection and testing to be undertaken by supplier to demonstrate conformance with requirements based on determination of service risk (e.g. on the basis of pressure class, material, valve size and service) or obligations.

3.2 Acronyms and abbreviations

The following acronyms and abbreviations apply for this specification and are presented alphabetically.

- ACCP ASTN Central Certification Program
- ANSI American National Standards Institute
- AOD argon oxygen decarburization
- API American Petroleum Institute
- ASNT American Society for Nondestructive Testing
- ASTM American Society of Testing and Materials
- ASME American Society of Mechanical Engineers
- BPVC boiler and pressure vessel code
- CE carbon equivalent (% C + % Mn / 6 + (% Cr + % Mo + % V) / 5 + (% Ni + % Cu) / 15), with chemical element concentration expressed in mass fraction percent.



CLR	crack length ratio
CSR	crack sensitivity ratio
CTR	crack thickness ratio
DN	nominal diameter
EBW	electron beam welding
EDS	element data sheet
EEMUA	Engineering Equipment & Materials Users Association
EN	European Norm (standard)
FCAW	flux-cored arc welding
GTAW	gas tungsten arc welding
HAZ	heat-affected zone
HBW	Brinell hardness with Tungsten ball
HIC	hydrogen-induced cracking
HIP	hot isostatic pressing
HR	Rockwell hardness
HRB	Rockwell hardness, B scale
HRC	Rockwell hardness, C scale
HV	Vickers hardness
HVOF	high velocity oxygen fuel
ISO	International Organization for Standardization
LBW	laser beam welding
MDS	material data sheet
MPCR	manufacturing procedure conformity record
MPS	manufacturing procedure summary
MSS	Manufacturers Standardization Society
MT	magnetic-particle testing
NACE	National Association of Corrosion Engineers
NDT	non-destructive testing
NORSOK	Norsk Sokkels Konkuranseposisjon (the Norwegian shelf's competitive position)
NPS	nominal pipe size
OD	outer diameter
PREN	pitting resistance equivalent number (%Cr + $3.3 \times \%$ (Mo + $0.5W$) + $16 \times \%N$), with chemical element concentration expressed in mass fraction percent.
PSL	product specification level
PT	penetrant testing
PTAW	plasma transfer arc welding
PWHT	postweld heat treatment
QL	quality level
QSL	quality specification level



- QTR qualification test record
- RT radiographic testing
- SAW submerged arc welding
- SMAW shielded-metal arc welding
- SMYS specified minimum yield strength
- UNS unified numbering system
- UT ultrasonic testing
- VT visual testing
- WC tungsten carbide

4 Material and element data sheets

4.1 General

The material data sheets (MDSs) are collated in Annex A. They define applicable options and/or requirements that supplement or amend the referenced material standard or specification. The material shall be delivered in accordance with the standard specification referenced in the MDSs including any additional requirements specified therein. Unless otherwise specified in the MDSs, all the requirements of the referenced standard specification shall apply. The latest issue of the referenced standard specification at the time of purchase shall apply.

Welded pipes MDSs specifying acceptance classes give welding quality factors ranging from 0.8 to 1.0 according to ASME B31.3. The required class shall be specified on the piping class sheet and the purchase order shall specify acceptable class for each relevant item.

The element data sheets (EDSs) are included in Annex B. They define the requirements for special processes and parts used in connection with manufacturing and/or assembly of piping and valves. Processes and parts shall comply with the minimum requirement specified in the EDS and any standard referenced therein.

4.2 MDS and EDS numbering system

A new numbering convention is used for all MDSs and a table comparing the current MDS number with the MDS number in the previous revision of this specification is presented in Annex A.

Each MDS and EDS number consists of a two-letter prefix followed by a three-digit sequential number and a supplementary requirements suffix.

The first letter is fixed and consists of the letter "I" to indicate an IOGP MDS or EDS.

The second letter identifies the type of material or element with the following interpretation:

- C carbon steels
- D ferritic-austenitic stainless steels, type 22Cr duplex, type 25Cr duplex
- H hard facing, by welding, thermal spray, metal plating or use of sintered material
- K copper-nickel alloy 90-10 and other copper alloys including aluminium bronze
- N nickel alloys
- O overlay welding, corrosion resistant



- R austenitic stainless steels, type 6Mo
- S austenitic stainless steels, excluding type 6Mo
- T titanium and titanium alloys
- U Precipitation-hardened stainless steels
- X high strength low alloyed steels.

The supplementary suffix "S" shall be used to designate a material delivered in accordance with the MDS plus the supplementary requirements for sour service, but excluding HIC testing.

The supplementary suffix "SH" shall be used to designate a material complying with the MDS including the supplementary requirements for sour service plus HIC testing and UT examination, where applicable to the material and product form.

Material data sheets designated with supplementary suffix "S" or "SH" also satisfy all the MDS requirements for general, non-sour service.

- EXAMPLE 1 MDS IC003 designates carbon steel fittings for general, non-sour service, as opposed to IC003S which designates carbon steel fittings which also comply with the additional supplementary requirements for sour service, excluding HIC testing.
- EXAMPLE 2 MDS IC003SH designates carbon steel fittings complying with the additional supplementary requirements for sour service plus HIC and UT testing, where applicable.

4.3 Implementation of statutory regulations

This specification is not intended to address any statutory regulations. The responsibility for complying with any such statutory regulations and the specification of any further additional requirements is the responsibility of the end (equipment) user.

4.4 Ferritic-austenitic stainless steels (MDS ID series)

The compositional and microstructural requirements including ferrite content and acceptance criteria for intermetallic phases and precipitates in parent material and welds are specified in accordance with ISO 17781. Compliance with ISO 17781 is considered to fulfil the microstructural requirements of ISO 15156-3 /NACE MR0175-3.

4.5 Mechanical testing

Tensile testing shall in general be carried out in accordance with the referenced standard specifications in the respective MDS. Where testing to ASTM A370 is specified, testing in accordance with ISO 6892-1 is considered equivalent and thereby also acceptable. The elongation shall be measured and reported in accordance with the selected tensile test standard ASTM A370 or ISO 6892-1. For specimens to ASTM A370, the gauge length shall be 50 mm as far as is practically possible.

Impact testing shall, in general, be carried out in accordance with the referenced standard specifications in the respective MDS. Where testing to ASTM A370 is specified, testing in accordance with ISO 148-1 using a striker radius of 8 mm is considered equivalent and thereby also acceptable.

The impact test temperature for carbon and duplex stainless steels is in general specified to be minus 46 °C. The use of a lower test temperature is acceptable, but the specified minimum absorbed energy shall apply unless otherwise agreed with the end (equipment) user.

Hardness testing shall be performed in strict compliance with the methods described in the MDS and EDS, as applicable. The use of alternative methods permitted by the product standard and use of conversion



tables or other correlations for individual materials shall require approval of the end (equipment) user. In case of dispute, the hardness scale stated in the MDS or EDS shall govern. For the purposes of this specification, ASTM E384 is equivalent to ISO 6507-1, ASTM E18 is equivalent to ISO 6508-1 and ASTM E10 is equivalent to ISO 6506-1. The use of portable hardness testing methods shall require approval by the end (equipment) user.

4.6 Machining of valve components from bar

When allowed by the product standard specifications, hollow cylindrically shaped parts, including valve bodies for weld-end and integral flanged valves, and pressure-controlling parts of valves, may be manufactured from cylindrically shaped bars, provided the requirements in the relevant MDS are met in full.

4.7 NDT of piping and valve components

4.7.1 General

Where MDSs specify NDT requirements, this is intended to represent the minimum level of NDT that shall be performed at the material manufacturing stage.

NDT of fabricated piping systems are not included in the MDSs and additional NDT may be required for valve components when a quality specification level (QSL) is specified by the purchaser in the valve data sheet or purchase order documentation. For details of any additional NDT requirements for finished valve components or piping assembly, reference shall be made to the applicable IOGP valve specification or piping fabrication.

Where MDSs do not specify additional NDT requirements, the relevant material standard shall apply with no additional requirements except as specified below in this section.

Where a frequency of inspection less than 100 % is specified, at least one item per lot shall be examined. If defects outside the acceptance criteria are detected, two or more items from the same lot shall be tested and if any of these two fails, all items in the lot shall be examined.

4.7.2 NDT Personnel

NDT personnel shall be qualified in accordance with ISO 9712 or ASNT SNT-TC-1A. Personnel performing NDT evaluation shall be certified according to Level 2. Certification shall be performed by an independent third-party certification body, or authorized qualifying body in accordance with ISO 9712 or the ASNT Central Certification Program (ACCP).

4.8 Pilot castings

4.8.1 General

The casting foundry/manufacturer shall produce a pilot casting (see definition in 3.1.15) prior to the production of castings, in accordance with MSS SP-147.

The pilot casting may be taken from the first production order of castings, subject to purchaser approval. Acceptance of a production casting as pilot casting shall require that NDT complies with the requirements for pilot casting and all testing specified in the MDS for production casting shall be met.

4.8.2 Material qualification ranges for pilot castings

A new pilot casting shall be produced when the casting material is outside the qualification ranges given in Table 1.



Pilot casting material type	Qualification range for pilot casting material
Carbon steel	All grades of carbon steel and low alloyed steel
Low-alloy steel	All grades of carbon steel and low alloyed steel
Austenitic stainless steel	All grades of austenitic stainless steel except 6Mo, Ni-alloys
22Cr and 25Cr duplex stainless steel	All grades of 22Cr and 25Cr duplex stainless steel
6Mo stainless steel	All grades of 6Mo and austenitic stainless steel, Ni-alloys
Nickel alloys	All grades of austenitic stainless steel including 6Mo, Ni-alloys
Titanium (un-alloyed)	All un-alloyed grades of titanium
Ni-Al bronze	All grades of Ni-Al bronze

Table 1 - Pilot casting material qualification ranges.

4.8.3 NDE of pilot castings

All pilot castings shall be evaluated without weld repairs.

All accessible internal and external surfaces of the pilot casting shall be inspected by VT, PT or MT. The extent of volumetric inspection shall be in accordance with the applicable casting MDS. The acceptance criteria shall be as stated in the applicable casting MDS, unless agreed otherwise with the end (equipment) user.

Dimensional inspection shall be in accordance with the casting design drawing.

A pilot casting that fails to comply with the requirements of the MDS shall be rejected. Corrective actions shall be implemented by the casting foundry/manufacturer and a new pilot casting shall be made to confirm effectiveness of the corrective actions.

Upon completion of all required examinations and tests, the documentation for the pilot casting shall be retained and be available for review at the casting foundry/manufacturer.



Annex A (normative) Material Data Sheets

A.1 List of material data sheets

The material data sheets are listed in Table 2 and compiled in this annex.

Table 2 – List of material data sheets per type of material

Type of Material	Material Standard and Grade(s)	Product Form	MDS No.	MDS Rev.	Previous MDS No. ^a
Non-impact	ASTM A106 Grade B	Seamless pipes	IC001	01	IC01
tested carbon steel	API SPEC 5L Grade B PSL1, PSL2	Seamless pipes	IC001	01	
	ASTM A672 Grade C60, C65, C70	Welded pipes	IC002	01	
	API SPEC 5L Grade B PSL1, PSL2	Welded pipes	IC002	01	
	ASTM A234 Grade WPB, WPBW	Wrought fittings	IC003	01	
	ASTM A105	Forgings	IC004	01	
	ASTM A516 Grade 60, 65, 70	Plates	IC005	01	
	ASTM A216 Grade WCB and WCC	Castings	IC006	01	IC02
	ASTM A696 Grade B or and C	Bars	IC007	01	IC01
Impact	ASTM A333 Grade 6	Seamless pipes	IC101	01	IC11
tested carbon steel	ASTM A671 Grade CC60, CC65, CC70	Welded pipes	IC102	01	
	ASTM A420 Grade WPL 6	Wrought fittings	IC103	01	
	ASTM A350 Grade LF2 and LF6	Forgings	IC104	01	
	ASTM A516 Grade 60, 65, 70	Plates	IC105	01	
	ASTM A352 Grade LCC	Castings	IC106	01	IC12
	ASTM A696 Grade B or and C	Bars	IC107	01	IC11
Ferritic- austenitic	ASTM A790 UNS S31803, UNS S32205	Seamless pipes	ID141	01	ID41
stainless steel type 22Cr Duplex	ASTM A928 UNS S31803, UNS S32205	Welded pipes	ID142	01	ID42
	ASTM A815 UNS S31803, UNS S32205	Wrought fittings	ID143	01	ID43
	ASTM A182 Grade F51, F60	Forgings	ID144	01	ID44



Type of Material	Material Standard and Grade(s)	Product Form	MDS No.	MDS Rev.	Previous MDS No. ^a
Ferritic-	ASTM A240 UNS S31803, UNS S32205	Plates	ID145	01	ID45
austenitic stainless	ASTM A995 Grade 4A (UNS J92205)	Castings	ID146	01	ID46
steel type 22Cr Duplex	ASTM A276/A479 UNS S31803, UNS S32205	Bars	ID147	01	ID47
	ASTM A789 UNS S31803, UNS S32205	Tubes	ID148	01	ID48
	ASTM A988 UNS S31803, S32205	HIP products	ID149	01	ID43/ ID44
Ferritic- austenitic	ASTM A790 UNS S32550, S32750, S32760	Seamless pipes	ID251	01	ID51
stainless steel type 25Cr Duplex	ASTM A928 UNS S32550, S32750 and S32760	Welded pipes	ID252	01	ID52
	ASTM A815 UNS S32550, S32750 and S32760	Wrought fittings	ID253	01	ID53
	ASTM A182 Grade F53 (UNS S32750), Grade F55 (UNS S32760), Grade F61 (UNS S32550)	Forgings	ID254	01	ID54
	ASTM A240 UNS S32550, S32750 and S32760	Plates	ID255	01	ID55
	ASTM A995 Grade 6A (UNS J93380), Grade 5A (UNS J93404)	Castings	ID256	01	ID56
	ASTM A276/A479 UNS S32550, S32750 and S32760	Bars	ID257	01	ID57
	ASTM A789 UNS S32550, S32750, S32760	Tubes	ID258	01	ID58
	ASTM A1082 (modified) UNS S32750, S32760 (strain hardened)	Bolting	ID259	01	ID59
	ASTM A1082 UNS S32750, S32760 (solution annealed)	Bolting	ID260	01	ID60
	ASTM A988 UNS S32750, S32750, S32505	HIP products	ID269	01	ID53/ ID54
Copper- nickel 90-10	ASTM B466 UNS C70600	Seamless pipes and tubes	IK101	01	IK01
	ASTM B467 UNS C70600	Welded pipes	IK102	01	
	EEMUA 234 UNS C70600	Wrought Fittings	IK103	01	
	EEMUA 234 UNS C70600	Flanges	IK104	01	



Type of Material	Material Standard and Grade(s)	Product Form	MDS No.	MDS Rev.	Previous MDS No. ^a
0	ASTM B171 UNS C70600	Plates and sheets	IK105	01	IK01
Copper- nickel 90-10	ASTM B151 UNS C70600	Bars and rods	IK107	01	
Aluminium - bronze castings	ASTM B148 UNS C95800	Castings	IK106	01	IK02
Nickel alloys	ASTM F467 UNS N06625 Grade 2	Nuts	IN100S ^b	01	IN03
	ASTM F468 UNS N06625	Studs, bolts, screws	IN100S ^b	01	
	ASTM B705 UNS N06625	Welded pipes	IN102S ^b	01	IN01
	ASTM B366 UNS N06625	Wrought fittings	IN103S ^b	01	
	ASTM B564 UNS N06625	Forgings	IN104S ^b	01	
	ASTM B443 UNS N06625	Plates	IN105S ^b	01	
	ASTM A494 Grade CW-6MC, CX 2MW	Castings	IN106S ^b	01	IN02
	ASTM B446 UNS N06625	Bars	IN107S ^b	01	IN01
	ASTM B444 UNS N06625	Seamless pipes and tubes	IN111S ^b	01	IN01
	ASTM B834 UNS N06625 Grade 1	HIP products	IN119S ^b	01	-
	ASTM A962, API STD 6ACRA Gr. 120K	Bolting	IN120S ^b	01	-
Austenitic stainless	ASTM A312 UNS S31254, UNS N08367, N08926	Seamless pipes	IR111	01	IR11
steel type 6Mo	ASTM A358 UNS S31254, UNS N08367, N08926	Welded pipes	IR112	01	IR12
	ASTM A403 UNS S31254, N08367, N08926	Wrought fittings	IR113	01	IR13
	ASTM A182 Grade F44 (UNS S31254), F62 (UNS N08367), UNS N08926	Forgings	IR114	01	IR14
	ASTM A240 UNS S31254, N08367, N08926	Plates	IR115	01	IR15
	ASTM A351 Grade CK-3MCuN, CN- 3MN	Castings	IR116	01	IR16
	ASTM A276/A479 UNS S31254, N08367, N08926	Bars	IR117	01	IR17
	ASTM A269 UNS S31254, N08367, N08926	Tubes	IR118	01	IR18

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Type of Material	Material Standard and Grade(s)	Product Form	MDS No.	MDS Rev.	Previous MDS No. ^a
Austenitic stainless steel type 6Mo	ASTM A988 UNS S31254, N08367	HIP products	IR119	01	-
Austenitic stainless	ASTM A312 Grade TP316	Seamless pipes	IS101	01	IS01
steel type	ASTM A312 Grade TP316	Welded pipes	IS102	01	
316	ASTM A358 Grade 316	Welded pipes	IS102	01	
	ASTM A403 Grade WP316	Wrought fittings	IS103	01	
	ASTM A182 Grade F316	Forgings	IS104	01	
	ASTM A240 Grade 316	Plates	IS105	01	
	ASTM A351 Grade CF3M, CF8M	Castings	IS106	01	IS02
	ASTM A276/A479 Grade 316	Bars	IS107	01	IS01
	ASTM A269 Grade 316	Tubes	IS108	01	
Austenitic	ASTM A312 Grade TP304	Seamless pipes	IS221	01	IS21
stainless steel type	ASTM A312 Grade TP304	Welded pipes	IS222	01	
304	ASTM A358 Grade 304	Welded pipes	IS222	01	
	ASTM A403 Grade WP304	Wrought fittings	IS223	01	
	ASTM A182 Grade F304	Forgings	IS224	01	
	ASTM A240 Grade 304	Plates	IS225	01	
	ASTM A351 Grade CF3, CF8	Castings	IS226	01	IS22
	ASTM A276/A479 Grade 304	Bars	IS227	01	IS21
	ASTM A269 Grade 304	Tubes	IS228	01	
Titanium	ASTM B861 Grade 2	Seamless pipes	IT101	01	IT01
Grade 2	ASTM B862 Grade 2	Welded pipes	IT102	01	
	ASTM B363 Grade WPT2/WPT2W	Wrought fittings	IT103	01	
	ASTM B381 Grade F2	Forgings	IT104	01	
	ASTM B265 Grade 2	Plates	IT105	01	
	ASTM B367 Grade C2	Castings	IT106	01	IT02
	ASTM B348 Grade 2	Bars	IT107	01	IT01
	ASTM B338 Grade 2	Tubes	IT108	01	



Type of Material	Material Standard and Grade(s)	Product Form	MDS No.	MDS Rev.	Previous MDS No. ^a
Precipitation -hardened stainless steels	ASTM A453 Grade 660 (UNS S66286)	Bolting	IU100	01	IN04
High strength low	ASTM A320 Grade L7, L7M, L43	Studs, bolts, screws (HDG)	IX100	01	IX07
alloy steel	ASTM A194 Grade 7, 7M, L43	Nuts (HDG)	IX100	01	IX07
	ASTM A320 Grade L7, L7M, L43	Studs, bolts, screws (Black or uncoated)	IX109	01	IX09
	ASTM A194 Grade 7, 7M	Nuts (Black or uncoated)	IX109	01	IX09
	ASTM A193 Grade B7, B7M	Studs, bolts, screws (Black or uncoated)	IX110	01	IX10
	ASTM A194 Grade 2H, 2HM	Nuts (Black or uncoated)	IX110	01	IX10
	ASTM A193 Grade B7, B7M	Studs, bolts, screws (HDG)	IX120	01	IX08
	ASTM A194 Grade 2H, 2HM	Nuts (HDG)	IX120	01	IX08
	ASTM A694 Grade F52, F60, F65	Forgings	IX124	01	-
	ASTM A29 Grade 4140	Bars	IX127	01	-

NOTE The supplementary suffix "S" is added to the MDS designation to indicate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service, but excluding HIC testing and UT examination. The supplementary suffix "SH" is added to the MDS designation to indicate a material complying with the MDS including the additional supplementary requirements for sour service plus HIC testing and UT examination, where applicable to the product form.

^a Previous MDS number in Rev. 1.1 of this specification.

^b Material data sheets for Ni-alloy type 625 are designated with supplementary suffix "S" only.



A.2 IOGP material data sheets

Material Data			C001 / IC001S ^a	Rev. 01		
TYPE OF MATERIAL: Non-impact tested carbon steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Seamless pipes	ASTM A106	В	-	ASTM A106 S6		
	API 5L	В	PSL1 or PSL2	-		
		Page 1 o	of 1			
Scope	This MDS defines applica specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.				
Metal Making	API 5L Gr.B PSL1 pipe s	teel shall be killed.				
Manufacturing	Cold-drawn pipes shall b	e heat treated after c	old forming.			
Chemical Composition	For ASTM A106 supplementary requirement S6 applies with the following restrictions: $C \le 0.23 $ %, $S \le 0.020 $ %, $P \le 0.025 $ %, $CE \le 0.43 $ % The following restrictions apply to API 5L pipes: $C \le 0.23 $ %, $CE \le 0.43 $ %					
	Microalloying elements (I		t be deliberately added.			
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional metallurgical, monufacturing	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and	Chemical composition					
certification requirements) ^ª	S ≤ 0.010 %					
	Hardness testing					
	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one length of pipe per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity.					
	The material shall be trac	ceable in accordance	with ISO 15156-2 /NACE MR0175-2	section 9 and this MDS.		
Marking	The pipes shall be marke	ed to ensure full trace	ability to melt and heat treatment lot.			
Certification	The material manufacture requirements standard ac		y system certified in accordance with aser.	ISO 9001 or another quality		
		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 document		Ũ			
	 Heat treatment condition 	on. For tempered cor	ndition, tempering temperature shall l	be stated.		



Material Data	Sheet	MDS No. IC	002 / IC002S ^a / IC002SH	^b Rev. 01		
TYPE OF MATERIAL:	Non-impact tested ca	arbon steel				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Welded pipes	ASTM A672	C60	Cl. 12 or Cl. 22 or Cl.32 or Cl.42	-		
	ASTM A672	C65	Cl. 12 or Cl. 22 or Cl.32 or Cl.42	-		
	ASTM A672	C70	Cl. 12 or Cl. 22 or Cl.32 or Cl.42	-		
	API 5L	В	PSL1 or PSL2	-		
		Pa	age 1 of 2			
Scope	This MDS defines a specification.	oplicable options a	nd/or requirements that supplement or	amend the referenced standard		
Metal Making	API 5L Gr.B PSL1 p	ipe steel shall be k	illed and made according to fine grain p	practice.		
Manufacturing	Ũ	•	nt and made using the SAW process. halysis A-No.1 per ASME BPVC Sec. IX	K, Table QW-442.		
Chemical	C ≤ 0.23 %, S ≤ 0.02	20 %, P ≤ 0.025 %,	CE ≤ 0.43 %			
Composition	Microalloying eleme	nts (Nb, V, Ti, B) sl	nall not be deliberately added.			
Heat Treatment	For products deliver (1 148 °F).	For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F).				
Non-Destructive Testing	Welded pipe to API	5L: 100 % RT of w	eld seam.			
Repair of Defects	Weld repair of the base material is not permitted.					
	Repairs to weld met chemistry requireme		n accordance with the standard specific manufacturing weld.	cation and shall meet the		
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and certification requirements) ^{a, b}	<u>Chemical compositi</u> S ≤ 0.003 % Ni < 1.0 % for the w					
. ,						
	 <u>Hardness testing</u> Welding procedure qualification testing for manufacturing and any 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. 					
	Vickers hardness pipe to include the	 Production testing shall be performed on one length of pipe per lot as follows: Vickers hardness traverse shall be made across the base material, HAZ and weld metal at both ends of the pipe to include the centre of the pipe wall and 1.0 mm - 2.0 mm below the internal and external surfaces, with a maximum hardness of 250HV. 				
	HIC testing and UT	examination				
		lies, one finished p	ipe per ASTM A672 S14 (lot) shall be to	ested as follows:		
	- HIC testing:	ocordonoc with NIA	CE TM0294 Juning Test Colution A			
	-		CE TM0284, using Test Solution A. shall be CLR \leq 15%, CTR \leq 5 %, CSR	< 2 %		
	-		hall be reported for each section.	<i>- ∠</i> /0.		
	- UT examination:					
	• ASTM A672, S1	1 shall apply.				
	The material shall b	e traceable in acco	rdance with ISO 15156-2 /NACE MR01	75-2 section 9 and this MDS.		



PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Welded pipes	ASTM A672	C60	Cl. 12 or Cl. 22 or Cl.32 or Cl.42	-		
	ASTM A672	C65	Cl. 12 or Cl. 22 or Cl.32 or Cl.42	-		
	ASTM A672	C70	Cl. 12 or Cl. 22 or Cl.32 or Cl.42	-		
	API 5L	В	PSL1 or PSL2	-		
	·	Pa	ge 2 of 2	·		
Marking	The pipes shall be	marked to ensure ful	Il traceability to melt and heat treatme	nt 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 following information: ed condition, tempering temperature s	shall be stated.		

^b The supplementary suffix "SH" shall be used to designate a material delivered in accordance with the MDS including the additional supplementary requirements for sour service plus HIC testing and UT examination.



Material Data	Sheet MD	S No. IC003 /	IC003S ^a / IC003SH ^b	Rev. 01		
TYPE OF MATERIAL: Non-impact tested carbon steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A234	WPB	-	ASTM A234 S3		
	ASTM A234	WPBW	-	ASTM A234 S3		
		Page 1 of	2			
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Chemical Composition		Supplementary requirement ASTM A234 S3 applies with the following restrictions: $C \le 0.23 $ %, $S \le 0.020 $ %, $P \le 0.025 $ %, $CE \le 0.43 $ %				
	Microalloying elements (I	Nb, V, Ti, B) shall not	be deliberately added.			
Heat Treatment	condition, the minimum te	empering temperature ittings, including those	enched and tempered. For products shall be 620 °C (1 148 °F). e manufactured by locally heating a			
Tensile Testing	specimens is not possible	e due to the size of the	ns cut from a fitting where dimensic e fitting, a prolongation or a length c oad as the fittings it represents sha	of starting material that has		
Non-Destructive Testing	UT is not acceptable in-li	UT is not acceptable in-lieu of RT.				
Repair of Defects	Weld repair of the base material is not permitted.					
	Repairs to weld metal are acceptable in accordance with the standard specification and shall me chemistry requirements of the original manufacturing weld.					
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and certification requirements) ^{a, b}	<u>Chemical composition</u> - S ≤ 0.010 % for WPB and WPBW fittings made from products other than flat-rolled or forged - S ≤ 0.003 % for WPBW fitting made from flat-rolled products - S ≤ 0.020 % for WPB fitting made from forging					
	Hardness testing		be performed in accordance with th	e requirements in ASTM		
		alification testing for m	nanufacturing and any repair weldin i6-2 section 7.3.3, using Vickers me			
		•	ordance with the requirements in A	STM A234 and shall include		
	HIC testing and UT examination					
	When suffix SH applies, one finished WPBW fitting made from flat-rolled products per lot shall be tested as follows:					
	- HIC testing:					
	-		284, using Test Solution A.	/		
		•	$CLR \le 15$ %, $CTR \le 5$ %, $CSR \le 2$ %	% .		
	UT testing of flat-rolled	-	eported for each section.			
	• ASTM A578, S1, S2.1	•				
			with ISO 15156-2 /NACE MR0175-2	2 section 9 and this MDS		



Material Data	Sheet	Sheet MDS No. IC003 / IC003S ^a / IC003SH ^b		^b Rev. 01		
TYPE OF MATERIAL: Non-impact tested carbon steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLA	ASS SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A234	WPB	-	ASTM A234 S3		
	ASTM A234	WPBW	-	ASTM A234 S3		
		Page 2 of 2	2			
Marking	The fittings shall be	marked to ensure full tracea	ability to melt and heat treatme	ent lot.		
Certification		acturer shall have a quality a a duality are a second accepted by the purchas		e with ISO 9001 or another quality		
		ments shall be issued in ac with this specification.	cordance with ISO 10474 /EN	10204 Type 3.1 and shall		
	The inspection docu	ments shall include the follo	owing information:			
	- Heat treatment co	ondition. For tempered cond	ition, tempering temperature s	shall be stated.		
		ed to designate a material de vice, but excluding HIC testi	livered in accordance with the	e MDS plus the additional		
^b The supplementar	ry suffix "SH" shall be us	sed to designate a material	delivered in accordance with t	he MDS including the additional		

The supplementary suffix "SH" shall be used to designate a material delivered in accordance with the MDS including the additional supplementary requirements for sour service plus HIC testing and UT examination.



Material Data	Sheet	MDS No. IC	004 / IC004S ^a	Rev. 01		
TYPE OF MATERIAL	: Non-impact tested carbor	steel				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A105	-	-	ASTM A105 S2, S4		
		Page 1 c	of 1			
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Chemical Composition	Supplementary requirement S4 applies with the following restrictions: $C \le 0.23 $ %, $S \le 0.020 $ %, $P \le 0.025 $ %, $CE \le 0.43 $ %					
	Microalloying elements (N	Nb, V, Ti, B) shall no	t be deliberately added.			
Heat Treatment	Normalized or normalized For products delivered in (1 148 °F).		uenched and tempered. tion, the minimum tempering tempera	ture shall be 620 °C		
Non-Destructive Testing	Visual inspection VT shall be carried out on each forging or 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. Valve forgings NDT Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the NDT requirements in this MDS shall apply.					
Repair of Defects	Weld repair is not permitt	ed.				
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and certification requirements) ^a	Hardness testing Production hardness testing shall be performed in accordance with the requirements in ASTM A105.					
. ,	The material shall be trac	eable in accordance	e with ISO 15156-2 /NACE MR0175-2	section 9 and this MDS.		
Marking	The forgings shall be man	ked to ensure full tra	aceability to melt and heat treatment l	ot.		
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 document	s shall include the fo	bllowing information:			
	- Heat treatment condition	on. For tempered co	ndition, tempering temperature shall b	be stated.		
	y suffix "S" shall be used to c quirements for sour service.	lesignate a material	delivered in accordance with the MDS	S plus the additional		



Material Data	Sheet MD	S No. IC005 / IC00	5S ^a / IC005SH ^b	Rev. 01		
TYPE OF MATERIAL	: Non-impact tested carbon	steel				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates	ASTM A516	60	-	-		
	ASTM A516	65	-	-		
	ASTM A516	70	-	-		
		Page 1 of 2				
Scope	This MDS defines applicab specification.	le options and/or requireme	nts that supplement or amend	d the referenced standard		
Chemical Composition	$C \le 0.23 $ %, $S \le 0.020 $ %, $P \le 0.025 $ %, $CE \le 0.43 $ % For Grade 60 plate 12.5 mm thick and thinner, $C \le 0.21 $ %					
	Microalloying elements (Na	o, V, Ti, B) shall not be delibe	erately added.			
Non-Destructive Testing	<u>Visual inspection</u> VT shall be carried out on each plate 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.					
	Valve plates NDT					
	Inspection of plates for valve parts shall be according to the applicable valve specification. If a QSL is specified by the purchaser, the requirements in this MDS shall apply.					
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and certification requirements) ^{a, b}	$\frac{Chemical \ composition}{S \le 0.003 \ \%}$					
requirements)	Hardness testing					
	Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one plate per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity at each location.					
	HIC testing and UT examination					
	When suffix SH applies, one plate per lot shall be tested as follows:					
	- HIC testing:					
	HIC testing in accordance with NACE TM0284, using Test Solution A.					
			5 %, CTR ≤ 5 %, CSR ≤ 2 %.			
		ick length shall be reported f	or each section.			
	- UT examination:					
	ASTM A578, S1, S2.1 s			postion 0 and this MDC		
			15156-2 /NACE MR0175-2 s	section 9 and this MDS.		
Marking	The plates shall be marked	to ensure full traceability to	melt and heat treatment lot.			



Material Data	Sheet	Rev. 01						
TYPE OF MATERIAL: Non-impact tested carbon steel								
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Plates	ASTM A516	60	-	-				
	ASTM A516	65	-	-				
	ASTM A516	70	-	-				
		Page 2 of	2					
Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another or 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. For tempered condition, tempering temperature shall be stated.								
		d to designate a material d rice, but excluding HIC test	elivered in accordance with the MD ing and UT examination.	S plus the additional				
^b The supplementary suffix "SH" shall be used to designate a material delivered in accordance with the MDS including the additional								

^D The supplementary suffix "SH" shall be used to designate a material delivered in accordance with the MDS including the additi supplementary requirements for sour service plus HIC testing and UT examination.



Material Data S	Sheet	MDS No. IC006 /	Rev. 01						
TYPE OF MATERIAL: Non-impact tested carbon steel									
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT					
Castings	ASTM A216	WCB	-	ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20					
	ASTM A216	WCC	-	ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20					
		Page 1 of 4							
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. For steel castings produced by the investment casting process, the requirements of ASTM A985 and this MDS shall apply.								
Chemical Composition	Supplementary requirements ASTM A216 S11 and S52 apply with the following restrictions: $C \le 0.23 $ %, $S \le 0.020 $ %, $P \le 0.025 $ %, $CE \le 0.43 $ %								
	, , , , , , , , , , , , , , , , , , , ,	Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.							
Heat Treatment	For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F).								
Extent of Testing	ASTM A703 S14 or ASTM	A985 S14 shall apply.							
Test Sampling	For castings with weight 250 kg (551 lb) or more the test blocks shall be integrally cast or gated onto the casting and shall accompany the castings through all heat treatment operations including any post weld stress relieving. Thickness of the test block shall be equal to the thickest part of the casting represented up to a maximum thickness of 100 mm (4 in). For flanged components, the largest flange thickness is the ruling section. Dimensions of test blocks and location of test specimens within the test blocks are shown in 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.								
	For investment casting, test sampling shall be according to ASTM A985. Test blocks shall accompany the castings through all heat treatment operations including any post weld stress relieving.								



Material Data	Sheet	MDS No. IC006 / IC006S ^a Re					
TYPE OF MATERIAL	: Non-impact tested carbo	on steel					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS		SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A216	WCB	-		ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20		
	ASTM A216	WCC	-		ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20		
		Page 2 of 4					
Now Door (more three	Manalinanaatian	1 age 2 01 4					
Non-Destructive Testing	Visual inspection						
	NDE requirement				duction casting		
	Frequency	Each pilot casting	roduction casting				
	Method	ANSI/MSS SP-55 100 % of all accessible surfaces including welding ends					
	Extent	100 % of all act	elding ends				
	Acceptance criteria ANSI/MSS SP-55						
	NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing.						
<u>Magnetic particle testing</u> ASTM A216 Supplementary requirement S4 shall apply as amended by this MDS:							
	NDE Requirement	Pilot casting (section 4	4.8)	Production casting ^a			
	Frequency ^b	100 %		100 %			
	Method	ASME BPVC Sec. V, Article 7 ASM		ASME BP	BPVC Sec. V, Article 7		
	Extent ^c	100 %			100 %		
	Acceptance criteria	ASME BPVC Sec. VIII, Div. 1, ASME BPVC S Appendix 7		ASME BPVC Se	ec. VIII, Div. 1, Appendix 7		
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. ^a Production valve casting, MT shall be according to the applicable valve specification. If a QSL is no specified by the purchaser, the requirements in this table shall apply. ^b Frequency of inspection 100 % means that each item shall be examined. ^c All accessible internal and external surfaces shall be examined. 						



Material Data	Sheet	MDS N	lo. IC	006 /	IC00	6 S ^a			Rev. 01	
TYPE OF MATERIAL: Non-impact tested carbon steel										
PRODUCT FORM	STANDARD	GRADE	GRADE ACCEPTANCE CLASS				SUPPLEMENTARY REQUIREMENT			
Castings	ASTM A216	WCB	WCB			-			ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20	
	ASTM A216	WCC			-			S52 AS1 S20	ΓΜ Α703 S12, S14,) ΓΜ Α985 S12, S14,	
		Pa	age 3 of	4						
Non-Destructive Testing	Radiographic testing ASTM A216 suppleme		nt S5 sha	all apply	as ame	-				
	NDE requirement	Pilot casting (section 4.8)	Valve castings ^a Other pressur containing					Other pressure containing castings ^b		
	Frequency ^c	100 %	NPS	DN		Pressu	ire class		100 %	
			< 2	< 50	≤ 300 N/R	600	900 N/R	≥ 1500 N/R		
			≥ 2 ≥ 6	≥ 50 ≥ 150	N/R N/R	5 %	5 % 5 %	5 % 100 %		
			≥ 10 ≥ 16	≥ 250 ≥ 400	5 % 5 %	5 % 5 %	5 % 100 %	100 % 100 %		
			≥ 20	≥ 500	5 %	100 %	100 %	100 %		
	Method	ASME BPVC Sec. V, Article 2								
	Extent	Areas defined by ASME B16.34 for special class valves, at abrupt changes in sections and at the junctions of risers, gates or feeders to the casting						t 100 % ^d		
	Acceptance criteria								-	
	 NOTE N/R means not required, unless specified otherwise by the purchaser. ^a Production valve casting, RT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. ^b Production casting other than valve casting. ^c Frequency of inspection 100 % means that each item shall be examined. When random examination (5 %) is specified, a minimum of one item per lot of each pattern in any purchase order shall be examined. ^d Production casting other than valve casting, inspection shall include other critical areas as defined in the purchase order and/or applicable product specification or standard. Sketches of the areas to be tested shall be established and agreed with the purchaser. 									
Repair of Defects	 ASTM A703 or ASTM A985, as applicable, supplementary requirement S20 shall apply with the following additional requirements: Repairs as described in ASTM A216 section 10.2 and 10.3 shall be considered major repairs and shall be documented in accordance with ASTM A703 or ASTM A985 S20.2. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this data 									
	 sheet using a cast p Weld repairs are not Examination of major 	t acceptable for								



Material Data S	Sheet	MDS No. IC006 / IC006S ^a Rev						
TYPE OF MATERIAL: Non-impact tested carbon steel								
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Castings	ASTM A216	WCB	-	ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20				
	ASTM A216	wcc	-	ASTM A216 S4, S5, S11, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20				
		Page 4 of 4						
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:							
manufacturing, testing and certification requirements) ^a	 <u>Hardness testing</u> Production 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 ISO 15156-2 /NACE MR0175-2 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. 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 in	formation:					
	- 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.								


Material Data Sheet		MDS No. IC007	Rev. 01		
TYPE OF MATERIAL	.: Non-impact tested carbon	steel			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bars	ASTM A696	В	-		
	ASTM A696	С	-		
	ASTM A105	-	-		
		Page 1 of 2			
Scope	specification.	onal requirements for valve	nents that supplement or amen		
Manufacturing	 bar forgings as defined hot rolled bars manufac (10 in). NOTE Cold finishing sha 				
Chemical Composition		P ≤ 0.025 %, CE ≤ 0.43 % lb, V, Ti, B) shall not be del	iberately added.		
Heat Treatment	Normalized or normalized and tempered or quenched and tempered. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F).				
Test Sampling	 <u>Valve parts manufactured from bar</u> Sampling of test specimens for bars intended for machining of valve parts shall comply with the following additional requirements: The mid-length of the axial tensile test specimen shall be located at a distance equal to the bar outside diameter or minimum of 100 mm (4 in), whichever is the greater, from the end of the bar, and the centreline of the specimen shall be located at a minimum distance of OD/4 from the surface. The centreline of the tangential tensile test specimen shall be located at a minimum distance of OD/4 from the surface. The centreline of the tangential tensile test specimen shall be located at a minimum distance of OD/4 from the surface and the mid-point of the specimens at a minimum of 100 mm (4 in) from the end of the bar. For bar with outside diameter < 100 mm (4 in): tensile test in accordance with the standard. For bar with outside diameter ≥ 100 mm (4 in): in addition to the standard requirement, one tensile test specimen shall be taken in tangential direction of the bar. The specified minimum tensile strength properties of the referenced standard shall be met in both directions. 				
Non-Destructive Testing	Visual Inspection VT shall be carried out on each bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. NDT of valve parts manufactured from bar Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.				
Repair of Defects	Weld repair is not permitte	ed.			
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 requirement of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS: Chemical composition S ≤ 0.020 %, Ni < 1.0 %				
			with the requirements in ASTM hall be 22HRC from three read		



Material Data	Sheet	MDS No. IC	007 / IC007S ^a	Rev. 01		
TYPE OF MATERIAL: Non-impact tested carbon steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A696	В	-			
	ASTM A696	C	-			
	ASTM A105	-	-			
		Page 2 o	f 2			
(additional						
metallurgical, manufacturing, testing and certification requirements) ^a						
manufacturing, testing and certification	The bars shall be ma	rked to ensure full tracea	bility to melt and heat treatment lot.			
manufacturing, testing and certification requirements) ^a	The material manufac		y system certified in accordance with I	SO 9001 or another qualit		
manufacturing, testing and certification requirements) ^a Marking	The material manufact requirements standar	cturer shall have a quality d accepted by the purchan nents shall be issued in a	y system certified in accordance with I			
manufacturing, testing and certification requirements) ^a Marking	The material manufact requirements standar The inspection docum confirm compliance w	cturer shall have a quality d accepted by the purchan nents shall be issued in a	y system certified in accordance with I aser. ccordance with ISO 10474 /EN 10204			



Material Data	Sheet	MDS No. IC10 ⁴	I / IC101S ^a	Rev. 0		
TYPE OF MATERIAL:	Impact tested carbon steel	1				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Seamless pipes	ASTM A333	6	-	-		
		Page 1 of 1		•		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Chemical	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %					
Composition	Microalloying elements (N	b, V, Ti, B) shall not be de	eliberately added.			
Heat Treatment	each pipe including any qu	During the heat treatment process, pipes shall be placed in such a way as to ensure free circulation around each pipe including any quenching operation. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C				
Impact Testing/ Toughness testing	Impact testing is required for thickness ≥ 6 mm (0.236 in); for pipes with a weld end, the weld end thickness shall govern. The test temperature shall be minus 46 °C (-50 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single.					
Repair of Defects	Weld repair is not permitte	d.				
Sour Service (additional metallurgical,			e purchaser, the material shall c MR0103, and the following add			
manufacturing, testing and	Chemical composition					
certification requirements) ^a	S ≤ 0.010 %					
	Hardness testing					
			ccordance with the requirement shall be 22HRC from three readi			
	The material shall be trace	able in accordance with	SO 15156-2 /NACE MR0175-2 s	section 9 and this MDS.		
Marking	The pipes shall be marked	to ensure full traceability	to melt and heat treatment lot.			
Certification	The material manufacturer requirements standard acc		em certified in accordance with I	SO 9001 or another qual		
	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 followin	g information:			
	 Heat treatment condition 	 For tempered condition 	, tempering temperature shall be	e stated.		

supplementary requirements for sour service.



		1				
TYPE OF MATERIAL	: Impact tested carbon st	eel				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Welded pipes	ASTM A671	CC60	Cl. 12 Cl. 22 or Cl.32 or Cl.42	ASTM A671 S2, S7, S1		
	ASTM A671	CC65	Cl. 12 Cl. 22 or Cl.32 or Cl.42	ASTM A671 S2, S7, S1		
	ASTM A671	CC70	Cl. 12 Cl. 22 or Cl.32 or Cl.42	ASTM A671 S2, S7, S1		
		Page 1 of 2	2			
Scope	This MDS defines applied specification.	cable options and/or requ	uirements that supplement or ame	nd the referenced standarc		
Manufacturing	ũ	0	e using the SAW process. 0.1 per ASME BPVC Sec. IX, Tabl	e QW-442.		
Chemical Composition	C ≤ 0.23 %, S ≤ 0.020 %	%, P ≤ 0.025 %, CE ≤ 0.4	3 %			
	Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.					
Heat Treatment		During the heat treatment process, pipes shall be placed in such a way as to ensure free circulation around each pipe including any quenching operation.				
Impact Testing/ Toughness testing	Impact testing is required for thickness \geq 6 mm (0.236 in); for pipes with a weld end, the weld end thickness shall govern.					
	The test temperature shall be minus 46 °C (-50 °F).					
	The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft single.					
Extent of Testing	For products delivered i (1 148 °F).	n the tempered conditior	n, the minimum tempering tempera	ature shall be 620 °C		
			equirement S2, as modified by this nent S14 shall apply for lot definition			
Non-Destructive Testing	ASTM A671 supplementary requirement S7 shall apply.					
Repair of Defects	Weld repair of the base	material is not permitted				
		re acceptable in accorda of the original manufact	nce with the standard specificatio uring weld.	n and shall meet the		
Sour Service (additional metallurgical,		156 /NACE MR0175 or I	y the purchaser, the material shal SO 17945 /NACE MR0103, and th			
manufacturing, testing and	Chemical composition					
certification	S ≤ 0.003 %					
requirements) ^{a, b}	Ni < 1.0 % for the weld	metal				
	Hardness testing					
		 Welding procedure qualification testing for manufacturing and any repair welding shall meet the requirements of NACE MR0175-2 /ISO 15156-2 section 7.3.3, using Vickers method, with a maximum 				
	 Production testing sh 	all be performed on one	length of pipe per lot as follows:			
	the pipe to include	the centre of the pipe wa	 Production testing shall be performed on one length of pipe per lot as follows: Vickers hardness traverse shall be made across the base material, HAZ and weld metal at both ends of the pipe to include the centre of the pipe wall and 1.0 mm - 2.0 mm (0.04 in - 0.08 in) below the internal and external surfaces, with a maximum hardness of 250HV. 			



I YPE OF MATERIAL	: Impact tested carbon	steel	-		
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Welded pipes	ASTM A671	CC60	Cl. 12 Cl. 22 or Cl.32 or Cl.42	ASTM A671 S2, S7, S14	
	ASTM A671	CC65	Cl. 12 Cl. 22 or Cl.32 or Cl.42	ASTM A671 S2, S7, S14	
	ASTM A671	CC70	Cl. 12 Cl. 22 or Cl.32 or Cl.42	ASTM A671 S2, S7, S14	
	•	Page 2 of	f 2		
(additional metallurgical, manufacturing, testing and certification requirements) ^{a, b}	 HIC testing and UT examination When suffix SH applies, one finished pipe per ASTM A671 S14 (lot) shall be tested as follows: HIC testing: HIC testing in accordance with NACE TM0284, using Test Solution A. Acceptance criteria per specimen shall be CLR ≤ 15 %, CTR ≤ 5 %, CSR ≤ 2 %. Maximum individual crack length shall be reported for each section. UT examination: ASTM A671, S11 shall apply. 				
			with ISO 15156-2 /NACE MR0175-2		
Marking	The pipes shall be m	narked to ensure full traces	ability to melt and heat treatment lot.		
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quarequirements 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. For tempered condition, tempering temperature shall be stated. 				
supplementary rec	I y suffix "S" shall be used quirements for sour serv y suffix "SH" shall be us	d to designate a material o ice, but excluding HIC tes ed to designate a materia	delivered in accordance with the MDS ting and UT examination. I delivered in accordance with the MI	S plus the additional	



Material Data	Sheet MI	DS No. IC103 / IC	103S ^a / IC103SH ^b	Rev. 01		
TYPE OF MATERIAL	: Impact tested carbon ste	el				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A420	WPL6	-	ASTM A960 S51, S53, S57, S69		
	ASTM A420	WPL6W	-	ASTM A960 S51, S53, S57, S69		
	Page 1 of 2					
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Chemical	C ≤ 0.23 %, S ≤ 0.020 %	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %				
Composition	Microalloying elements (I	Nb, V, Ti, B) shall not be d	eliberately added.			
Heat Treatment	each fitting including any All hot formed or forged f shall be heat treated afte	quenching operation. ittings, including those ma r manufacture.	placed in such a way as to ensu nufactured by locally heating a p	portion of the fitting stock,		
	For products delivered in the tempered condition, the minimum tempering temperature shall be 620 $^{\circ}$ C (1 148 $^{\circ}$ F).					
Tensile Testing	ASTM A960 supplementary requirement S51 shall apply as amended by this MDS. Tensile testing shall be carried out on specimens cut from a fitting where dimensions permit. When removal of specimens is not possible due to the size of the fitting, a prolongation or a length of starting material that has been heat treated in the same heat treatment load as the fittings it represents shall be used.					
Impact Testing/ Toughness testing	Impact testing is required for thickness ≥ 6 mm (0.236 in); for fittings with a weld end, the weld end thickness shall govern. The test temperature shall be minus 46 °C (-50 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single.					
Hardness testing		minimum two fittings, inclu	apply with the following requirer Iding parent material, weld and I			
Extent of Testing	Impact testing shall also	be carried out for each he	at and heat treatment load.			
Non-Destructive	UT is not acceptable in-li	eu of RT.				
Testing	Magnetic particle testing					
	ASTM A960 Supplement	ary requirement S53 and S	S69 shall apply as amended by	this MDS:		
	NDE Requirement		Nominal Thickness			
		< 12.7 mm (¹ / ₂	in) ≥1	2.7 mm (¹ / ₂ in)		
	Frequency ^a	10 %		100 %		
	Method		ASME BPVC Sec. V, Article 7			
	Extent ^b 100 %					
	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 6					
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. ^a Frequency of inspection 100 % means that each item shall be examined. When random examination (10 %) is specified, a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. 					
	^b All accessible inter	nal and external surfaces s	shall be examined.			
Repair of Defects		•	e with the standard specification	and shall meet the		



TYPE OF MATERIAL	: Impact tested carbon s	steel				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A420	WPL6	-	ASTM A960 S51, S53, S57, S69		
	ASTM A420	WPL6W	-	ASTM A960 S51, S53, S57, S69		
		Page 2 of	2			
Sour Service (additional metallurgical,			by the purchaser, the material shall on ACE MR0103, and the following add			
manufacturing, testing and	Chemical composition					
certification requirements) ^{a, b}	- S ≤ 0.010 % for WF	PL6 and WPL6W fittings r	nade from products other than flat-ro	olled or forged		
requirements)	 S ≤ 0.003 % for WPL6W fitting made from flat-rolled products 					
	- S ≤ 0.020 % for WPL6 fitting made from forging or hot rolled/wrought bar					
	 Ni < 1.0 % for the weld metal of WPL6W fittings 					
	Hardness testing					
	For WPL6W fittings, in addition to the hardness testing requirement in the MDS, welding procedure qualification testing for manufacturing and any 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.					
	HIC testing and UT examination					
	When suffix SH applies, one finished WPL6W fitting made from flat-rolled products per lot shall be tested as follows:					
	- HIC testing:					
	HIC testing in accordance with NACE TM0284, using Test Solution A.					
	• Acceptance criteria per specimen shall be CLR \leq 15 %, CTR \leq 5 %, CSR \leq 2 %.					
	Maximum individual crack length shall be reported for each section.					
	- UT examination of flat-rolled product before manufacture:					
	ASTM A578 S1, S2.1 shall apply.					
	The material shall be traceable in accordance with ISO 15156-2 /NACE MR0175-2 section 9 and this MDS.					
Marking	The fittings shall be m	arked to ensure full trace	ability 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 /EN 10204 Type 3.1 and shall confirm compliance with this specification.					
		ents shall include the foll	0			
	- Heat treatment cond	dition. For tempered cond	lition, tempering temperature shall b	e stated.		
			elivered in accordance with the MDS	S plus the additional		
	quirements for sour servic ry suffix "SH" shall be use	C C	5			

^b The supplementary suffix "SH" shall be used to designate a material delivered in accordance with the MDS including the additional supplementary requirements for sour service plus HIC testing and UT examination.



Material Data S	Sheet	MDS No. IC104 /	IC104S ^a	Rev. 01		
TYPE OF MATERIAL:	Impact tested carbon stee	I				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A350	LF2	Class 1	ASTM A350 S6 ASTM A961 S55		
	ASTM A350	LF6	Class 1 or 2	ASTM A350 S6 ASTM A961 S55		
		Page 1 of 2		·		
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard		
Chemical Composition	Supplementary requirementary c \leq 0.23 %, S \leq 0.020 %,	nt ASTM A350 S6 applies wi P ≤ 0.025 %, CE ≤ 0.43 %	ith the following restrictions:			
	LF2 forgings: microalloying	g elements (Nb, V, Ti, B) sha	all not be deliberately added.			
Heat Treatment	each forging including any		aced in such a way as to ens roducts delivered in the temp 8 °F).			
Impact Testing/ Toughness testing	Impact testing is required for thickness ≥ 6 mm (0.236 in); for forgings with a weld end, the weld end thickness shall govern. The test temperature shall be minus 46 °C (-50 °F) for grade LF2 and minus 51 °C (-60 °F) for grade LF6. The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single.					
Extent of Testing	One set of tensile, impact and hardness testing shall be carried out for each heat and 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).					
Non-Destructive Testing	Visual inspection VT shall be carried out on each forging 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. Magnetic particle testing ASTM A961 Supplementary requirement S55 shall apply as amended by this MDS:					
	NDE Requirement		Forgings			
	Frequency ^a		10 %			
	Method	AS	SME BPVC Sec. V, Article 7			
	Extent ^b					
	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 6 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing.					
	 ^a For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. ^b All accessible internal and external surfaces shall be examined. 					
	<u>Valve forgings NDT</u> Inspection shall be according to the applicable valve specification.					
		o 11 1	pecification. nents in this MDS shall apply			
Repair of Defects	Weld repair is not permitte					
Sour Service (additional metallurgical, monufacturing			ourchaser, the material shall on R0103, and the following add			
manufacturing, testing and certification requirements) ^a	<u>Hardness testing</u> Production hardness testir	ng shall be performed in acco	ordance with the requirement	s in ASTM A350.		
	The material shall be trace	eable in accordance with ISC	15156-2 /NACE MR0175-2	section 9 and this MDS.		



Material Data	Sheet	MDS No. IC	MDS No. IC104 / IC104S ^a				
TYPE OF MATERIAL: Impact tested carbon steel							
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Forgings	ASTM A350	LF2	Class 1	ASTM A350 S6 ASTM A961 S55			
	ASTM A350	LF6	Class 1 or 2	ASTM A350 S6 ASTM A961 S55			
		Page 2 of	12				
Marking	The forgings shall be	e marked to ensure full tra	ceability 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.						
		ments shall be issued in a with this specification.	ccordance with ISO 10474 /EN 102	04 Type 3.1 and shall			
	The inspection docu	ments shall include the fol	lowing information:				
	- Heat treatment condition. For tempered condition, tempering temperature shall be stated.						
	y suffix "S" shall be use quirements for sour serv	5	delivered in accordance with the MD	S plus the additional			



TYPE OF MATERIAL:	Impact tested carbon stee	el 🛛				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates	ASTM A516	60	-	ASTM A516 S5		
	ASTM A516	65	-	ASTM A516 S5		
	ASTM A516	70	-	ASTM A516 S5		
		Page 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Chemical	C ≤ 0.23 %, S ≤ 0.020 %,	P ≤ 0.025 %, CE ≤ 0.43 %	6			
Composition	For Grade 60 plate 12.5 n	nm $(^{1}/_{2}$ in) thick and thinne	er, C ≤ 0.21 %			
	Microalloying elements (N	lb, V, Ti, B) shall not be d	eliberately added.			
Heat Treatment	During the heat treatment	process, components sh	all be placed in such a way as to	ensure free circulation		
	around each plate including					
Impact Testing/	Impact testing is required	for thickness ≥ 6 mm (0.2	36 in). The test temperature sha	II be minus 46 °C (-50 °F		
Toughness testing		energy for full size specime	ens shall be 27 J (20 ft lbf) avera	ge and 20 J (15 ft lbf)		
	single. The test specimen shall be taken in the longitudinal orientation to the final direction of rolling.					
				or ronning.		
Non-Destructive Testing	Visual inspection					
	VT shall be carried out on each plate 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.					
	Valve plates NDT					
	Inspection of plates for valve parts shall be according to the applicable valve specification.					
	If a QSL is not specified b	by the purchaser, the requ	irements in this MDS shall apply			
Repair of Defects	Weld repair is not permitte	ed.				
Sour Service (additional metallurgical,			ne purchaser, the material shall of MR0103, and the following add			
manufacturing, testing and	Chemical composition					
certification requirements) ^{a, b}	S ≤ 0.003 %					
requirements)	Hardness testing					
	Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one plate per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity at each location.					
	HIC testing and UT exam When suffix SH applies, c		ested as follows:			
	- HIC testing:					
	HIC testing in accordance with NACE TM0284, using Test Solution A;					
	• Acceptance criteria per specimen shall be CLR \leq 15 %, CTR \leq 5 %, CSR \leq 2 %.					
		crack length shall be repo	rted for each section.			
	- UT examination:	4 - h - H - m - 1				
	ASTM A578 S1; S2.1 shall apply.					
			ISO 15156-2 /NACE MR0175-2			



Material Data	Sheet	MDS No. IC105 /	IC105S ^a / IC105SH ^b	Rev. 01
TYPE OF MATERIAL	: Impact tested carbo	n steel		
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Plates	ASTM A516	60	-	ASTM A516 S5
	ASTM A516	65	-	ASTM A516 S5
	ASTM A516	70	-	ASTM A516 S5
		Page 2 of	2	
Certification		acturer shall have a quality ard accepted by the purcha	system certified in accordance with aser.	ISO 9001 or another quality
		uments shall be issued in a with this specification.	ccordance with ISO 10474 /EN 1020	4 Type 3.1 and shall
	The inspection docu	uments shall include the fol	lowing information:	
	- Heat treatment co	ondition. For tempered con	dition, tempering temperature shall b	e stated.
		ed to designate a material o vice, but excluding HIC tes	delivered in accordance with the MDS ting and UT examination.	S plus the additional
		sed to designate a material vice plus HIC testing and U	I delivered in accordance with the ME	DS including the additional



Material Data S	Sheet	MDS No. IC106	/ IC106S ^a	Rev. 01	
TYPE OF MATERIAL:	Impact tested carbon stee	el			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S23	
				ASTM A703 S8, S14, S20	
		Page 1 of 3			
Scope	This MDS defines applica specification.	ble options and/or requirem	ents that supplement or ame	end the referenced standard	
Chemical Composition		ent S23 applies with the follo P \leq 0.025 %, CE \leq 0.43 %	owing restrictions:		
	Microalloying elements (N	lb, V, Ti, B) shall not be deli	berately added.		
Heat Treatment	each casting including pos	ssible quenching operation.		nsure free circulation around	
	For products delivered in (1 148 °F).	the tempered condition, the	minimum tempering temper	ature shall be 620 °C	
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	Test blocks shall be integrally cast or gated onto the casting and shall accompany the castings through all here treatment operations including any post weld stress relieving. Thickness of the test block shall be equal to the thickest part of the casting represented up to a maximum thickness of 100 mm (4 in). For flanged components, the largest flange thickness is the ruling section. Dimensions of test blocks and location of test specimens within the test blocks are shown in the figure below for integral and gated test block. The test specimens shall be taken within the cross hatched area. Distance from end of test specimen to end of test block shall minimum be T/4.				
	T/2 X T/4 T/4 T/4 T/4 T/4 T/4 T/4 T/4 T/4 T/4				
Non-Destructive	Visual inspection				
Testing	NDE requirement	Pilot casting (sectio		oduction casting	
	Frequency	Each pilot casting		production casting	
	Method		ANSI/MSS SP-55		
	Extent	100 % of all a	accessible surfaces including	welding ends	
	Acceptance criteria		ANSI/MSS SP-55		
	NOTE the testing shall cleaned prior to		ing, if applicable. Non-machi	ned surfaces shall be	



Material Data	Sheet	MDS N	o. IC1	06 / I	IC106	Sa			Rev.
TYPE OF MATERIAL	.: Impact tested carbon s	steel						1	
PRODUCT FORM	STANDARD	GRADE		4	ACCEP	TANCE	CLASS		EMENTARY REMENT
Castings	ASTM A352	LCC		-	- AST		ASTM A	352 S4, S5, S23	
								ASTM A	A703 S8, S14, S2
		Pa	age 2 of	3					
Non-Destructive	Magnetic particle testi	ng							
Testing	ASTM A352 Suppleme	entary requireme	ent S4 sh	all apply	/ as ame	ended by	this MDS	S:	
	NDE Requirement	Pilot casting (section 4.8) Production		oduction o	asting ^a				
	Frequency ^b		100 %)				100 %	, D
	Method	ASME BF	PVC Sec	. V, Artio	cle 7		ASME	BPVC Sec	. V, Article 7
	Extent ^c		100 %)				100 %	, D
	Acceptance criteria	ASME BF	PVC Sec Appendi		iv. 1,	ASN	IE BPVC	Sec. VIII,	Div. 1, Appendix
	NOTE The testing s cleaned prior				ng, if app	licable. I	Non-mac	hined surfa	aces shall be
	 Production valve specified by the p Frequency of insp All accessible interesting 	ourchaser, the re- pection 100 % m	quiremei eans tha	nts in thi t each it	s table s tem shal	hall app I be exar	ly.	somoalion.	
	Radiographic testing					بمامما امبر		. .	
	ASTM A352 suppleme		nt 55 sna	all apply					
	NDE requirement	Pilot casting (section 4.8)	Valve castings ^a Oth press contai				Other		
								pressure containing castings ^b	
	Frequency ^c	100 %	NPS DN Pressure class					100 %	
			_		≤ 300	600	900	≥ 1500	
			< 2	< 50	N/R	N/R	N/R	N/R	
			≥ 2	≥ 50	N/R	5 %	5 %	5 %	
			≥ 6	≥ 150	N/R	5 %	5 %	100 %	
			≥ 10	≥ 250	5 %	5 %	5 %	100 %	
			≥ 16	≥ 400	5 %	5 %	100 %	100 %	
			≥ 20	≥ 500	5 %	100 %	100 %	100 %	
	Method						Article 2		
	Extent	Areas defined I changes in	sections	and at		tions of r			100 % ^d
	Acceptance criteria					-	. 1, Appe	ndix 7	
	NOTE N/R means r	not required, unle	ess speci	fied othe	erwise b	y the pu	chaser.		
	^a Production valve casting, RT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply.								
	specified by the p	-	 ^b Production casting other than valve casting. ^c Frequency of inspection 100 % means that each item shall be examined. When random examination (5 %) is specified, a minimum of one item per lot of each pattern in any purchase order shall be 						
	 b Production castin c Frequency of insp 	g other than valu pection 100 % m	ve castin eans tha	g. t each it	tem shal				



Material Data	Sheet	MDS No. IC106	/ IC106S ^a	Rev. 01		
TYPE OF MATERIAL	: Impact tested carbon stee	el				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S23 ASTM A703 S8, S14, S20		
		Page 3 of 3		A01111 A1 03 00, 014, 020		
Repair of Defects	 Repairs as described i documented in accord The repair welding pro sheet using a cast plat Weld repairs are not a 	 ASTM A703 supplementary requirement S20 shall apply with the following additional requirements: 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. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this data sheet 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) ^{a, b}	of ISO 15156 /NACE M the MDS: <u>Hardness testing</u> - Production hardness te on the pilot casting and readings taken in close - Welding procedure qua NACE MR0175-2 /ISO	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:				
	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. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: - Heat treatment condition. For tempered condition, tempering temperature shall be stated.					
	y suffix "S" shall be used to o quirements for sour service.	designate a material delivere	ed in accordance with the MI	DS plus the additional		



Material Data	Sheet	MDS No. IC107	7 / IC107S ^a	Rev. 01		
TYPE OF MATERIAL: Impact tested carbon steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A696	В	-	ASTM A696 S5		
	ASTM A696	С	-	ASTM A696 S5		
	ASTM A350	LF2	Class 1			
	ASTM A350	LF6	Class 1 or 2			
		Page 1 of 2		-		
Scope	specification.	nal requirements for valve	ments that supplement or amen e parts DN 100 (NPS 4) and und			
Manufacturing	 Bars shall be manufactured to the following requirements: bar forgings as defined in ASTM A788 and certified to ASTM A350; or hot rolled bars manufactured to ASTM A696 Grade B or C to a maximum outside diameter of 250 mm (10 in). NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted. 					
Chemical Composition	$C \le 0.23 $ %, $S \le 0.020 $ %, $P \le 0.025 $ %, $CE \le 0.43 $ % Except for ASTM A350 LF6 bars, microalloying elements (Nb, V, Ti, B) shall not be deliberately added.					
Heat Treatment	Normalized or normalized and tempered or quenched and tempered as a separate operation. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F). During the heat treatment process, bars shall be placed in such a way as to ensure free circulation around					
Impact Testing/ Toughness testing	each bar including any quenching operation. Impact testing is required for thickness ≥ 6 mm (0.236 in); for bars with a weld end, the weld end thickness shall govern. The test temperature shall be minus 46 °C (-50 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 21 J (15 ft lbf) single.					
Test Sampling	 requirements: The mid-length of the a outside diameter or min centreline of the specim The centreline of the specim The centreline of the tai OD/4 from the surface a the bar. The notch of the impact For bar with outside dia taken. For bar with outside dia axial direction of the ba taken in tangential direction minimum of 100 mm (4) 	is for bars intended for maximum of 100 mm (4 in), when shall be located at a ningential tensile and impact test and the mid-point of the spand the mid-point of the spand the	achining of valve parts shall con achining of valve parts shall con thichever is the greater, from the ninimum distance of OD/4 from to test specimens shall be locate pecimens at a minimum of 100 i neated perpendicular to the bars the tensile and one set impact te test specimen and one set impact te test specimen and one set impact tipe of the tensile test specimer in.	a distance equal to the bar e end of the bar, and the the surface. ed at a minimum distance of mm (4 in) from the end of surface. st specimens shall be pecimens shall be taken in ict test specimens shall be a shall be located a		



Material Data	Sheet	MDS No. IC10)7 / IC107S ^a	Rev. 01		
TYPE OF MATERIAL: Impact tested carbon steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A696	В	-	ASTM A696 S5		
	ASTM A696	С	-	ASTM A696 S5		
	ASTM A350	LF2	Class 1			
	ASTM A350	LF6	Class 1 or 2			
		Page 2 of 2				
Non-Destructive Testing	<u>Visual inspection</u> VT shall be carried out on each bar in accordance with the product standard. The testing shall b after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing.					
	<u>NDT of valve parts manufactured from bar</u> Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply including magnetic particle testing according to the following table.					
	NDE Requirement	Part manufactured from bar				
	Frequency ^a	10 %				
	Method	ASME BPVC Sec. V, Article 7				
	Extent ^b		100 %			
	Acceptance criteria	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 6				
	 For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined. 					
Repair of Defects	Weld repair is not permitte	ed.				
Sour Service (additional metallurgical,			the purchaser, the material shall CE MR0103, and the following ad			
manufacturing, testing and certification	<u>Chemical composition</u> $S \le 0.020$ % Ni ≤ 1.0 %					
requirements) ^a	S ≤ 0.020 %, Ni < 1.0 %					
	<u>Hardness testing</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 o the end surface of one bar per lot. The maximum hardness shall be 22HRC from three readings taken in clos proximity.					
	The material shall be traceable in accordance with ISO 15156-2 /NACE MR0175-2 section 9 and this MDS.					
Marking	The bars shall be marked	to ensure full traceabilit	y to melt and heat treatment lot.			
Certification	The material manufacture requirements standard ac		stem certified in accordance with	ISO 9001 or another qua		
	The inspection document confirm compliance with t		ordance with ISO 10474 /EN 1020	04 Type 3.1 and shall		
	The inspection document	s shall include the follow	ing information:			
	 The inspection documents shall include the following information: Heat treatment condition. For tempered condition, tempering temperature shall be stated. 					



Material Data	Sheet	MDS No. ID141 /	ID141S ^a	Rev. 01
TYPE OF MATERIAL	.: Ferritic-Austenitic stainles	s steel type 22Cr duplex		
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Seamless pipes	ASTM A790	UNS S31803	-	-
	ASTM A790	UNS S32205	-	-
		Page 1 of 1		
Scope	This MDS defines applicable specification.	e options and/or requireme	nts that supplement or amer	nd the referenced standard
Qualification	Manufacturers and the man M-650. The qualification test		e qualified in accordance wit ents of this MDS.	th ISO 17782 or NORSOK
Metal Making	The melt shall be refined by	AOD or equivalent method.		
Chemical Composition	UNS S31803: N = 0.14 % - 0).20 %		
Heat Treatment	The pipes shall be solution a Pipes shall be placed in such during the heat treatment pro	h a way as to ensure free ci	ooling. rculation of heating and cooli	ng media around each pipe
Impact Testing/ Toughness testing	The sampling of test specime	ens, testing methodology an	d acceptance criteria shall cc	omply with ISO 17781 QL II.
Hardness testing	Hardness testing shall be pe	rformed by the Rockwell C r	nethod.	
Corrosion testing	The sampling of test speci ISO 17781.	mens, testing methodology	and acceptance criteria sh	nall be in accordance with
Micrographic Examination	The sampling of test specin including ferrite measurement		and acceptance criteria for r ith ISO 17781.	microstructural examination
Extent of Testing	One tensile, one set of ir measurements shall be carri		t and one micrographic ex at treatment lot.	amination including ferrite
Repair of Defects	Weld repair is not permitted.			
Sour Service (additional metallurgical,			urchaser, the material shall c R0103, and the following add	
manufacturing, testing and certification requirements) ^a			ordance with the requirement be 28HRC from three reading	
	The material shall be traceat	ble in accordance with ISO 1	5156-3 /NACE MR0175-3 se	ection 7.2 and this MDS.
Surface Treatment and Finish	Finished pipes shall be pickle	ed or bright annealed.		
Marking	The pipes shall be marked to	ensure full traceability to he	eat and heat treatment lot.	
Certification	requirements standard accept	oted by the purchaser.	certified in accordance with I	
	compliance with this specific	ation.	e with ISO 10474 /EN 10204	Type 3.1 and shall confirm
	The inspection documents s			
	 The MPS identification or Stool manufacturar: 	the MCPR/QTR number use	ea;	
		rature, holding time and que ced hot finished and direct c	nching medium shall be state quenched).	ed (holding time is not
	entary suffix "S" shall be used ry requirements for sour servic		vered in accordance with the	MDS plus the additional



Material Data S	sheet	MDS No. ID142 /	ID142S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic-Austenitic stainles	s steel type 22Cr duplex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Welded pipes	ASTM A928	UNS S31803	Class 1, 3, 4 and 5	ASTM A928 S3, S4	
	ASTM A928	UNS S32205	Class 1, 3, 4 and 5	ASTM A928 S3, S4	
	-	Page 1 of 2			
Scope	This MDS defines applicat specification.	ole options and/or requireme	nts that supplement or amen	d the referenced standard	
Qualification		nufacturing process shall be esting shall meet the requiren	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK	
Metal Making	The melt shall be refined b	by AOD or equivalent method	1.		
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %			
Welding	same examinations as for qualification shall be carrie	the production testing and sh	BPVC Section IX or ISO 156 hall fulfil the acceptance crite grade (UNS number) as usec equires requalification.	ria of ISO 17781. The	
Heat Treatment	The pipes shall be solution	n annealed followed by rapid	cooling.		
		uch a way as to ensure free on nent process including quence	circulation of heating and coo	ling media around each	
Impact Testing/Toughness testing	The sampling of test specimens, testing methodology and acceptance criteria shall comply with ISO 17781 QL II.				
Corrosion testing	The sampling of test speci ISO 17781.	mens, testing methodology a	and acceptance criteria shall	be in accordance with	
Micrographic Examination	The sampling of test speci	nt S4 shall apply as modified imens, testing methodology a nents shall be in accordance	and acceptance criteria for m	icrostructural examination	
Extent of Testing			d one micrographic examinati carried out for each heat and		
	same heat, same process		cceeding the lot definition in t procedure and same heat tro the product standards.		
Non-Destructive Testing	Liquid penetrant testing ASTM A928 Supplementa	ry requirement S3 shall apply	y as amended by this MDS:		
	NDE Requirement		Welded pipe		
	Frequency ^a		10 %		
	Method	AS	SME BPVC Sec. V, Article 6		
	Extent ^b		100 %		
	Acceptance criteria	ASME B	PVC Sec. VIII, Div. 1, Appen	dix 8	
		d of the examined pipe shall	bration, pickling/bright annea be ground flush in a length o		
		ation (10 %), a minimum of or ot shall be as defined for me	ne item per lot in any purchas chanical testing.	se order shall be	
		essible internal surfaces of th	•		



PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Welded pipes	ASTM A928	UNS S31803	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
	ASTM A928	UNS S32205	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
		Page 2 of 2		·		
Repair of Defects	Weld repair of base m	naterial is not permitted.				
		ne requirements for production as per the original production	on welding above shall apply to th n weld.	ne repair WPS. Repair weld		
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and	Hardness testing					
certification requirements) ^a	- Welding procedure qualification testing for manufacturing and repair welding shall require hardness testing. Hardness surveys shall comply with NACE MR0103 /ISO 17945 section 13.8.2, using Vickers method with a maximum hardness of 310HV (average), 320HV (single value).					
	 Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one length of pipe per lot. The maximum hardness of the base material, HAZ and weld metal shall be 28HRC from three readings taken in close proximity at each location. 					
	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 pipes shall be pickled or bright annealed.					
Marking	The pipes shall be ma	arked to ensure full traceabil	ity 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 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	 MPS identification or MCPR/QTR number used; 				
	 Manufacturer of the 	•				
	 Solution annealing 	temperature, holding time a	ind quench medium shall be state	ed.		



Material Data	Sheet	MDS No. ID1	43 / ID143S ^a	Rev. 01		
TYPE OF MATERIAL:	Ferritic-Austenitic stainles	s steel type 22Cr du	plex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A815	UNS S31803	WP-W, WP-S or WP-WX	ASTM A815 S2, S7		
	ASTM A815	UNS S32205	WP-W, WP-S or WP-WX	ASTM A815 S2, S7		
		Page 1 of 3	3			
Scope	This MDS defines applicable specification.	ble options and/or requ	uirements that supplement or amer	nd the referenced standard		
Qualification	Manufacturers and the ma M-650. The qualification te		hall be qualified in accordance with equirements of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined b	y AOD or equivalent r	nethod.			
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %				
Welding	The WPS shall be qualified in accordance with ASME BPVC Sec. IX or ISO 15614-1 and shall include the same examinations as for the base material and shall meet the acceptance criteria of ISO 17781. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make (brand name) of welding consumables requires requalification.					
Heat Treatment	The fittings shall be solutio	on annealed followed b	by water/liquid quenching.			
	Fittings shall be placed in s fitting during the heat treat		rre free circulation of heating and c g quenching.	ooling media around each		
Tensile Testing	where dimensions permit. prolongation or a length of	Supplementary requirement S2 shall apply. Tensile testing shall be carried out on specimens cut from a fitting where dimensions permit. When removal of specimens is not possible due to the size of the fitting, a prolongation or a length of starting material that has been heat treated in the same heat treatment load as the fittings it represents shall be used.				
Impact Testing/ Toughness testing	The sampling of test species ISO 17781 QL II.	mens, testing method	ology and acceptance criteria shall	comply with		
Corrosion testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781.					
Micrographic Examination	The sampling of test speci including ferrite measurem		ology and acceptance criteria for m dance with ISO 17781.	nicrostructural examination		
Extent of Testing	One tensile, impact tests a shall be carried out for eac		l one micrographic examination inc	luding ferrite measurement		
	A test lot shall include all fi ± 5 mm (± 0.2 in) and, when		neat and heat treatment load, with with the same WPS.	a wall thickness range of		
			the requirements in ASTM A815 sł , it shall be hardness tested as req			



Material Data	Sheet	MDS No. ID14	13 / ID143S ^a	Rev. 01			
TYPE OF MATERIAL	: Ferritic-Austenitic stainle	ess steel type 22Cr dup	lex				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Wrought fittings	ASTM A815	UNS S31803	WP-W, WP-S or WP-WX	ASTM A815 S2, S7			
	ASTM A815	UNS S32205	WP-W, WP-S or WP-WX	ASTM A815 S2, S7			
		Page 2 of 3					
Non-Destructive	Ultrasonic testing is not a	acceptable as replaceme	nt for RT of fittings.				
Testing	Liquid penetrant testing	tary requirement S7 shall	apply as amended by this MDS				
	NDE Requirement		Nominal Thickness				
		Seamless fit		elded fittings ^a			
	Frequency ^b	10 %	tingo ti	100 %			
	Method		ASME BPVC Sec. V, Article				
	Extent ^c	100 %					
	Acceptance criteria	ASME BPVC Sec. VIII, Div. 1, Appendix 8					
	 ^b Frequency of inspection 100 % means that each item shall be examined. When random examination (10 %) is specified, a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. ^c All accessible internal and external surfaces shall be examined. For welded fittings, the testing shall cover the weld only. 						
Repair of Defects	Weld repair of base mate For repair of welds, the r be heat treated as per th	equirements for production	on welding shall apply to the rep d.	air WPS. Repair welds shall			
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
manufacturing, testing and	Hardness testing						
certification requirements) ^ª	 Welding procedure qualification testing for manufacturing and repair welding shall require hardness testing. Hardness surveys shall comply with NACE MR0103 /ISO 17945 section 13.8.2, using Vickers method with a maximum hardness of 310HV (average), 320HV (single value). 						
	 Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two fittings per lot. When only one fitting is produced, it shall be hardness tested as required. The maximum hardness of the base material, HAZ and weld metal shall be 28HRC from three readings taken in close proximity at each location. 						
	proximity at each loca	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.					
		ceable in accordance wit	h ISO 15156-3 /NACE MR0175-	3 section 7.2 and this MDS.			
Surface Treatment and Finish	The material shall be tra		h ISO 15156-3 /NACE MR0175- ces do not require pickling.	3 section 7.2 and this MDS.			



Material Data	Sheet	MDS No. ID1	MDS No. ID143 / ID143S ^a				
TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 22Cr duplex							
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Wrought fittings	ASTM A815	UNS S31803	WP-W, WP-S or WP-WX	ASTM A815 S2, S7			
	ASTM A815	UNS S32205	WP-W, WP-S or WP-WX	ASTM A815 S2, S7			
		Page 3 of 3					
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 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 MCPR/QTR number used; 						
	- Steel manufactur	 Steel manufacturer of the starting material for the finished product; 					
	- Solution annealin	g temperature, holding time a	and quench medium shall be state	ed.			
	ry suffix "S" shall be use quirements for sour serv	5	ivered in accordance with the MD	S plus the additional			



Material Data S	sheet	MDS No. ID144 /	ID144S ^a	Rev. 01		
TYPE OF MATERIAL:	TYPE OF MATERIAL: Ferritic-Austenitic Stainless Steel type 22Cr duplex					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A182	F51 (UNS S31803)		ASTM A961 S56		
	ASTM A182	F60 (UNS S32205)		ASTM A961 S56		
	Page 1 of 2					
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 (12 in). For thickness exceeding					
		ion and specification requirem				
Qualification		anufacturing process shall be esting shall meet the requiren		ISO 17782 or NORSOK		
Metal Making	The melt shall be refined	by AOD or equivalent method	I.			
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %				
Heat Treatment	The forgings shall be solu	tion annealed followed by wa	ter/liquid quenching.			
		n such a way as to ensure fre at treatment process including		cooling media around each		
Impact Testing/ Toughness testing	The sampling of test specimens, testing methodology 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 for forging with weld ends. Test specimens shall be taken from the surface and the centre of the forging with no weld ends.					
Micrographic Examination	including ferrite measuren specimens shall be taken	imens, testing methodology a nents shall be in accordance from the surface and the cen v 10 mm (0.4 in) minimum.	with ISO 17781 for forging w	ith weld ends. Test		
Extent of Testing		and corrosion test, and one m ch heat and heat treatment lo		uding ferrite measurement		
	e e	ed out on the forgings with hea				
		I 2 000 kg (4 400 lb) for forgin orgings with as forged weight :	· / / · · · ·	o 50 kg (110 lb), and		
Non-Destructive Testing	<u>Visual inspection</u> VT shall be carried out on each forging in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. <u>Liquid penetrant testing</u> ASTM A961 Supplementary requirement S56 shall apply as amended by this MDS:					
	NDE Requirement		Forgings ^a			
	Frequency ^b		10 %			
	Method Extent °	AS	SME BPVC Sec. V, Article 6			
	Acceptance criteria	ASME R	100 % PVC Sec. VIII, Div. 1, Appen	dix 8		
	NOTE The testing shal pickled prior to t ^a Forgings of size DN	l be carried out after machinir he testing.				
	The test lot shall be a	ttion (10 %), a minimum of on as defined for mechanical tes al and external surfaces shall	ting.	e order shall be examined.		



TYPE OF MATERIAL: Ferritic-Austenitic Stainless Steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A182	F51 (UNS S31803)		ASTM A961 S56		
	ASTM A182	F60 (UNS S32205)		ASTM A961 S56		
		Page 2 of 2	1			
Non-Destructive Testing	<u>Valve forgings NDT</u> Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.					
Repair of Defects	Weld repair is not permitt	ed.				
Sour Service (additional metallurgical, manufacturing,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
testing and certification requirements) ^a	<u>Hardness testing</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two forgings per lot. When only one part is produced, it shall be hardness tested as required. 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 forgings shall be pickled. Machined surfaces do not require pickling.					
Marking	The forgings shall be ma	rked to ensure full traceability	to heat and heat treatment lo	ot.		
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:					
	 The MPS identification or the MCPR/QTR number used; 					
	 Steel manufacturer; 					
	 Solution annealing terr 	nperature, holding time and qu	enching medium shall be sta	ated.		



Material Data S	sheet	MDS No. ID145 /	ID145S ^a	Rev. 01		
TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates, sheets, strips	ASTM A240	UNS S31803	-	ASTM A240 S1		
	ASTM A240	UNS S32205	-	ASTM A240 S1		
		Page 1 of 2				
Scope	This MDS defines applicat specification.	ble options and/or requireme	ents that supplement or amen	d the referenced standard		
Qualification		nufacturing process shall be esting shall meet the requirer	e qualified in accordance with ments of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined b	by AOD or equivalent method	d.			
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %				
Heat Treatment	The plates shall be solutio	n annealed followed by wate	er/liquid quenching.			
		uch a way as to ensure free treatment process including	circulation of heating and co quenching.	oling media around		
Tensile Testing	Tensile test specimens sha	all be sampled in the transve	erse orientation to the direction	on of final rolling.		
Impact testing/ Toughness testing	The sampling of test speci ISO 17781 QL II.	mens, testing methodology	and acceptance criteria shall	comply with		
Corrosion testing	The sampling of test speci ISO 17781.	mens, testing methodology	and acceptance criteria shall	be in accordance with		
Micrographic Examination		mens, testing methodology a nents shall be in accordance	and acceptance criteria for m with ISO 17781.	icrostructural examination		
Extent of Testing		pact tests and corrosion test, ried out for each heat of stee	, and one micrographic exam al and heat treatment lot.	ination including ferrite		
Non-Destructive	Visual Inspection					
Testing			th the product standard. The ces shall be cleaned prior to			
	Valve plate NDT					
	Inspection of plate for valv specified by the purchaser	e parts shall be according to , the requirements in this MI	the applicable valve specific DS shall apply.	cation. If a QSL is not		
Repair of Defects	Weld repair is not permitte	ed.				
Sour Service (additional metallurgical,		6 /NACE MR0175 or ISO 17	burchaser, the material shall o 945 /NACE MR0103, and the			
manufacturing, testing and	Hardness testing					
certification requirements) ^ª	Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one plate per lot. For coil, tests shall be carried out at both ends of the coil. The maximum hardness shall be 28HRC from three readings taken in close proximity at each location.					
	The material shall be trace	eable in accordance with ISC) 15156-3 /NACE MR0175-3	section 7.2 and this MDS.		
Surface Treatment and Finish	Finished plates, sheets or	strips shall be pickled.				
Marking	The plates, sheets or strip	s shall be marked to ensure	full traceability to heat and h	eat treatment lot.		



Material Data Sheet		MDS No. ID14	MDS No. ID145 / ID145S ^a				
TYPE OF MATERIAL:	TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Plates, sheets, strips	ASTM A240	UNS S31803	-	ASTM A240 S1			
	ASTM A240	UNS S32205	-	ASTM A240 S1			
		Page 2 of 2					
Certification		cturer shall have a quality sy rd accepted by the purchase	stem certified in accordance with r.	ISO 9001 or another quality			
	The inspection docu compliance with this		with ISO 10474 /EN 10204 Type	3.1 and shall confirm			
	The inspection docu	ments shall include the follow	ing information:				
	 MPS identification 	or MCPR/QTR number used	1;				
	- Steel manufacture	er;					
	- Solution annealing temperature, holding time and quench medium shall be stated.						



Material Data S	Sheet	MDS No. ID146 /	MDS No. ID146 / ID146S ^a			
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A995	4A (UNS J92205)	-	ASTM A995 S5, S6, S11, ASTM A703 S20.		
		Page 1 of 3				
Scope	This MDS defines applica specification.	ble options and/or requireme	nts that supplement or amer	nd the referenced standard		
Qualification		anufacturing process shall be esting shall meet the requiren		ISO 17782 or NORSOK		
Metal Making		by AOD or equivalent method d by ISO 17782 is regarded to				
Chemical Composition	N = 0.14 % - 0.30 %					
Heat Treatment	The castings shall be solu	ution annealed followed by wa	ter/liquid quenching.			
		in such a way as to ensure fre eatment process including qu		cooling media around each		
Impact testing/ Toughness testing	The sampling of test spec ISO 17781 QL II.	imens, testing methodology a	and acceptance criteria shall	comply with		
Corrosion testing	The sampling of test species ISO 17781.	imens, testing methodology a	and acceptance criteria shall	be in accordance with		
Micrographic Examination	The sampling of test specincluding ferrite measurer	timens, testing methodology a nents shall be in accordance	and acceptance criteria for m with ISO 17781.	nicrostructural examination		
Extent of Testing	measurement shall be ca	pact tests and corrosion test, rried out for each heat of stee I 5 000 kg (11 000 lb) in weigt	I and heat treatment load (in			
Test Sampling	The test blocks shall be in	n compliance with ISO 17781.				
Non-Destructive	Visual inspection					
Testing	NDE requirement	Pilot casting (section	4.8) Proc	duction casting		
	Frequency	Each pilot casting	Each	production casting		
	Method		ANSI/MSS SP-55			
	Extent	100 % of all ac	cessible surfaces including v	welding ends		
	Acceptance criteria		MSS SP-55			
	NOTE The testing sha cleaned prior to	III be carried out after machini the testing.	ng, if applicable. Non-machi	ined surfaces shall be		



	- Formitie Accessible Ctr	inland Ctarl to							
YPE OF MATERIAL	: Ferritic -Austenitic Sta	ainiess Steel ty	pe 22Cr c	nuplex					
PRODUCT FORM	STANDARD	GRADE			ACCE	PTANCI	E CLASS		PPLEMENTARY QUIREMENT
castings	ASTM A995	4A (UNS	J92205)		-				M A995 S5, S6, S M A703 S20.
			Page 2 of	3					
lon-Destructive esting	Liquid penetrant testin ASTM A995 Supplem		nent S6 sh	all apply	/ as ame	ended by	this MDS	S:	
	NDE Requirement	Pilot ca	asting (se	ction 4.	8)		Pro	duction	casting ^a
	Frequency ^b		100 %					100 %	6
	Method	ASME BI	PVC Sec.	V, Articl	e 6		ASME E	PVC Sec	c. V, Article 6
	Extent ^c		100 %					100 %	6
	Acceptance criteria	ASME BI	PVC Sec. Appendix	-	. 1,	ASM	EBPVC	Sec. VIII,	Div. 1, Appendix 7
	 ^a Production valve specified by the ^b Frequency of inst 	vickled prior to the testing. Juction valve castings, PT shall be according to the applicable valve specification. If a QSL is not fied by the purchaser, the requirements in this table shall apply. Juncy of inspection 100 % means that each item shall be examined. Cessible internal and external surfaces shall be examined.							
	Radiographic testing ASTM A995 supplem NDE requirement	Pilot casting	ent S5 sh	all apply		Produc	tion cast		Other pressu
	ASTM A995 supplem	Pilot	ent S5 sh	all apply			tion cast		
	ASTM A995 supplem	Pilot casting	ent S5 sh	all apply		Produc	tion cast a ^a		containing
	ASTM A995 supplem	Pilot casting (section 4.8)				Produc castings	tion cast a ^a		containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS	DN < 50	Valve ≤ 300 N/R	Produc castings Pressur 600 N/R	tion cast a re class 900 N/R	ing ≥ 1500 N/R	containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS <2 ≥2	DN < 50 ≥ 50	Valve ≤ 300 N/R N/R	Produc castings Pressur 600 N/R 5 %	tion cast a re class 900 N/R 5 %	ing ≥ 1500 N/R 5 %	containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS < 2	DN < 50 ≥ 50 ≥ 150	Valve ≤ 300 N/R N/R N/R	Produc castings Pressur 600 N/R 5 %	tion cast e class 900 N/R 5 % 5 %	ing ≥ 1500 N/R 5 % 100 %	containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS < 2	DN < 50	Valve ≤ 300 N/R N/R 5 %	Produc castings Pressur 600 N/R 5 % 5 % 5 %	tion cast • class 900 N/R 5 % 5 % 5 %	ing ≥ 1500 N/R 5 % 100 % 100 %	containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS < 2	DN < 50 ≥ 50 ≥ 150	Valve ≤ 300 N/R N/R N/R	Produc castings Pressur 600 N/R 5 %	tion cast e class 900 N/R 5 % 5 %	ing ≥ 1500 N/R 5 % 100 %	containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS < 2	DN < 50	Valve ≤ 300 N/R N/R 5 % 5 %	Produc castings Pressur 600 N/R 5 % 5 % 5 % 5 % 100 %	tion cast a e class 900 N/R 5 % 5 % 100 % 100 %	ing ≥ 1500 N/R 5 % 100 % 100 % 100 %	containing castings ^b
	ASTM A995 supplem	Pilot casting (section 4.8)	NPS < 2 ≥ 2 ≥ 6 ≥ 10 ≥ 16 ≥ 20 d by ASM	DN < 50 ≥ 50 ≥ 250 ≥ 400 ≥ 500 ASI E B16.3 ad at the	Valve ≤ 300 N/R N/R 5 % 5 % 5 % WE BPV 4 for sp junctior	Produc castings Pressur 600 N/R 5 % 5 % 5 % 5 % 100 % /C Sec. \ ecial class is of rise	tion cast a re class 900 N/R 5 % 5 % 5 % 100 % 100 % /, Article ss valves	ing ≥ 1500 N/R 5 % 100 % 100 % 100 % 100 % 2 at abrup	t 100 % d
	ASTM A995 supplem	Pilot casting (section 4.8) 100 %	NPS < 2 ≥ 2 ≥ 6 ≥ 10 ≥ 16 ≥ 20 d by ASM ections ar	DN < 50 ≥ 50 ≥ 250 ≥ 400 ≥ 500 E B16.3 d at the to th	Valve ≤ 300 N/R N/R 5 % 5 % 5 % ME BPV 4 for sp junctior e castin	Produc castings Pressur 600 N/R 5 % 5 % 5 % 100 % /C Sec. \ ecial class so frise g	tion cast a e class 900 N/R 5 % 5 % 100 % 100 % 100 % /, Article s valves rs, gates	ing ≥ 1500 N/R 5 % 100 % 100 % 100 % 100 % 2 at abrup or feeder	100 %
	ASTM A995 supplem	Pilot casting (section 4.8) 100 % Areas define changes in se	NPS < 2 ≥ 2 ≥ 6 ≥ 10 ≥ 16 ≥ 20 A by ASM ections ar	DN < 50 ≥ 50 ≥ 250 ≥ 400 ≥ 500 ASI E B16.3 ad at the to th SME BF	Valve ≤ 300 N/R N/R 5 % 5 % 5 % ME BPV 4 for sp junctior e castin PVC Sec	Pressur 600 N/R 5 % 5 % 5 % 100 % (C Sec. \ ecial class is of rise g	tion cast a e class 900 N/R 5 % 5 % 100 % 100 % 100 % /, Article as valves rs, gates v. 1, App	ing ≥ 1500 N/R 5 % 100 % 100 % 100 % 100 % 2 at abrup or feeder	t 100 % d
	ASTM A995 supplem	Pilot casting (section 4.8) 100 % 100 % Areas define changes in second not required, un casting, RT sha purchaser, the r	NPS < 2 ≥ 2 ≥ 2 ≥ 10 ≥ 16 ≥ 20 A by ASM ections ar A alless spec all be accord equireme	DN < 50	Valve ≤ 300 N/R N/R 5 % 5 % 5 % ME BPV 4 for sp junctior e castin ≥VC Sec erwise b the app	Produc castings Pressur 600 N/R 5 % 5 % 5 % 100 % /C Sec. \ ecial class of rise g c. VIII, Di py the pup blicable v	tion cast a e class 900 N/R 5 % 5 % 100 % 100 % /, Article s valves rs, gates v. 1, App rchaser. alve spec	ing ≥ 1500 N/R 5 % 100 % 100 % 100 % 100 % 2 at abrup or feeder endix 7	t 100 % d



TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex							
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Castings	ASTM A995	4A (UNS J92205)	-	ASTM A995 S5, S6, S1 ASTM A703 S20.			
		Page 3 of 3	I	I			
Repair of Defects	All major repairs as define supplementary requiremer		documented in accordance wit	h ASTM A703			
	The repair welding proced following:	ure shall be qualified in ac	cordance with ASTM A488 or I	SO 11970 and the			
	 welding procedure shall 	be qualified on the same	cast material grade (UNS num	per) as used in production			
	 change of specific make processes; 	e of filler metal (brand nam	nes) requires requalification for	SMAW and FCAW			
	 microstructure examina accordance with ISO 17 		Charpy V-notch and corrosion	tests shall be carried out i			
		•	aining parts shall also include R	т.			
	Weld repairs are not acceptable for castings that leak during pressure testing.						
	Post weld heat treatment is required after all weld repairs.						
	If a minor cosmetic repair is required, heat treatment may be excluded providing the welding procedure meets all the specified microstructural, mechanical and corrosion material requirements of this data sheet in the as- welded condition.						
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
manufacturing, testing and	<u>Hardness testing</u>						
certification requirements) ^ª	 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 28HRC from three readings taken in close proximity at each location. 						
	 Welding procedure qualification testing for all repair welding shall require hardness testing. Hardness surveys shall comply with NACE MR0103 /ISO 17945 section13.8.2, using Vickers method with a maximum hardness of 310HV (average), 320HV (single value). 						
	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 castings shall be	pickled. Machined surface	es do not require pickling.				
Marking	The castings shall be mark	ked to ensure full traceabil	ity to heat and heat treatment l	ot.			
Certification	The material manufacturer requirements standard acc		m certified in accordance with	SO 9001 or another quali			
	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:				
	- The MPS identification	or the MCPR/QTR numbe	r used;				
	- Steel melting and refinir	ng practice;					
	 Solution annealing temp 	perature, holding time and	 Solution annealing temperature, holding time and quenching medium shall be stated. 				

supplementary requirements for sour service.



Material Data S	Sheet	MDS No. ID147 /	ID147S ^a	Rev. 01	
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bars	ASTM A276	UNS S31803			
	ASTM A276	UNS S32205			
	ASTM A479	UNS S31803			
	ASTM A479	UNS S32205			
	ASTM A182	F51 (UNS S31803)			
	ASTM A182	F60 (UNS S32205)			
		Page 1 of 3	•	·	
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard	
	bars, when permitted by th	ne valve specification.	arts DN 100 (NPS 4) and unc		
			thickness of 300 mm (12 in). nents shall be subject to agre		
Qualification		nufacturing process shall be esting shall meet the requirer	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK	
Metal Making	The melt shall be refined b	by AOD or equivalent method	1.		
Manufacturing	Bars shall be manufacture	d to the following requiremen	nts:		
	00	in ASTM A788 and certified			
	 hot or cold finished cylin 300 mm (12 in). 	ndrical shaped bar manufacti	ured to ASTM A276 or A479	with maximum diameter of	
		Il be restricted to turning, gri rming is not permitted.	nding or polishing (singly or i	n combination); cold	
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %			
Heat Treatment	Bars shall be solution anne	ealed followed by water/liqui	d quenching.		
		ch a way as to ensure free ci process including quenching	rculation of heating and cool	ing media around each bar	
Tensile Testing	properties of the reference	d standard specification in b	his MDS, all tensile tests sha oth directions. The centreline e with ASTM A370 Annex A.		
Impact Testing/ Toughness testing		e tangential direction is requ	nce criteria shall comply with ired by this MDS, the accept		
Corrosion testing			and acceptance criteria shall rface and the centre of the ba		
Micrographic Examination	including ferrite measurem	ents shall be in accordance	and acceptance criteria for m with ISO 17781. Test specim ea of 10 mm (0.4 in) by 10 m	nens shall be taken from	
Extent of Testing		corrosion tests, and one micr ch lot as defined in ASTM A4	ographic examination includ 84.	ing ferrite measurements	



Material Data S	Sheet	MDS No. ID147 /	ID147S ^a	Rev. 01			
TYPE OF MATERIAL:	TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bars	ASTM A276	UNS S31803					
	ASTM A276	UNS S32205					
	ASTM A479	UNS S31803					
	ASTM A479	UNS S32205					
	ASTM A182	F51 (UNS S31803)					
	ASTM A182	F60 (UNS S32205)					
		Page 2 of 3					
Test Sampling	equal to the bar outside d bar. <u>Valve parts manufactured</u> For bars with outside diar testing and impact testing	iameter or minimum of 100 n <u>I from bar</u> neter ≥ 100 mm (4 in) intende i in the longitudinal direction,	ansverse) specimens shall b nm (4 in), whichever is the g ed for machining of valve par one tensile test specimen an n. Acceptance criteria shall c	reater, from the end of the ts, in addition to tensile id one set of three impact			
Non-Destructive Testing			n the product standard. The te ices shall be cleaned prior to				
	<u>NDT valve parts manufactured from bar</u> Inspection of valve parts manufactured from bar shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply including liquid penetrant testing according to the following table.						
	NDE Requirement	Part manufactured from bar ^a					
	Frequency ^b		10 %				
	Method	A	SME BPVC Sec. V, Article 6				
	Extent ^c		100 %	adix 8			
	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. a Part of size DN > 50 (NPS > 2). b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. c All accessible internal and external surfaces shall be examined.						
Repair of Defects	Weld repair is not permitte	ed.					
Sour Service (additional metallurgical, manufacturing,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
testing and certification requirements)	<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 trac	eable in accordance with ISC	0 15156-3 /NACE MR0175-3	section 7.2 and this MDS.			
Surface Treatment and Finish	Finished product shall be	white pickled.					
Marking	The bars shall be marked	to ensure full traceability to I	heat and heat treatment lot.				



Material Data Sheet		MDS No. ID147 /	Rev. 01					
TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel type 22Cr duplex								
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Bars	ASTM A276	UNS S31803						
	ASTM A276	UNS S32205						
	ASTM A479	UNS S31803						
	ASTM A479	UNS S32205						
	ASTM A182	F51 (UNS S31803)						
	ASTM A182	F60 (UNS S32205)						
		Page 3 of 3						
Certification	The material manufacture requirements standard ac	er shall have a quality system cepted by the purchaser.	certified in accordance with	ISO 9001 or another quality				
	The inspection document confirm compliance with	s shall be issued in accordan his specification.	ce with ISO 10474 /EN 1020	4 Type 3.1 and shall				
	The inspection document	s shall include the following ir	nformation:					
	- The MPS identification	or the MCPR/QTR number u	ised;					
	- Steel manufacturer of	starting material;						
	 Solution annealing terr 	perature, holding time and qu	uenching medium shall be sta	ated.				
		lesignate a material delivered	 Solution annealing temperature, holding time and quenching medium 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. 					



Material Data S	Sheet	MDS No. ID148 /	ID148S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic-Austenitic stainles	s steel type 22Cr duplex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Tubes	ASTM A789	UNS S31803			
	ASTM A789	UNS S32205			
		Page 1 of 1			
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard	
Qualification		nufacturing process shall be sting shall meet the requirer	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK	
Metal Making	The melt shall be refined b	y AOD or equivalent method	1.		
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %			
Heat Treatment	Tubes shall be placed in s	n annealed followed by rapid uch a way as to ensure free nent process including rapid	circulation of heating and co	oling media around each	
Impact Testing/ Toughness testing	The sampling of test speci ISO 17781 QL II.	mens, testing methodology a	and the acceptance criteria s	hall comply with	
Corrosion testing	The sampling of test speci ISO 17781.	mens, testing methodology a	and acceptance criteria shall	be in accordance with	
Micrographic Examination		mens, testing methodology a ents shall be in accordance	and acceptance criteria for m with ISO 17781.	icrostructural examination	
Extent of Testing			est, and one micrographic ex ed in the standard for mecha		
Repair of Defects	Weld repair is not permitte	d.			
Sour Service (additional metallurgical,			urchaser, the material shall o 945 /NACE MR0103, and the		
manufacturing, testing and	Hardness testing				
certification requirements) ^a			ordance with the requirement RC from three readings take		
	The material shall be trace	able in accordance with ISO	15156-3 /NACE MR0175-3	section 7.2 and this MDS.	
Surface Treatment and Finish	Finished tubes shall be pic	kled or bright annealed.			
Certification	The material manufacturer requirements standard acc		certified in accordance with I	ISO 9001 or another quality	
	The inspection documents compliance with this specified		ISO 10474 /EN 10204 Type	3.1 and shall confirm	
	The inspection documents shall include the following information:				
	 MPS identification or M0 	,			
	- Steel manufacturer of th	-			
	 Solution annealing temp 	perature, holding time and qu	ench medium shall be stated	d.	
	v suffix "S" shall be used to de uirements for sour service.	esignate a material delivered	in accordance with the MDS	plus the additional	



Material Data S	Sheet	MDS No. ID149 /	ID149S ^a	Rev. 01			
TYPE OF MATERIAL:	TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
HIP products	ASTM A988	UNS S31803		ASTM A988 S5			
	ASTM A988	UNS S32205		ASTM A988 S5			
		Page 1 of 2					
Scope	standard specification. Product covered by this M	ble options and/or requireme	hickness of 300 mm (12 in).				
Qualification	Manufacturers and the ma	ents shall be subject to agree anufacturing process shall be esting shall meet the requiren	qualified in accordance with	ISO 17782 or NORSOK			
Metal Making		de from AOD-refined metal. F composition, particle size and		nogenous mixture of			
Chemical Composition	UNS S31803: N = 0.14 %	- 0.20 %					
Heat Treatment	Products shall be placed i	solution annealed followed by n such a way as to ensure fre tment process including quer	e circulation of heating and	cooling media around each			
Impact Testing/ Toughness testing	The sampling of test spec ISO 17781 QL II.	imens, testing methodology a	and the acceptance criteria sl	hall comply with			
Corrosion testing		imens, testing methodology a t with weld ends. Test specin ends.					
Micrographic Examination	including ferrite measuren specimens shall be taken	imens, testing methodology a nents shall be in accordance from the surface and the cen by 10 mm (0.4 in) minimum.	with ISO 17781 for HIP prod	uct with weld ends. Test			
Extent of Testing	measurement shall be car	pact tests and corrosion test, ried out for each lot. A lot sha edure and same heat treatme	all include all products from a				
Non-Destructive Testing	Visual inspection VT shall be carried out on each item in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing ASTM A988 supplementary requirement S5 shall apply as amended by this MDS:						
	NDE Requirement		HIP product ^a				
	Frequency ^b		10 %				
	Method	AS	ME BPVC Sec. V, Article 6				
	Extent ^c		100 %				
	Acceptance criteria	ASME B	PVC Sec. VIII, Div. 1, Appen	dix 8			
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. ^a Parts of size DN > 50 (NPS > 2). ^b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. ^c All accessible internal and external surfaces shall be examined. 						
Repair of Defects	Weld repair is not permitte	ed.					



Material Data	Sheet	MDS No. ID149 /	ID149S ^a	Rev. 01		
TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 22Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
HIP products	ASTM A988	UNS S31803		ASTM A988 S5		
	ASTM A988	UNS S32205		ASTM A988 S5		
	1	Page 2 of 2		I		
Sour Service (additional metallurgical,		ments are specified by the p 6 /NACE MR0175 or ISO 179				
manufacturing, testing and certification requirements) ^a	<u>Hardness testing</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A two parts per lot. When only one part is produced, it shall be hardness tested as required. The m hardness shall be 25HRC 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 components shal	I be pickled. Machined surfac	ces do not require pickling.			
Marking		ive a unique identity marked hroughout production of the d in this MDS.				
Certification	The material manufacturer requirements standard acc	r shall have a quality system cepted by the purchaser.	certified in accordance with I	SO 9001 or another quality		
		The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.				
	The inspection documents	The inspection documents shall include the following information:				
	 MPS identification or MCPR/QTR number used; 					
	- Steel manufacturer of th	ne starting material (powder)	for the finished product;			
	- Solution annealing temperature, holding time and quench medium shall be stated.					

supplementary requirements for sour service.



Material Data S	Sheet	MDS No. ID251 /	ID251S ^a	Rev. 01		
TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 25Cr duplex						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Seamless pipes	ASTM A790	UNS S32550				
	ASTM A790	UNS S32750				
	ASTM A790	UNS S32760				
		Page 1 of 1				
Scope	This MDS defines applicat standard specification.	ble options and/or requireme	nts that supplement or amen	d the referenced ASTM		
Qualification		nufacturing process shall be esting shall meet the requirer	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined b	by AOD or equivalent method	I.			
Chemical Composition	PREN ≥ 40.0					
Heat Treatment	Pipes shall be placed in su	n annealed followed by rapid uch a way as to ensure free o nent process including quenc	circulation of heating and coo	ling media around each		
Impact Testing/ Toughness testing	The sampling of test speci ISO 17781 QL II.	mens, testing methodology a	and acceptance criteria shall	comply with		
Hardness testing	Hardness testing shall be	performed by the Rockwell C	method.			
Corrosion testing	The sampling of test speci ISO 17781.	mens, testing methodology a	and acceptance criteria shall	be in accordance with		
Micrographic Examination		mens, testing methodology a nents shall be in accordance	and acceptance criteria for m with ISO 17781.	icrostructural examination		
Extent of Testing		pact tests and corrosion test, ried out for each heat and he	and one microstructure exar at treatment lot.	nination including ferrite		
Repair of Defects	Weld repair is not permitte	d.				
Sour Service (additional metallurgical,			urchaser, the material shall c 945 /NACE MR0103, and the			
manufacturing, testing and	Hardness testing					
certification requirements)			ordance with the requirement Il be 32HRC from three readi			
	The material shall be trace	eable in accordance with ISO	15156-3 /NACE MR0175-3	section 7.2 and this MDS.		
Surface Treatment and Finish	Finished pipes shall be pic	kled or bright annealed.				
Marking	The pipes shall be marked	to ensure full traceability to	heat and heat treatment lot.			
Certification	The material manufacturer requirements standard acc		certified in accordance with I	SO 9001 or another quality		
	The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.					
		shall include the following in	formation:			
	- MPS identification or MO	CPR/QTR number used;				
	- Steel manufacturer;	and the first of the second	and an all the second			
		perature, holding time and qu duced hot finished and direct	ench medium shall be stated t quenched).	a (nolding time is not		
	suffix "S" shall be used to de uirements for sour service.	esignate a material delivered	in accordance with the MDS	plus the additional		


Material Data	Sheet	MDS No. ID25	2 / ID252S ^a	Rev. 01		
TYPE OF MATERIAL	: Ferritic-Austenitic stainle	ess steel type 25Cr dupl	ЭХ			
PRODUCT FORM	STANDARD	GRADE	SUPPLEMENTARY REQUIREMENT			
Welded pipes	ASTM A928	UNS S32550	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
	ASTM A928	UNS S32750	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
	ASTM A928	UNS S32760	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
		Page 1 of 2	ł			
Scope	This MDS defines applic specification.	able options and/or requir	ements that supplement or amer	d the referenced standard		
Qualification		nanufacturing process sha testing shall meet the req	II be qualified in accordance with uirements of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined	by AOD or equivalent me	ethod.			
Chemical Composition	PREN ≥ 40.0					
Welding	same examinations as for qualification shall be carr	The WPS shall be qualified in accordance with ASME BPVC Sec. IX or ISO 15614-1 and shall include the same examinations as for the production testing and shall fulfil the acceptance criteria of ISO 17781. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make (brand name) of welding consumables requires requalification.				
Heat Treatment	nt The pipes shall be solution annealed followed by rapid cooling.					
		Pipes shall be placed in such a way as to ensure free circulation of heating and cooling media around each pipe during the heat treatment process including quenching.				
Impact Testing/ Toughness testing	The sampling of test spe ISO 17781 QL II.	The sampling of test specimens, testing methodology and acceptance criteria shall comply with ISO 17781 QL II.				
Corrosion testing	The sampling of test spe ISO 17781.	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781.				
Micrographic Examination	The sampling of test spe	ent S4 shall apply as more cimens, testing methodole ments shall be in accordation	bgy and acceptance criteria for m	icrostructural examination		
Extent of Testing			test, and one microstructure exa	mination including ferrite		
	measurement shall be carried out for each heat and heat treatment lot. A lot of pipe is defined as the quantity of product not exceeding the lot definition in the standard and from the					
	same heat, same processing conditions including weld procedure and same heat treatment load.					
	For continuous furnaces	, the lot definition shall co	mply with the product standards.			
Non-Destructive Testing	Liquid penetrant testing					
-	ASTM A928 Supplementary requirement S3 shall apply as amended by this MDS:					
	NDE Requirement		Welded pipe			
	Frequency ^a		10 %			
	Method		ASME BPVC Sec. V, Article 6			
	Extent ^b		100 %			
	Acceptance criteria	ASM	IE BPVC Sec. VIII, Div. 1, Apper	ndix 8		
		end of the examined pipe	r calibration, pickling/bright annea shall be ground flush in a length o			
	examined. The test	 ^a For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. 				



TYPE OF MATERIAL	: Ferritic-Austenitic sta	inless steel type 25Cr dup	olex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Welded pipes	ASTM A928	UNS S32550	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
	ASTM A928	UNS S32750	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
	ASTM A928	UNS S32760	Class 1, 3, 4 and 5	ASTM A928 S3, S4		
		Page 2 of 2				
Repair of Defects	For repair of welds, the	naterial is not permitted. he requirements for producti as per original production w	ion welding above shall apply to the	e repair WPS. Repair weld		
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and certification requirements) ^a	 <u>Hardness testing</u> Welding procedure qualification testing for manufacturing and repair welding shall require hardness testing. Hardness surveys shall comply with NACE MR0103 /ISO 17945 section13.8.2, using Vickers method with a maximum hardness of 310HV (average), 320HV (single value). Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one length of pipe per lot. The maximum hardness of the base material, HAZ and weld metal shall be 32HRC 					
	from three readings taken in close proximity at each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.					
Surface Treatment and Finish		be pickled or bright annealed				
Marking	The pipes 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 qualit requirements standard accepted by the purchaser.					
	The inspection documents shall be 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 MCPR/QTR number used; 					
	- Manufacturer of th	e starting material;				
	- Solution appoaling	tomporaturo, bolding timo a	and quench medium shall be state	d		



Material Data Sh	eet	MDS No. ID2	53 / ID253S ^a	Rev. 01		
TYPE OF MATERIAL: Fe	rritic-Austenitic stainle	ss steel type 25Cr duple	x			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS SUPPLEMENTA REQUIREMENT			
Wrought fittings	ASTM A815	UNS S32550	WP-W, WP-S or WP- WX	ASTM A815 S2, S7		
	ASTM A815	UNS S32750	WP-W, WP-S or WP- WX	ASTM A815 S2, S7		
	ASTM A815	UNS S32760	WP-W, WP-S or WP- WX	ASTM A815 S2, S7		
		Page 1 of 3	L			
Scope	This MDS defines app standard specification.		irements that supplement or am	end the referenced		
Qualification		e manufacturing process shon testing shall meet the re	nall be qualified in accordance window and the qualified in accordance window and this MDS.	ith ISO 17782 or NORSOK		
Metal Making	The melt shall be refin	ed by AOD or equivalent n	nethod.			
Chemical Composition	PREN ≥ 40.0	PREN ≥ 40.0				
Welding	The WPS shall be qualified in accordance with ASME BPVC Sec. IX or ISO 15614-1 and shall include the same examinations as for the production testing and shall fulfil the acceptance criteria of ISO 17781. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make (brand name) of welding consumables requires requalification.					
Heat Treatment	Fittings shall be placed	lution annealed followed b d in such a way as to ensu ring the heat treatment pro	re free circulation of heating and	cooling media		
Tensile Testing	Supplementary requirement S2 shall apply. Tensile testing shall be carried out on specimens cut from a fitting where dimensions permit. When removal of specimens is not possible due to the size of the fitting, a prolongation or a length of starting material that has been heat treated in the same heat treatment load as the fittings it represents shall be used.					
Impact Testing/ Toughness testing	The sampling of test specimens, testing methodology 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.					
Micrographic Examination			blogy and acceptance criteria for I be in accordance with ISO 1778			
Extent of Testing		sts and corrosion test, and carried out for each lot as	one micrographic examination ir defined below.	ncluding ferrite		
		all fittings from the same h where applicable, welded w	heat and heat treatment load, with vith the same WPS.	h a wall thickness range of		
			he requirements in ASTM A815 it shall be hardness tested as re			



Material Data Sh	eet	MDS No. ID253 /	/ ID253S ^a	Rev. 01			
TYPE OF MATERIAL: Fe	rritic-Austenitic stainless	s steel type 25Cr duplex					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Wrought fittings	ASTM A815	UNS S32550	WP-W, WP-S or WP- WX	ASTM A815 S2, S7			
	ASTM A815	UNS S32750	WP-W, WP-S or WP- WX	ASTM A815 S2, S7			
	ASTM A815	UNS S32760	WP-W, WP-S or WP- WX	ASTM A815 S2, S7			
		Page 2 of 3					
Non-Destructive Testing	Liquid penetrant testing	acceptable as replacement fo ntary requirement S7 shall app	-	S:			
	NDE Requirement		Nominal Thickness				
		Seamless fittings	We	elded fittings ^a			
	Frequency ^b	10 %		100 %			
	Method	AS	ME BPVC Sec. V, Article 6	;			
	Extent ^c	100 %					
	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8						
	 ^a Welded fittings of size DN > 50 (NPS > 2). ^b Frequency of inspection 100 % means that each item shall be examined. When random examination (10 %) is specified, a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. ^c All accessible internal and external surfaces shall be examined. For welded fittings, the testing shall cover the weld only. 						
Repair of Defects	Weld repair of base mat	erial is not permitted					
	For repair of welds, the	requirements for production w per the original production we		pair WPS. Repair welds			
Sour Service (additional metallurgical, manufacturing, testing	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
and certification	Hardness testing						
requirements) ^a	 Welding procedure qualification testing for manufacturing and repair welding shall require hardness testing. Hardness surveys shall comply with NACE MR0103 /ISO 17945 section13.8.2, using Vickers method with a maximum hardness of 310HV (average), 320HV (single value). 						
	 Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two fittings per lot. When only one fitting is produced, it shall be hardness tested as required. The maximum hardness of the base material, HAZ and weld metal shall be 32HRC from three readings taken in close proximity at each location. 						
	The material shall be tra MDS.	aceable in accordance with IS	O 15156-3 /NACE MR0175	-3 section 7.2 and this			
Surface Treatment and Finish	Finished fittings shall be	pickled. Machined surfaces of	do not require pickling.				
Marking	The fittings shall be mar	ked to ensure full traceability	to heat and heat treatment	lot.			



Material Data Sheet		MDS No. ID2	MDS No. ID253 / ID253S ^a				
TYPE OF MATERIAL: Ferritic-Austenitic stainless steel type 25Cr duplex							
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Wrought fittings	ASTM A815	UNS S32550	WP-W, WP-S or WP- WX	ASTM A815 S2, S7			
	ASTM A815	UNS S32750	WP-W, WP-S or WP- WX	ASTM A815 S2, S7			
	ASTM A815	UNS S32760	WP-W, WP-S or WP- WX	ASTM A815 S2, S7			
	L	Page 3 of 3					
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 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 MCPR/QTR number used; 						
	 Steel manufacturer of the starting material for the finished product; 						
	- Solution annealin	g temperature, holding time	and quench medium shall be sta	ted.			



Material Data S	Sheet	MDS No. ID254 /	ID254S ^a	Rev. 01		
TYPE OF MATERIAL:	Ferritic -Austenitic Stainle	ess Steel, Type 25Cr duplex				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A182	F53 (UNS S32750)		ASTM A961 S56		
	ASTM A182	F55 (UNS S32760)		ASTM A961 S56		
	ASTM A182	F61 (UNS S32550)		ASTM A961 S56		
		Page 1 of 2				
Scope	standard specification.	ble options and/or requireme				
		IDS is limited to a maximum to a maximum to and specification requirement				
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.					
Chemical Composition	PREN ≥ 40.0					
Heat Treatment	The forgings shall be solu	tion annealed followed by wa	ter/liquid quenching.			
		n such a way as to ensure fre atment process including que		cooling media around each		
Impact Testing/ Toughness testing	The sampling of test spec ISO 17781 QLII.	The sampling of test specimens, testing methodology and acceptance criteria shall comply with ISO 17781 QLII.				
Corrosion testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781 for forging with weld ends. Test specimens shall be taken from the surface and the centre of the forging with no weld ends.					
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 for forging with weld ends. Test specimens shall be taken from the surface and the centre of the forging with no weld ends and shall sample a area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.					
Extent of Testing	shall be carried out for ea	and corrosion test, and one n ch heat and heat treatment lo	bad.	C C		
	A test lot shall not exceed	ed out on the forging with hea 2 000 kg (4 400 lb) for forgir orgings with as forged weight	igs with as forged weight up			



	Ferritic -Austenitic Stain	less Steel, Type 25Cr dup	lex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A182	F53 (UNS S32750)		ASTM A961 S56		
	ASTM A182	F55 (UNS S32760)		ASTM A961 S56		
	ASTM A182	F61 (UNS S32550)		ASTM A961 S56		
		Page 2 of 2				
Non-Destructive Testing	performed after machinir Liquid penetrant testing	ng, if applicable, and non-m	cordance with the product stand achined surfaces shall be pickle apply as amended by this MDS	ed prior to the testing.		
	NDE Requirement		Forgings ^a			
	Frequency ^b		10 %			
	Method		ASME BPVC Sec. V, Article 6			
	Extent ^c		100 %			
	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8					
	All accessible internal and external surfaces shall be examined. <u>Valve forgings NDT</u> Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.					
Repair of Defects	-					
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	Weld repair is not permitted. When compliance with sour service requirements is specified by the purchaser, the material shall conform to ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS: Hardness testing Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 or two forgings per lot. When only one part is produced, it shall be hardness tested as required. 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.					
Marking	The forgings shall be ma	rked to ensure full traceabil	lity to heat and heat treatment le	ot.		
Certification	requirements standard a The inspection documen confirm compliance with	ccepted by the purchaser. ts shall be issued in accord	em certified in accordance with lance with ISO 10474 /EN 1020			



Material Data S	sheet	MDS No. ID255 /	ID255S ^a	Rev. 01		
TYPE OF MATERIAL:	Ferritic-Austenitic stainles	s steel type 25Cr duplex				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates, sheets, strips	ASTM A240	UNS S32550		ASTM A240 S1		
	ASTM A240	UNS S32750		ASTM A240 S1		
	ASTM A240	UNS S32760		ASTM A240 S1		
		Page 1 of 2				
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard		
Qualification		nufacturing process shall be esting shall meet the requiren	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined b	by AOD or equivalent method	I.			
Chemical Composition	PREN ≥ 40.0					
Heat Treatment	Plates shall be placed in s	n annealed followed by wate uch a way as to ensure free ment process including quen	circulation of heating and cod	oling media around each		
Tensile Testing	Tensile test specimens sha	all be sampled in the transve	rse orientation to the directio	n of final rolling.		
Impact Testing/ Toughness testing	The sampling of test speci ISO 17781 QL II.	mens, testing methodology a	and acceptance criteria shall	comply with		
Corrosion testing	The sampling of test speci ISO 17781.	mens, testing methodology a	and acceptance criteria shall	be in accordance with		
Micrographic Examination		mens, testing methodology a nents shall be in accordance	and acceptance criteria for mi with ISO 17781.	icrostructural examination		
Extent of Testing		pact tests and corrosion test, ried out for each heat and he	and one micrographic examination to the second s	ination including ferrite		
Non-Destructive	Visual Inspection					
Testing	VT shall be carried out on after machining, if applicat	each plate in accordance wit ble, and non-machined surfa	th the product standard. The ces shall be cleaned prior to	testing shall be performed the testing.		
	Valve plate NDT					
	Inspection shall be accord the requirements in this M		pecification. If a QSL is not sp	pecified by the purchaser,		
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional metallurgical,			urchaser, the material shall c 945 /NACE MR0103, and the			
manufacturing, testing and	Hardness testing					
certification requirements) ^ª	per lot. For coil, tests shall		ith the requirements in ASTM of the coil. The maximum har cation.			
	The material shall be trace	eable in accordance with ISO	15156-3 /NACE MR0175-3	section 7.2 and this MDS.		
Surface Treatment and Finish	Finished plates, sheets an	d strips shall be pickled.				
Marking	The plates, sheets and str	ips shall be marked to ensur	e full traceability to heat and	heat treatment lot.		



Material Data Sheet		MDS No. ID25	MDS No. ID255 / ID255S ^a			
TYPE OF MATERIAL:	Ferritic-Austenitic sta	ninless steel type 25Cr dupl	ex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates, sheets, strips	ASTM A240	UNS S32550		ASTM A240 S1		
	ASTM A240	UNS S32750		ASTM A240 S1		
	ASTM A240	UNS S32760		ASTM A240 S1		
		Page 2 of 2				
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 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 MCPR/QTR number used; 					
	 Steel manufacturer of the starting material for the finished product; 					
	 Solution annealing 	temperature, holding time a	nd quench medium shall be state	d.		
	suffix "S" shall be used irements for sour servi		rered in accordance with the MDS	S plus the additional		



Material Data S	Sheet	MDS No. ID256 /	ID256S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic -Austenitic Stainle	ss Steel, Type 25Cr duplex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Castings	ASTM A995	5A (UNS J93404)		ASTM A995 S5, S6, S11 ASTM A703 S20	
	ASTM A995	6A (UNS J93380)		ASTM A995 S5, S6, S11 ASTM A703 S20	
		Page 1 of 3			
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard	
Qualification		anufacturing process shall be esting shall meet the requiren		ISO 17782 or NORSOK	
Metal Making		by AOD or equivalent method I by ISO 17782 is regarded to			
Chemical Composition	PREN ≥ 40.0				
Heat Treatment	The castings shall be solu	tion annealed followed by wa	ter/liquid quenching.		
		n such a way as to ensure fre atment process including que		cooling media around each	
Impact Testing/ Toughness testing	The sampling of test spec ISO 17781 QL II.	imens, testing methodology a	and acceptance criteria shall	comply with	
Corrosion testing	The sampling of test spec ISO 17781.	imens, testing methodology a	and acceptance criteria shall	be in accordance with	
Micrographic Examination		imens, testing methodology a nents shall be in accordance		icrostructural examination	
Extent of Testing	One tensile, one set of impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each heat of steel and heat treatment load (including any PWHT). A test lot shall not exceed 5 000 kg (11 000 lb) in weight.				
Test Sampling		compliance with ISO 17781.			
Non-Destructive Testing	Visual inspection				
resung	NDE requirement	Pilot casting (section	4.8) Prod	uction casting	
	Frequency	Each pilot casting	Each p	roduction casting	
	Method		ANSI/MSS SP-55		
	Extent	100 % of all ac	cessible surfaces including w	velding ends	
	Acceptance criteria		MSS SP-55		
	NOTE The testing shall cleaned prior to	be carried out after machinir the testing.	ng, if applicable. Non-machin	ed surfaces shall be	



Material Data		MDS I							Rev. (
TYPE OF MATERIAL	: Ferritic -Austenitic Stat	inless Steel, T	ype 25Cr a	luplex				T		
PRODUCT FORM	STANDARD	GRADE		4	ACCEP	TANCE	CLASS		UPPLEMENTARY EQUIREMENT	
Castings	ASTM A995	5A (UNS	J93404)						A995 S5, S6, S′	
									A703 S20	
	ASTM A995	6A (UNS	J93380)						A995 S5, S6, S A703 S20	
	1	F	Page 2 of 3							
on-Destructive	Liquid penetrant testing									
esting	ASTM A995 Suppleme	· · ·				ded by th				
	NDE Requirement	Pilot ca	sting (sec	tion 4.8)			Produ	ction cas	sting ^a	
	Frequency ^b		100 %					100 %		
	Method	ASME BF	PVC Sec. V	, Article	6	А	SME BP	VC Sec. \	/, Article 6	
	Extent °		100 %					100 %		
	Acceptance criteria		PVC Sec. V Appendix 7		,	ASME	BPVC Se	ec. VIII, Di	v. 1, Appendix	
	pickled prior ^a Production valve specified by the	 OTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. Production valve castings, PT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. 								
	 Frequency of inspection 100 % means that each item shall be examined. All accessible internal and external surfaces shall be examined. 									
	Radiographic testing	atom requirem	ant CE abal	l onnh i o		had by th				
	NDE requirement	Pilot Production casting					a			
		casting (section 4.8)	asting Valve casti			contai		Other pressu containing castings		
	Frequency ^c	100 %	NPS	DN		Pressure class			100 %	
					≤ 300	600	900	≥ 1500		
			< 2	< 50	N/R	N/R	N/R	N/R		
			≥ 2	≥ 50	N/R	5 %	5 %	5 %		
			≥ 6	≥ 150	N/R	5 %	5 %	100 %		
			≥ 10	≥ 250	5 %	5 %	5 %	100 %		
			≥ 16	≥ 400	5 %	5 %	100 %	100 %		
			≥ 20	≥ 500	5 %	100 %	100 %	100 %		
	Method			ASM	BPVC	Sec. V, J	Article 2		1	
	Extent	Areas defined changes in se		B16.34 at the ju	for spec nctions	ial class	valves, a		100 % ^d	
	Acceptance criteria		۵۵		casting C Sec. 1	VIII, Div.	1. Anner	idix 7		
	^a Production valve specified by the p	urchaser, the re	all be accor equirement	ding to th s in this t	ne applio	able valv	ve specif	cation. If	a QSL is not	
	 specified by the purchaser, the requirements in this table shall apply. Production casting other than valve casting. Frequency of inspection 100 % means that each item shall be examined. When random examination (5 %) is specified, a minimum of one item per lot of each pattern in any purchase order shall be examined. Production casting other than valve casting, inspection shall include other critical areas as defined in the purchase order and/or applicable product specification or standard. Sketches of the areas to be tested shall be established and agreed with the purchaser. 									



TYPE OF MATERIAL: Ferritic -Austenitic Stainless Steel, Type 25Cr duplex								
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Castings	ASTM A995	5A (UNS J93404)		ASTM A995 S5, S6, S1 ASTM A703 S20				
	ASTM A995	6A (UNS J93380)		ASTM A995 S5, S6, S1 ASTM A703 S20				
		Page 3 of 3		A31101 A703 320				
Repair of Defects	All major repairs as d requirement S20.2.		mented in accordance with A703	supplementary				
		ocedure shall be qualified in a	accordance with ASTM A488 or I	SO 11970 and this data				
	- welding procedure	shall be qualified on the same	e cast material grade (UNS num	ber) as used in production				
	 change of specific processes; 	make of filler metal (brand na	mes) requires requalification for	SMAW and FCAW				
	 microstructure exa accordance with IS 		t, Charpy V-notch and corrosion	tests shall be carried out				
	Examination of major repair welds on pressure containing parts shall also include RT.							
	Weld repairs are not acceptable for castings that leak during pressure testing.							
	Post weld heat treatment is required after all weld repairs.							
	If a minor cosmetic repair is required, heat treatment may be excluded providing the welding procedure meets all the specified microstructural, mechanical and corrosion material requirements of this data sheet in the as- welded condition.							
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirement of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:							
manufacturing, testing and	Hardness testing							
certification requirements) ^a	 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 32 HRC from three readings taken in close proximity at each location. 							
	 Welding procedure qualification testing for all repair welding shall require hardness testing. Hardness surveys shall comply with NACE MR0103 /ISO 17945 section 13.8.2, using Vickers method with a maximum hardness of 310HV (average), 320HV (single value). 							
	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 castings sha	all be pickled. Machined surface	ces do not require pickling.					
Marking	The castings shall be	marked to ensure full traceab	pility to heat and heat treatment l	ot.				
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another qualit 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 docun	The inspection documents shall include the following information:						
	- The MPS identification	tion or the MCPR/QTR numb	er used;					
	- Steel melting and r	efining practice;						
	 Steel melting and refining practice; Solution annealing temperature, holding time and quenching medium shall be stated. 							



Material Data S	Sheet	MDS No. ID257 /	ID257S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic -Austenitic Stainles	ss Steel, Type 25Cr duplex	7		
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bars	ASTM A276	UNS S32550			
	ASTM A276	UNS S32750			
	ASTM A276	UNS S32760			
	ASTM A479	UNS S32550			
	ASTM A479	UNS S32750			
	ASTM A479	UNS S32760			
	ASTM A182	F53 (UNS S32750)			
	ASTM A182	F55 (UNS S32760)			
	ASTM A182	F61 (UNS S32550)			
		Page 1 of 3			
Scope	This MDS defines applicate standard specification.	ble options and/or requireme	nts that supplement or amen	d the referenced ASTM	
	This MDS includes addition bars, when permitted by the		arts DN 100 (NPS 4) and unc	ler manufactured from	
		Product covered by this MDS is limited to a maximum thickness of 200 mm (8 in). For thickness exceeding 200 mm (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	Bars shall be manufacture	d to the following requirement	nts:		
	00	in ASTM A788 and certified			
	 hot or cold finished cylir 200 mm (8 in). 	ndrical shaped bar manufact	ured to ASTM A276 or A479	with maximum diameter of	
	NOTE Cold finishing sha	Il be restricted to turning, gri rming is not permitted.	nding or polishing (singly or i	n combination); cold	
Chemical Composition	PREN ≥ 40.0				
Heat Treatment	The bars shall be solution	annealed followed by water/	liquid quenching		
	Bars shall be placed in suc	•	irculation of heating and cooli	ing media around each bar	
Tensile Testing	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 A.				
Impact Testing/ Toughness testing	Except as modified in the test 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	including ferrite measurem	ents shall be in accordance	and acceptance criteria for m with ISO 17781. Test specim rea of 10 mm (0.4 in) by 10 m	nens shall be taken from	
Extent of Testing		corrosion tests, and one mici th lot as defined in ASTM A4	rographic examination includi	ng ferrite measurements	



Material Data	Sheet	MDS No. ID257	/ ID257S ^a	Rev. 01
TYPE OF MATERIAL	: Ferritic -Austenitic Stainl	ess Steel, Type 25Cr duple	x	
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bars	ASTM A276	UNS S32550		
	ASTM A276	UNS S32750		
	ASTM A276	UNS S32760		
	ASTM A479	UNS S32550		
	ASTM A479	UNS S32750		
	ASTM A479	UNS S32760		
	ASTM A182	F53 (UNS S32750)		
	ASTM A182	F55 (UNS S32760)		
	ASTM A182	F61 (UNS S32550)		
		Page 2 of 3		
Test Sampling	The mid-length of axial (longitudinal) and tangential (transverse) specimens shall be located at a distance equal to the bar outside diameter or minimum of 100 mm (4 in), whichever is the greater, from the end of bar.			
	Valve parts manufactured from bar For bars with outside diameter ≥ 100 mm (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			h the product standard. The te aces shall be cleaned prior to	
		manufactured from bar shall	be according to the applicable ts in this MDS shall apply inc	
	NDE Requirement	Part manufactured from bar ^a		
	Frequency ^b		10 %	
	Method	A	SME BPVC Sec. V, Article 6	
	Extent ^c		100 %	
	Acceptance criteria	ASME	BPVC Sec. VIII, Div. 1, Apper	ndix 8
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. ^a Part of size DN > 50 (NPS > 2). ^b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. ^c All accessible internal and external surfaces shall be examined. 			
Repair of Defects	Weld repair is not permit	ted.		
Sour Service (additional metallurgical, manufacturing,		56 /NACE MR0175 or ISO 1	purchaser, the material shall of 7945 /NACE MR0103, and the	
testing and certification requirements) ^a			cordance with the requirement dness shall be 32HRC from th	



Material Data	Sheet	MDS No. ID257	/ ID257S ^a	Rev. 01
TYPE OF MATERIAL	: Ferritic -Austenitic Stain	less Steel, Type 25Cr duple	x	
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bars	ASTM A276	UNS S32550		
	ASTM A276	UNS S32750		
	ASTM A276	UNS S32760	***	
	ASTM A479	UNS S32550		
	ASTM A479	UNS S32750		
	ASTM A479	UNS S32760		
	ASTM A182	F53 (UNS S32750)		
	ASTM A182	F55 (UNS S32760)		
	ASTM A182	F61 (UNS S32550)		
		Page 3 of 3		
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	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	e white pickled.		
Marking	The bars shall be marke	d to ensure full traceability to	heat and heat treatment lot.	
Certification		er shall have a quality system	certified in accordance with	ISO 9001 or another quality
	The inspection documer confirm compliance with	ts shall be issued in accordar this specification.	nce with ISO 10474 /EN 1020	4 Type 3.1 and shall
	The inspection documer	ts shall include the following i	information:	
	- The MPS identificatio	n or the MCPR/QTR number	used;	
	- Steel melting and refi			
	 Solution annealing ter 	nperature, holding time and q	uenching medium shall be sta	ated.
	y suffix "S" shall be used to uirements for sour service.	designate a material delivere	d in accordance with the MDS	plus the additional



Material Data S		MDS No. ID258 /		Rev. 0′	
TYPE OF MATERIAL:	Ferritic-Austenitic stainles	s steel type 25Cr duplex			
Product Form	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Tubes	ASTM A789	UNS S32550			
	ASTM A789	UNS S32750			
	ASTM A789	UNS S32760			
		Page 1 of 1		•	
Scope	This MDS defines applicab standard specification.	ble options and/or requireme	nts that supplement or amen	d the referenced ASTM	
Qualification		nufacturing process shall be sting shall meet the requirer	e qualified in accordance with ments of this MDS.	ISO 17782 or NORSOK	
Metal Making	The melt shall be refined b	y AOD or equivalent method	d.		
Chemical Composition	PREN ≥ 40.0				
Heat Treatment	The tubes shall be solution	n annealed followed by rapid	cooling.		
	Tubes shall be placed in su	Tubes shall be placed in such a way as to ensure free circulation of heating and cooling media around each tube during the heat treatment process including rapid cooling.			
Impact Testing/ Toughness testing	The sampling of test specient ISO 17781 QL II.	The sampling of test specimens, testing methodology and the acceptance criteria shall comply with ISO 17781 QL II.			
Corrosion testing	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781.				
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.				
Extent of Testing			est, and one micrographic ex ed in the standard for mechar		
Repair of Defects	Weld repair is not permitte	d.			
Sour Service (additional metallurgical,			purchaser, the material shall o 945 /NACE MR0103, and the		
manufacturing, testing and	Hardness testing				
certification requirements) ^a			ordance with the requirement RC from three readings take		
	The material shall be trace	able in accordance with ISC) 15156-3 /NACE MR0175-3	section 7.2 and this MDS.	
Surface Treatment and Finish	Finished tubes shall be pic	kled or bright annealed.			
Marking	The tubes shall be marked	I to ensure full traceability to	heat and heat treatment lot.		
Certification	The material manufacturer requirements standard acc		certified in accordance with I	SO 9001 or another quali	
	The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.				
	The inspection documents	shall include the following in	nformation:		
	- MPS identification or MC				
	- Steel heat and refining p				
	 I – Solution annealing temp 	perature, holding time and qu	iench medium shall be stated	ł	



Material Data S	Sheet	MDS No. ID259 /	ID259S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic -Austenitic Stainle	ss Steel, Type 25Cr duplex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bolting (strain hardened)	ASTM A1082 (modified)	UNS S32550	-	ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
	ASTM A1082 (modified)	UNS S32760	-	ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
		Page 1 of 2			
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard	
Qualification	in accordance with ISO 17 MDS. Manufacturers and the ma working (except for cold ro	Manufacturers and the manufacturing process for bars as pre-material for bolting to this MDS shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS. Manufacturers and the manufacturing process for production of bolting that involves any further hot/cold working (except for cold rolling of threads) and/or heat treatment of bar pre-material shall be separately qualified in accordance with ISO 17782 or NORSOK M-650 and this MDS.			
Metal Making	The melt shall be refined by AOD or equivalent method.				
Manufacturing	Headed bolts shall be manufactured by machining from A276 Condition S strain hardened bar. No further working of the strain hardened bar is permitted. Nuts shall be machined from solution annealed and water quenched bar or forgings. Threads on studs and bolts may be made by cold rolling or machining. Threads in nuts shall be machined.				
Chemical Composition	PREN ≥ 40.0				
Heat Treatment	No heat treatment of the s	train hardened bar and boltir	ng shall be permitted.		
Tensile Testing	accordance with ASTM F6	Tensile testing of studs and headed bolt shall be carried out on a sample representing the finished bolting in accordance with ASTM F606 Method 2 or 2A. All tensile tests shall meet the specified properties of ASTM A276 Condition S.			
Impact Testing/ Toughness testing	representing the finished b	oolting. Charpy V-notch tests	nce with the requirements in shall be carried out at -46 °C hree specimens, 35 J (26 ft ll	C (-50 °F) and the	
Hardness testing		on S. Hardness may be mea	t exceed the values in ASTM sured at bar outer surface be		
Proof Load Testing	A1082 S5 shall apply to at	least one nut per test lot - th	ne load shall comply with A19	94 Grade 7.	
			o proof load testing for nuts w fied in ASTM A276 Condition		
Corrosion testing			he finished bolting. The sample accordance with the princip		
Micrographic Examination	testing methodology and a		he finished bolting. The samp tructural examination includir		
Extent of Testing	measurement shall be car		and one micrographic exami re a test lot is as-defined in A for the bar material.		



Material Data	Sheet	MDS No. ID259 /	ID259S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic -Austenitic Stainle	ss Steel, Type 25Cr duplex	(
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bolting (strain hardened)	ASTM A1082 (modified)	UNS S32550	-	ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
	ASTM A1082 (modified)	UNS S32760	-	ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
Page 2 of 2					
Non-Destructive Testing	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.				
Repair of Defects	Weld repair is not permitte	Weld repair is not permitted.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	Material covered by this MDS is not referenced in ISO 15156 /NACE MR0175 nor ISO 17945 /NACE MR0103. NOTE Use of this material in sour service shall require separate qualification according to ISO 15156-3 /NACE MR0175-3 or ISO 17945/ NACE MR0103, as applicable. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. The inspection documents required in this MDS shall also include the qualification test reports.				
Dimensional Tolerances	The maximum size of stud	ds/bolts shall be M50 (2 in).			
Marking	ASTM A962 S66 shall app	bly.			
Certification	The material manufacture requirements standard ac		certified in accordance with I	SO 9001 or another quality	
	The inspection documents confirm compliance with the		ce with ISO 10474 /EN 1020	4 Type 3.1 and shall	
	The inspection documents	s shall include the following in	nformation:		
		or the MCPR/QTR number u	used (for bar and/or bolting as	appropriate);	
	- Bar manufacturer;				
	 Heat treatment condition pre-material shall be stated 		ng temperature, holding time a	and quenching medium for	
	y suffix "S" shall be used to d uirements for sour service.	esignate a material delivered	d in accordance with the MDS	plus the additional	



Material Data S	Sheet	MDS No. ID260	/ ID260S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic-Austenitic Stainle	ss Steel, Type 25Cr duple	(
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bolting (solution annealed)	ASTM A1082	UNS S32550		ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
	ASTM A1082	UNS S32750		ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
	ASTM A1082	UNS S32760		ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66	
		Page 1 of 2			
Scope	This MDS defines applica standard specification.	ble options and/or requirem	ents that supplement or amen	d the referenced ASTM	
Qualification	Manufacturers and the manufacturing process for bars as pre-material for bolting to this MDS shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS. Manufacturers and the manufacturing process for production of bolting that involves any further hot/cold working (except for cold rolling of threads) and/or heat treatment of bar pre-material shall be separately qualified in accordance with ISO 17782 or NORSOK M-650 and this MDS.				
Metal Making	The melt shall be refined	The melt shall be refined by AOD or equivalent method.			
Manufacturing	Threads on studs and bo	Threads on studs and bolts may be made by cold rolling or machining. Threads in nuts shall be machined.			
Chemical Composition	PREN ≥ 40.0				
Impact Testing/ Toughness testing	representing the finished	bolting. Charpy V-notch test	ance with the requirements in s shall be carried out at -46 °C three specimens, 35 J (26 ft I	C (-50 °F) and the	
Proof Load Testing	A1082 S5 shall apply to a	at least one nut per test lot - t	the load shall comply with A19	94 Grade 7M.	
			to proof load testing for nuts ified in ASTM A1082 for the s		
Corrosion testing			the finished bolting. The sam in accordance with the princip		
Micrographic Examination	Testing shall be carried out on a sample representing the finished bolting. The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with the principles in ISO 17781.				
Extent of Testing	One tensile, one set of impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each test lot where a test lot is as-defined in ASTM A962 for non-heat treated, strain hardened bolting including the same lot for the bar material.				
Non-Destructive Testing			reas of threads, shanks, and h bolts/studs and ASTM F812 f		
Repair of Defects	Weld repair is not permitt	ed.			



Material Data	Sheet	MDS No. ID26	60 / ID260S ^a	Rev. 01		
TYPE OF MATERIAL	TYPE OF MATERIAL: Ferritic-Austenitic Stainless Steel, Type 25Cr duplex					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bolting (solution annealed)	ASTM A1082	UNS S32550		ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66		
	ASTM A1082	UNS S32750		ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66		
	ASTM A1082	UNS S32760		ASTM A1082 S5 or S6 (nuts only), ASTM A962 S66		
		Page 2 of 2				
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:					
manufacturing, testing and	Hardness testing					
certification requirements) ^ª	Production hardness	testing shall be performed in	accordance with the requiremen	ts in ASTM A1082.		
requirements	Hardness may be measured at bar outer surface before threading or in area not affected by the thread rolling operation. The maximum hardness for UNS S32750 and UNS S32760 shall be 32HRC from three readings taken in close proximity. The maximum hardness for grade UNS S32550 shall not exceed 31HRC.					
	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.					
Marking	ASTM A962 S66 shal	l apply.				
Certification		turer shall have a quality system d accepted by the purchase	stem certified in accordance with	ISO 9001 or another quality		
	The inspection docum confirm compliance w		rdance with ISO 10474 /EN 1020	4 Type 3.1 and shall		
	The inspection docum	ents shall include the follow	ing information:			
		tion or the MCPR/QTR num	ber used (for bar and/or bolting as	s appropriate);		
	- Bar manufacturer;					
	 Solution annealing 	temperature, holding time a	nd quenching medium shall be st	ated.		
	y suffix "S" shall be used uirements for sour servic		vered in accordance with the MDS	S plus the additional		



Material Data S	Sheet	MDS No. ID269 /	ID269S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic-Austenitic stainle	ess steel type 25Cr duplex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
HIP products	ASTM A988	UNS S32750		ASTM A988 S5	
	ASTM A988	UNS S32760		ASTM A988 S5	
	ASTM A988	UNS S32505		ASTM A988 S5	
		Page 1 of 2			
Scope	specification. Product covered by this I	able options and/or requireme MDS is limited to a maximum to on and specification requireme	hickness of 200 mm (8 in). F	or thickness exceeding	
Qualification		nanufacturing process shall be testing shall meet the requirer		ISO 17782 or NORSOK	
Metal Making		ade from AOD-refined metal. I composition, particle size and		nogenous mixture of	
Chemical Composition	PREN ≥ 40.0				
Heat Treatment	The HIP product shall be	solution annealed followed by	v water/liquid quenching.		
	Products shall be placed in such a way as to ensure free circulation of heating and cooling media around each fitting during the heat treatment process including quenching.				
Impact Testing/ Toughness testing	The sampling of test species ISO 17781 QL II.	The sampling of test specimens, testing methodology and the 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 for HIP product with weld ends. Test specimens shall be taken from the surface and the centre of the product with no weld ends.				
Micrographic Examination	including ferrite measure specimens shall be taken	cimens, testing methodology a ments shall be in accordance n from the surface and the cen) by 10 mm (0.4 in) minimum.	with ISO 17781 for HIP prod	uct with weld ends. Test	
Extent of Testing	One tensile, one set of impact tests and corrosion test, and one microstructure examination including ferrite measurement shall be carried out for each lot. A lot shall include all products from a single powder blend, same manufacturing procedure and same heat treatment load.				
Non-Destructive Testing	<u>Visual inspection</u> VT shall be carried out on each item in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. <u>Liquid penetrant testing</u> ASTM A988 supplementary requirement S5 shall apply as amended by this MDS:				
	NDE Requirement		HIP product ^a		
	Frequency ^b		10 %		
	Method	AS	SME BPVC Sec. V, Article 6		
	Extent ^c		100 %		
	Acceptance criteria	ASME B	PVC Sec. VIII, Div. 1, Appen	idix 8	
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. ^a Parts of size DN > 50 (NPS > 2). ^b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined The test lot shall be as defined for mechanical testing. 				
		al and external surfaces shall	•		



Material Data S	Sheet	MDS No. ID269 /	ID269S ^a	Rev. 01	
TYPE OF MATERIAL:	Ferritic-Austenitic stainles	s steel type 25Cr duplex			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
HIP products	ASTM A988	UNS S32750		ASTM A988 S5	
	ASTM A988	UNS S32760		ASTM A988 S5	
	ASTM A988	UNS S32505		ASTM A988 S5	
Page 2 of 2					
Repair of Defects	Weld repair is not permitte	ed.			
Sour Service (additional		ments are specified by the p 6 /NACE MR0175 or ISO 179			
metallurgical, manufacturing,	Hardness testing				
testing and certification requirements) ^ª	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two parts per lot. When only one part is produced, it shall be hardness tested as required. The maximum hardness shall be 32HRC from three readings taken in close proximity.				
	The material shall be trace	eable in accordance with ISO	15156-3 /NACE MR0175-3	section 7.2 and this MDS.	
Surface Treatment and Finish	Finished components shal	Finished components shall be pickled. Machined surfaces do not require pickling.			
Marking	The powder blend shall have a unique identity marked on the powder container and this identity shall be recorded and maintained throughout production of the product. The components shall be marked to ensure full traceability to lot as defined in this MDS.				
Certification	The material manufactures requirements standard acc	r shall have a quality system cepted by the purchaser.	certified in accordance with	SO 9001 or another quality	
	The inspection documents compliance with this speci	shall be in accordance with fication.	ISO 10474 /EN 10204 Type	3.1 and shall confirm	
	The inspection documents	shall include the following in	formation:		
	- MPS identification or M	CPR/QTR number used;			
		ne starting material (powder)			
	 Solution annealing temp 	perature, holding time and qu	ench medium shall be stated	d.	
	suffix "S" shall be used to de uirements for sour service.	esignate a material delivered	in accordance with the MDS	plus the additional	



MDS No. IK101

Rev. 01

TYPE OF MATERIAL: Copper-Nickel 90-10						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Seamless pipes and tubes	ASTM B466	UNS C70600	-	-		
		Page 1 of 1				
Scope	This MDS defines ap specification.	olicable options and/or requ	irements that supplement or amer	nd the referenced standard		
Design and Dimensional Standards	The EEMUA standard	d No. 234: "Copper Nickel a	lloy piping for offshore application	s specification" shall apply.		
Manufacturing	Cold forming or hot for material manufacture		ing to written procedures establish	ed in cooperation with the		
Chemical Composition	Zn ≤ 0.50 %, Pb ≤ 0.0	Zn ≤ 0.50 %, Pb ≤ 0.02 %, C ≤ 0.05 %				
Heat Treatment	Hot formed pipe and tube: products hot formed in the temperature range of 760 °C (1 400 °F) to 800 °C (1 472 °F) do not need annealing after forming. Cold formed pipe and tube: annealed.					
Tensile Testing		Tensile test specimens shall be taken from each lot where a lot is defined as all products of the same type and nominal size, which are produced from the same heat of material and subject to the same finishing operation.				
Extent of Testing	Each length of finishe	d pipe shall be subjected to	o a hydrostatic test.			
Test Sampling	Test samples may be	Test samples may be cut from the products themselves, from prolongations or from sacrificial pipe and tube.				
Repair of Defects	Weld repair is not per	Weld repair is not permitted.				
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	There are no additional requirements to the MDS when sour service is specified by the purchaser.					
Hydrostatic Tests	Each length of finishe	d pipe shall be subjected to	a hydrostatic test.			
Certification	requirements standar	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.				
	Compliance with this		e with ISO 10474 /EN 10204 Type	3.1 and shall confirm		



Material Data Sheet MDS No. IK102 Rev. 01 TYPE OF MATERIAL: Copper-Nickel 90-10 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Welded pipes UNS C70600 ASTM B467 Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. Design and The EEMUA standard No. 234: "Copper Nickel alloy piping for offshore applications specification" shall apply. Dimensional Standards Chemical Zn ≤ 0.50 %, Pb ≤ 0.02 %; C ≤ 0.05 % Composition Forming Cold forming or hot forming may be used according to written procedures established in cooperation with the material manufacturers. Welding An electric fusion welding process shall be used. Welding procedures shall be established and qualified in accordance with ASME BPVC Sec. IX. Hot formed pipes: pipes hot formed in the temperature range of 760 °C (1 400 °F) to 800 °C (1 472 °F) do not Heat Treatment need annealing after forming. Cold formed pipes: annealed. Welded pipes: annealed or as-welded from annealed materials. Tensile test specimens shall be taken from each lot where a lot is defined as all products of the same type and **Tensile Testing** nominal size, which are produced from the same heat of material and subject to the same finishing operation. Test Sampling Test samples may be cut from the products themselves, from prolongations or from sacrificial pipes. Non-Destructive Radiographic testing Testing - SCH 10S: Welded pipes shall be spot radiographed to the extent of not less than 300 mm (12 in) per 15 m (49 ft) of weld; Other schedules: All welds shall be 100 % radiographed. The radiographic testing shall be in accordance with the requirements of the ASME BPVC Sec. VIII, Div. 1, Paragraph UW-51 and UW-52 for 100 % and spot radiography, respectively. **Repair of Defects** Weld repair of base material is not permitted. For repair of welds, the requirements for production welding shall apply to the repair WPS. Sour Service There are no additional requirements to the MDS when sour service is specified by the purchaser. (additional metallurgical, manufacturing. testing and certification requirements) Hydrostatic Tests Each length of finished pipe shall be subjected to a hydrostatic test 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 in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.



MDS No. IK103

Rev. 01

TYPE OF MATERIAL: Copper-Nickel 90-10

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Fittings	EEMUA 234	UNS C76000	-	-			
		Page 1 of 1					
Scope	This MDS defines app specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Design and Dimensional Standards	The EEMUA standard	l No. 234: "Copper Nickel a	loy piping for offshore applications	s specification" shall apply.			
Manufacturing	Cold forming or hot fo material manufacture		ng to written procedures establish	ed in cooperation with the			
Chemical Composition	For fittings subject to $Zn \le 0.50$ %, Pb ≤ 0.0	0. 1	position shall be modified as follow	S:			
Welding		An electric fusion welding process shall be used. Welding procedures shall be established and qualified in accordance with ASME BPVC Sec. IX.					
Heat Treatment	not need annealing af Cold formed fittings: a	Hot formed fittings: fittings hot formed in the temperature range of 760 °C (1 400 °F) to 800 °C (1 472 °F) do not need annealing after forming. Cold formed fittings: annealed. Welded fittings: annealed or as-welded from annealed materials.					
Tensile Testing			lot where a lot is defined as all pro heat of material and subject to the				
Test Sampling	Test samples may be	cut from the products them	selves, from prolongations or from	n sacrificial fittings.			
Repair of Defects		aterial is not permitted.					
	For repair of welds, th	e requirements for producti	on welding shall apply to the repa	ir WPS.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	There are no additional requirements to the MDS when sour service is specified by the purchaser.						
Certification		turer shall have a quality sy d accepted by the purchase	rstem certified in accordance with	ISO 9001 or another quality			
	The inspection docum compliance with this s		e with ISO 10474 /EN 10204 Type	3.1 and shall confirm			



MDS No. IK104

Rev. 01

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Flanges	EEMUA 234	UNS C76000					
		Page 1 of 1					
Scope	This MDS defines ap specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.					
Design and Dimensional Standards	The EEMUA standar	d No. 234: "Copper Nickel a	Iloy piping for offshore applications	s specification" shall apply.			
Manufacturing	Cold forming or hot for material manufacture		ing to written procedures establish	ed in cooperation with the			
Chemical Composition	For flanges subject to Zn \leq 0.50 %, Pb \leq 0.1	0	position shall be modified as follow	VS:			
Heat Treatment	not need annealing a	Hot formed flanges: flanges hot formed in the temperature range of 760 °C (1 400 °F) to 800 °C (1 472 °F) do not need annealing after forming. Cold formed flanges: annealed.					
Tensile Testing	Tensile test specime nominal size, which a	Tensile test specimens shall be taken from each lot where a lot is defined as all products of the same type and nominal size, which are produced from the same heat of material and subject to the same finishing operation.					
Test Sampling	Test samples may be cut from the products themselves, from prolongations or from sacrificial flanges.						
Repair of Defects	Weld repair is not pe	Weld repair is not permitted.					
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	There are no additional requirements to the MDS when sour service is specified by the purchaser.						
Certification		cturer shall have a quality s rd accepted by the purchas	ystem certified in accordance with er.	ISO 9001 or another quality			
		The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.					



MDS No. IK105

Rev. 01

TYPE OF MATERIAL: Copper-Nickel 90-10

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates	ASTM B171	UNS C70600				
		Page 1 of 1				
Scope	This MDS defines app specification.	licable options and/or requ	rements that supplement or amer	nd the referenced standard		
Design and Dimensional Standards	The EEMUA standard	No. 234: "Copper Nickel a	loy piping for offshore applications	s specification" shall apply.		
Manufacturing	Cold forming or hot fo material manufacture		ng to written procedures establish	ed in cooperation with the		
Chemical Composition		For plates subject to welding, the chemical composition shall be modified as follows: Zn \leq 0.50 %, Pb \leq 0.02 %, C \leq 0.05 %				
Heat Treatment		Plate shall be annealed. Hot rolled/forged plate in the temperature range of 760 °C (1 400 °F) to 800 °C (1 472 °F) do not need annealing after forming.				
Tensile Testing		Tensile test specimens shall be taken from each lot where a lot is defined as all products of the same type and nominal size, which are produced from the same heat of material and subject to the same finishing operation.				
Test Sampling	Test samples may be cut from the products themselves, from prolongations or from sacrificial plates.					
Repair of Defects	Weld repair is not per	mitted.				
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	There are no additional requirements to the MDS when sour service is specified by the purchaser.					
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 docum compliance with this s		e with ISO 10474 /EN 10204 Type	3.1 and shall confirm		



Material Data Sheet MDS No. IK106 Rev. 01 TYPE OF MATERIAL: Aluminium bronze PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Castings UNS C95800 ASTM B148 Page 1 of 2 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. Heat Treatment Heat treatment may be carried out at the discretion of the manufacturer. Extent of Testing One tensile test shall be carried out for each lot as defined by the in ASTM B148. Non-Destructive Visual inspection Testina VT shall be carried out on each casting in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing Pilot casting (section 4.8) NDE Production casting ^a Requirement Frequency ^b 100 % 100 % ASME BPVC Sec. V, Article 6 ASME BPVC Sec. V, Article 6 Method Extent ⁶ 100 % 100 % ASME BPVC Sec. VIII, Div. 1, Appendix 7 ASME BPVC Sec. VIII, Div. 1, Appendix 7 Acceptance criteria NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. Production valve castings, PT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. b Frequency of inspection 100 % means that each item shall be examined. All accessible internal and external surfaces shall be examined. Radiographic testing Pilot **NDE** requirement **Production casting** casting Valve castings ⁴ Other pressure (section 4.8) containing castings Frequency ^c 100 % 100 % NPS DN Pressure class ≤ 150 300 < 250 N/R N/R < 10 ≥ 10 ≥ 250 5 % 5 % Method ASME BPVC Sec. V, Article 2 Areas defined by ASME B16.34 for special class valves, at 100 % ^d Extent abrupt changes in sections and at the junctions of risers, gates or feeders to the casting ASME BPVC Sec. VIII, Div. 1, Appendix 7 Acceptance criteria NOTE N/R means not required, unless specified otherwise by the purchaser. Production valve casting, RT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. Production casting other than valve casting. Frequency of inspection 100 % means that each item shall be examined. When random examination (5 %) is specified, a minimum of one item per lot of each pattern in any purchase order shall be examined. Production casting other than valve casting, inspection shall include other critical areas as defined in the purchase order and/or applicable product specification or standard. Sketches of the areas to be tested shall be established and agreed with the purchaser.



Material Data Sheet		MDS No. IK106	MDS No. IK106	
TYPE OF MATERIAL	: Aluminium bronze			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Castings	ASTM B148	UNS C95800		
		Page 2 of 2		
Repair of Defects	 Repairs that exceed those described in ASTM B148 section 10.1 shall be considered major repairs. All major repairs shall be documented with a sketch showing location and size of excavations. Weld repairs are not acceptable for castings that leak during the final pressure testing. Repairs by peening and impregnation are prohibited. The repair welding procedure shall be qualified in accordance with ASME BPVC Sec. IX; a change of filler metal brand names requires requalification. 			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	There are no additional requirements to the MDS when sour service is specified by the purchaser.			
Certification	requirements standa The inspection docur compliance with this The inspection docur	cturer shall have a quality system rd accepted by the purchaser. nents shall be in accordance with specification. nents shall include the following i ndition (annealing temperature).	n ISO 10474 /EN 10204 Type	



MDS No. IK107

Rev. 01

TYPE OF MATERIAL: Copper-Nickel 90-10

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Rods and bars	ASTM B151	UNS C70600				
		Page 1 of 1				
Scope	This MDS defines applical specification.	ble options and/or requireme	ents that supplement or amen	d the referenced standard		
Design and Dimensional Standards	The EEMUA standard No.	The EEMUA standard No. 234: "Copper Nickel alloy piping for offshore applications specification" shall apply.				
Manufacturing	Cold forming or hot formin material manufacturers.	Cold forming or hot forming may be used according to written procedures established in cooperation with the material manufacturers.				
Heat Treatment	Rods and bars hot formed in the temperature range of 760 °C (1 400 °F) to 800 °C (1 472 °F) do not need annealing after forming. Cold formed rods and bars: annealed.					
Tensile Testing	Tensile test specimens shall be taken from each lot where a lot is defined as all products of the same type and nominal size, which are produced from the same heat of material and subject to the same finishing operation.					
Test Sampling	Test samples may be cut from the products themselves, from prolongations or from sacrificial rods and bars.					
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional metallurgical, manufacturing, testing and certification requirements)	There are no additional requirements to the MDS when sour service is specified by the purchaser.					
Certification	The material manufacture requirements standard ac		certified in accordance with I	SO 9001 or another quality		
	The inspection documents compliance with this spec		ISO 10474 /EN 10204 Type	3.1 and shall confirm		



TYPE OF MATERIAL	: Nickel alloy type 625					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bolting	ASTM F468	UNS N06625				
	ASTM F467	UNS N06625	Grade 2			
	·	Page 1 of 1				
Scope	This MDS defines applicat specification.	ble options and/or requiren	nents that supplement or amen	d the referenced standard		
Metal Making		R) or equivalent multiple re	OD or VOD followed by electro efining methods. In alternative, n as ESR or VAR.			
Manufacturing	heat treatment.	·	y machining or rolling. Thread	rolling shall be done after		
	Threads in nuts shall be m	Threads in nuts shall be machined.				
Tensile Testing	For sizes above 37.5 mm (1½ in) in diameter the strength properties shall be agreed.					
Non-Destructive Testing	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.					
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional	The material shall conform to the requirements of ISO 15156/ NACE MR0175 or ISO 17945 /NACE MR0103 and this MDS.					
metallurgical, manufacturing, testing and certification requirements) [°]	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.					
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 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 conditions (annealing temperature and time shall be stated); 					
	 Original inspection docu 	ments of the bar material	shall be included in the docum	entation.		



MDS No. IN102S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloy type 625

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Welded pipes	ASTM B705	UNS N06625 Grade 1	Class 2			
		Page 1 of 1				
Scope	This MDS defines applicat standard specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.				
Metal Making	vacuum arc remelting (VA	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.				
Welding	Welding procedures shall same material grade (UNS	be qualified in accordance S number) as used in produ	with ASME BPVC Sec. IX or action.	ISO 15614-1 using the		
Heat Treatment		uch a way as to ensure free nent process including any	e circulation of heating and co rapid cooling/quenching	ooling media around each		
Extent of Testing		A lot shall consist of all pipes of the same type, size and wall thickness, manufactured from one heat of material, and using the same classification of welding product.				
Repair of Defects	Weld repair of base material is not permitted. For repair of welds, the requirements for production welding shall apply to the repair WPS.					
Sour Service (additional metallurgical,	The material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this MDS.					
manufacturing, testing and certification requirements) ^a	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and th MDS.					
Surface Treatment and Finish	Finished pipes shall be pic	Finished pipes shall be pickled.				
Marking	The pipe 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 conditio	n (annealing temperature s	hall be stated).			
^a The supplementary su requirements for sour		al delivered in accordance	with the MDS plus the addition	onal supplementary		



MDS No. IN103S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloy type 625

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM B366	UNS N06625 Grade 1	WP CI. S, WP CI. W, WP CI. WX	ASTM B366 S3		
		Page 1 of 1				
Scope	This MDS defines app specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.				
Metal Making	vacuum arc remelting		OD or VOD followed by electro efining methods. In alternative, a as ESR or VAR.			
Welding	material grade (UNS r	hall be qualified in accordance number) as used in production. al classification requires requal		SO 15614-1 using the same		
Heat Treatment		I in such a way as to ensure fre treatment process including an	ee circulation of heating and coo y rapid cooling/quenching.	oling media around each		
Extent of Testing		A lot shall consist of all fittings of the same type, size, and wall thickness, manufactured from one heat of material, and, if welding is performed, using the same classification of welding product.				
Non-Destructive Testing		S3 shall apply to the weld end area of 10 % of seamless fittings from each lot and 100 % of welded fittings above NPS2. For welded fittings, the testing shall cover the weld only.				
Repair of Defects	Weld repair of base m	aterial is not permitted.				
	For repair of welds, th	e requirements for production	welding shall apply to the repair	r WPS.		
Sour Service (additional	The material shall cor and this MDS.	The material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0 and this MDS.				
metallurgical, manufacturing, testing and certification requirements) ^a	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 fittings shall be pickled. Machined surfaces do not require pickling.					
Marking	The fittings shall be m	arked 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 qualit 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 docum	The inspection documents shall include the following information:				
	 Heat treatment condition (annealing temperature shall be stated). 					



MDS No. IN104S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloy type 625 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT ASTM B564 **UNS N06625** ASTM B564 S5.3 Forgings Page 1 of 2 Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by electro slag remelting (ESR) or Metal Making 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 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. Non-Destructive Visual Inspection Testing VT shall be carried out on each forging or bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing ASTM B564 Supplementary requirement S5.3 shall apply as amended by this MDS: **NDE Requirement** Forgings Frequency^t 10 % Method ASME BPVC Sec. V, Article 6 Extent ° 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. Parts of size DN > 50 (NPS > 2). For random examination (10%), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined. Valve forgings NDT Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Weld repair is not permitted. Sour Service The material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103 (additional and this MDS metallurgical, manufacturing, The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. testing and certification requirements)^a Surface Treatment Finished components shall be pickled. Machined surfaces do not require pickling. and Finish Marking The component shall be marked to ensure full traceability to heat and heat treatment lot.



Material Data	Material Data Sheet		MDS No. IN104S ^a		
TYPE OF MATERIAL	: Nickel alloy type 625				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Forgings	ASTM B564	UNS N06625		ASTM B564 S5.3	
		Page 2 of 2			
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 ISC confirm compliance with this specification.			ordance with ISO 10474 /EN 1020	4 Type 3.1 and shall	
	The inspection documents shall include the following information:				
	 Heat treatment condition (annealing temperature shall be stated). 				
^a The supplementar requirements for s	, .	naterial delivered in accord	ance with the MDS plus the additi	onal supplementary	



MDS No. IN105S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloy type 625

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates, sheets, strips	ASTM B443	UNS N06625 Grade 1				
		Page 1 of 1				
Scope	This MDS defines apprecification.	blicable options and/or requir	ements that supplement or amen	d the referenced standard		
Metal Making	VAR (vacuum arc ren	(EF) melt shall be refined by nelting) or equivalent multiple I by single refining method su	AOD or VOD followed by ESR (refining methods. In alternative, ich as ESR or VAR.	electro slag remelting) or vacuum induction melting		
Heat Treatment	-	• •	way as to ensure free circulation ent process including any rapid o	5 5		
Non-Destructive Testing	<u>Visual Inspection</u> VT shall be carried out on each plate 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.					
	Valve plate NDT					
	Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.					
Repair of Defects	Weld repair is not per	mitted.				
Sour Service (additional	The material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this MDS.					
metallurgical, manufacturing, testing and certification requirements) ^a				section 7.2 and this MDS.		
Surface Treatment and Finish	Finished components	shall be pickled.				
Marking	The plates, sheets an	d strips shall be marked to e	nsure 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 quali 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 docum	The inspection documents shall include the following information:				
	- Heat treatment condition (annealing temperature shall be stated).					


Material Data S	Sheet	MDS No. IN106S		Rev. 01		
TYPE OF MATERIAL:	Nickel alloy					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A494	Grade CW6MC (UNS N26625)		ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16		
	ASTM A494	Grade CX2MW (UNS N26022)		ASTM A494 S2, S3 ASTM A781 S16		
		Page 1 of 4		ASTM A957 S16		
Scope	specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. For castings produced by the investment casting process, the requirements of ASTM A957 and this MDS shall				
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. Induction melting of AOD refined ingot is regarded to be equivalent to AOD refined materials.					
Heat Treatment		n such a way as to ensure fre atment process including que		cooling media around each		
Corrosion testing	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The corrosion test specimen shall be at the same location as those for mechanical testing. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF. The acceptance criteria are: - No pitting at 20x magnification; - The weight loss shall be less than 4.0 g/m ² .					
Extent of Testing	Tensile test and corrosion test lot shall not exceed 5	test shall be made for each h 000 kg (11 000 lb).	neat and heat treatment load	(including any PWHT). A		
Test Sampling	operations. Thickness of the test block thickness is the ruling sect Dimensions of test blocks The test specimens shall b test block shall minimum b	and location of test specimer be taken within the cross hato	t part of the casting castings as within the test blocks are s thed area. Distance from end nto the casting. $\frac{T/4}{50 \text{ mm}} = \frac{T/4}{T/4}$; the largest flange shown in the figure below.		
	Integrated Test Block	st sampling shall be accordin operations including any pos				



Material Data Sheet		MDS No. IN106S			Rev. 01		
TYPE OF MATERIAL	: Nickel alloy						
PRODUCT FORM	STANDARD		GRADE ACCEPTANCE CLASS		SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A494		Grade CW6MC (UNS N26625)			ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16	
	ASTM A494		Grade CX2MW (UNS N26022)			ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16	
			Page 2 of 4			·	
Non-Destructive	Visual inspection						
Testing	NDE requireme	ent	Pilot casting (section	4.8)	Production casting		
	Frequency		Each pilot casting		Each p	production casting	
	Method			ANSI/	MSS SP-55		
	Extent		100 % of all ac	cessible s	urfaces including w	velding ends	
	Acceptance criter	ia		MS	S SP-55		
	pickled	prior to	Il be carried out after machini o the testing.			ed surfaces shall be	
	NDE Requirement		Pilot casting (section 4.8)	-	Production casting ^a		
	Frequency ^b		100 %		100 %		
	Method		ASME BPVC Sec. V, Article	6	ASME BP\	/C Sec. V, Article 6	
	Extent ^c		100 %			100 %	
	Acceptance criteria	ASME BPVC Sec. VIII, Div. 1, Appendix 7 ASME BPVC Sec. VIII, Div.		c. VIII, Div. 1, Appendix 7			
	cleaned	prior to	all be carried out after machin o the testing. Istings, PT shall be according				
	 specified by ^b Frequency or 	the pur f inspe	chaser, the requirements in the transference of the characteristic	nis table sl item shall	nall apply. be examined.		
		einterr	iai anu external sunaces shal	i be exam	neu.		



Material Data		MDS N	lo. IN′	106S	а				Rev. 0′
PRODUCT FORM	STANDARD	GRADE			ACCE	PTANC	E CLAS		PPLEMENTARY QUIREMENT
Castings	ASTM A494	Grade CW6MC (UNS N26625)						AST	M A494 S2, S3 M A781 S16 M A957 S16
	ASTM A494	Grade CX2MW (UNS N26022)				AST	M A494 S2, S3 M A781 S16 M A957 S16		
		P	age 3 of	4					
	Radiographic testing ASTM A494 suppleme	ntary requireme	nt S2 sha	all apply	as ame	ended by	this MD	S:	
	NDE requirement	Pilot			Production casting				
		casting (section 4.8)			Valve	castings	a		Other pressure containing castings ^b
	Frequency ^c	100 %	NPS	DN		Pressu	ire class	i	100 %
					≤ 300	600	900	≥ 1500	
			< 2	< 50	N/R	N/R	N/R	N/R	
			≥2	≥ 50	N/R	5%	5%	5%	
			≥ 6 ≥ 10	≥ 150 ≥ 250	N/R 5 %	5 % 5 %	5 % 5 %	100 % 100 %	
			≥ 10	≥ 250 ≥ 400	5%	5%	100 %	100 %	
			≥ 20	≥ 500	5%	100 %	100 %	100 %	
	Method			451		C Sec 1	√, Article	2	
	Extent	Areas defin abrupt changes	s in secti	SME B16	6.34 for at the j	special c unctions	class valv	ves, at	100 % ^d
	Acceptance criteria		A	SME BF	VC Sec	. VIII, Di	iv. 1, App	endix 7	1
	 NOTE N/R means ^a Production valve specified by the p ^b Production castin ^c Frequency of insp (5 %) is specified examined. ^d Production castin the purchase order tested shall be essented and the set of t	ourchaser, the re g other than val pection 100 % m , a minimum of o g other than val er and/or applica	Il be acco equirement ve castin heans that one item ve castin able prod	ording to nts in th g. at each i per lot o g, inspe luct spee	o the ap is table tem sha of each i ction sh cificatio	plicable shall app Il be exa pattern ir all includ	valve spe bly. Imined. V n any pur de other o	ecification. Vhen ranc chase orc critical are	lom examination ler shall be as as defined in



Material Data	Sheet	MDS No. IN106S	Rev. 01		
TYPE OF MATERIAL	: Nickel alloy				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Castings	ASTM A494	Grade CW6MC (UNS N26625)		ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16	
	ASTM A494	Grade CX2MW (UNS N26022)		ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16	
		Page 4 of 4	<u> </u>	I	
Repair of Defects	 All major repairs as defined by A494 shall be documented in accordance with A781 S16 or A957 S16, as applicable. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and as follows Welding shall be carried out with Ni-based consumable with enhanced Mo and Cr content compared to the base material; Welding procedure shall be qualified on the same cast material grade (UNS number) as used in production Change of specific make of filler metal (brand names) requires requalification for SMAW and FCAW processes; A macro and corrosion test specimen shall include the weld zone; Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material. Examination of major repair welds on pressure containing parts shall also include RT. Weld repairs are not acceptable for castings that leak during pressure testing. Post weld heat treatment is required after all major weld repairs. If a minor cosmetic repair is required, heat treatment may be excluded providing the welding procedure meets all the specified microstructural, mechanical and corrosion material requirements of this data sheet in the as-welded condition. 				
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a The material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945/NACE and this MDS.					
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 th				
		s shall include the following in			
	- Heat treatment conditio	on (annealing temperature sh	all be stated);		
	 Melting and refining pro 				
	 MPS identification or M 	CPR/QTR number used.			

requirements for sour service.



MDS No. IN107S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloy type 625

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bars	ASTM B446	UNS N06625 Grade 1					
		Page 1 of 1					
Scope	This MDS defines applic specification.	able options and/or requirem	ents that supplement or amen	d the referenced standard			
Metal Making	vacuum arc remelting (V	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 meltin (VIM) can be followed by single refining method such as ESR or VAR.					
Heat Treatment		uch a way as to ensure free t process including any rapic	circulation of heating and cool cooling/quenching.	ing media around each ba			
Non-Destructive	Visual inspection						
Testing	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.						
	NDT valve parts manufa	ctured from bar					
	Inspection of valve parts manufactured from bar shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply including liquid penetrant testing according to the following table.						
	NDE Requirement	Р	art manufactured from bar ^a				
	Frequency ^b		10 %				
	Method	ŀ	ASME BPVC Sec. V, Article 6				
	Extent ^c		100 %				
	Acceptance criteria	ASME	BPVC Sec. VIII, Div. 1, Apper	ndix 8			
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. ^a Part of size DN > 50 (NPS > 2). ^b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. ^c All accessible internal and external surfaces shall be examined. 						
Repair of Defects	Weld repair is not permit	ted.					
Sour Service (additional	The material shall confor and this MDS.	m to the requirements of ISC	0 15156 /NACE MR0175 or IS	O 17945 /NACE MR0103			
metallurgical, manufacturing, testing and certification requirements) ^a	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 pi	ckled.					
Marking	The bars shall be marked	d to ensure full traceability to	heat and heat treatment lot.				
Certification		er shall have a quality syster ccepted by the purchaser.	n certified in accordance with	ISO 9001 or another qual			
	The inspection documen confirm compliance with		nce with ISO 10474 /EN 1020	4 Type 3.1 and shall			
	The inspection documen	ts shall include the following	information:				
	 Heat treatment condition (annealing temperature shall be stated). 						



MDS No. IN111S^a

Rev. 01

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Seamless pipes and tubes	ASTM B444	UNS N06625 Grade 1						
		Page 1 of 1						
Scope	This MDS defines app specification.	licable options and/or requirem	ents that supplement or amer	d the referenced standard				
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	Pipes and tubes shall be placed in such a way as to ensure free circulation of heating and cooling media around each product during the heat treatment process including any rapid cooling/quenching.							
Repair of Defects	Weld repair is not permitted.							
Sour Service (additional	itional and this MDS.							
metallurgical, manufacturing, testing and certification requirements) ^a	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this N							
Surface Treatment and Finish	Finished pipes and tubes shall be pickled.							
Marking	The pipes and tubes shall be marked to ensure full traceability to heat and heat treatment lot.							
Certification	Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or and 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:						
	The inspection docum	ents shall include the following	information:					



MDS No. IN119S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloy type 625

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
HIP Products	ASTM B834	UNS N06625 Grade 1		ASTM B834 S1, S2			
		Page 1 of 1	•				
Scope	This MDS defines applica specification.	ble options and/or requirement	nts that supplement or amen	d the referenced standard			
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	Gas atomized powder made from vacuum-refined metal. Powder blends shall be a homogenous mixture of powder heats in terms of composition, particle size and other properties.						
Heat Treatment	Components shall be placed in such a way as to ensure free circulation of heating and cooling media aroun each component during the heat treatment process including any rapid cooling/quenching.						
Non-Destructive Testing	<u>Visual Inspection</u> VT shall be carried out on each item in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing						
	NDE Requirement		HIP product ^a				
	Frequency ^b		10 %				
	Method	AS	SME BPVC Sec. V, Article 6				
	Extent ^c	Extent ^c 100 %					
	Acceptance criteria	Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8					
	 pickled prior to the testing. Parts of size DN > 50 (NPS > 2). For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined. 						
Repair of Defects	Weld repair is not permitt	ed.					
Sour Service (additional metallurgical,	The material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this MDS.						
metanurgicai, manufacturing, testing and certification requirements) ^a	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 sha	all be pickled. Machined surfac	ces do not require pickling.				
Marking		ave a unique identity marked throughout production of the pat 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.						
	confirm compliance with t	•		4 Type 3.1 and shall			
		s shall include the following in					
		arting material (powder) for the	·				
	- Heat treatment condition (annealing temperature shall be stated);						
	 Heat treatment condition MPS identification or M 		an be stated),				



MDS No. IN120S^a

Rev. 01

TYPE OF MATERIAL: Nickel alloys

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bolting	API STD 6ACRA	UNS N07718	120K	ASTM A962 S56			
	·	Page 1 of 1					
Scope	This MDS defines appli specification.	cable options and/or requ	irements that supplement or amer	nd the referenced standard			
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 general	requirements shall be acc	ording to ASTM A962 as amende	d by this MDS.			
	Threads on studs and b machined.	oolts shall be made by col	d rolling after precipitation hardeni	ng. Threads in nuts shall I			
Heat Treatment	Solution annealing and	ageing heat treatment sh	all be carried out after the final ho	t forming operation.			
Impact Testing/ Toughness testing	The impact testing requ	irements of API6ACRA sl	nall apply.				
Hardness	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 in accordance with ASTM A194 and the acceptance criteria shall comply with the requirements for Grade 7.						
Extent of Testing	For heat treatment in continuous furnace a heat treatment load (lot) is defined as all bolting heat treated continuously in the same furnace, or maximum for 8 h of operation, of the same heat and nominal thickness.						
Non-Destructive Testing	comply with requirement Liquid Penetrant Testing	nts specified in ASTM F78 g	all areas of threads, shanks, and l 8 for bolts/studs and ASTM F812 TM A962. Supplementary requirer	for nuts.			
Repair of Defects	Weld repair is not perm	itted.					
Sour Service (additional							
metallurgical, manufacturing, testing and certification requirements) [°]	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this M						
Surface Treatment and Finish	White pickled.						
Marking	Each bolting shall be m	arked to ensure full tracea	ability to melt and heat treatment l	ot.			
Certification	requirements standard	accepted by the purchase					
	confirm compliance with	n this specification.	ordance with ISO 10474 /EN 1020	4 Type 3.1 and shall			
		nts shall include the follow	0				
	- 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 						
		melting and refining practi		nceing temperature and			



specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined b PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	GRADE UNS S31254 UNS N08367 UNS N08926 Page 1 of 1 le options and/or requirement nufacturing process shall be sting shall meet the require y AOD or equivalent metho					
ASTM A312 ASTM A312 ASTM A312 This MDS defines applicab specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined by PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	UNS S31254 UNS N08367 UNS N08926 Page 1 of 1 e options and/or requirement nufacturing process shall be sting shall meet the require y AOD or equivalent metho	ents that supplement or amena e qualified in accordance with ments of this MDS.	d the referenced standard			
ASTM A312 ASTM A312 This MDS defines applicab specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined b PREN \geq 40.0 The pipes shall be solution Pipes shall be placed in su	UNS N08367 UNS N08926 Page 1 of 1 le options and/or requirement nufacturing process shall be sting shall meet the require y AOD or equivalent metho	e qualified in accordance with nents of this MDS.				
ASTM A312 This MDS defines applicab specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined b PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	UNS N08926 Page 1 of 1 le options and/or requirement nufacturing process shall be sting shall meet the required y AOD or equivalent metho	e qualified in accordance with nents of this MDS.				
This MDS defines applicab specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined b PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	Page 1 of 1 le options and/or requireme nufacturing process shall be sting shall meet the require y AOD or equivalent metho	e qualified in accordance with nents of this MDS.				
specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined b PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	le options and/or requirement nufacturing process shall be sting shall meet the require y AOD or equivalent metho	e qualified in accordance with nents of this MDS.				
specification. Manufacturers and the mar M-650. The qualification ter The melt shall be refined b PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	nufacturing process shall be sting shall meet the require y AOD or equivalent metho	e qualified in accordance with nents of this MDS.				
M-650. The qualification ter The melt shall be refined by PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su	sting shall meet the require	ments of this MDS.	ISO 17782 or NORSOK			
PREN ≥ 40.0 The pipes shall be solution Pipes shall be placed in su		d.				
The pipes shall be solution Pipes shall be placed in su	annealed followed by rapid					
Pipes shall be placed in su	annealed followed by rapid					
		The pipes shall be solution annealed followed by rapid cooling. Pipes shall be placed in such a way as to ensure free circulation of heating and cooling media around each pipe during the heat treatment process including quenching.				
Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The test shall expose the external and						
internal surfaces and a cross section surface in full wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF.						
One tensile and corrosion t	test shall be carried out for	each heat and heat treatment	lot.			
Weld repair is not permittee	d.					
Hardness testing						
The material shall be trace	able in accordance with ISC) 15156-3 /NACE MR0175-3 s	section 7.2 and this MDS			
Finished pipes shall be picl	kled or bright annealed.					
The pipes shall be marked	to ensure full traceability to	heat and heat treatment lot.				
The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another qualit requirements standard accepted by the purchaser.						
The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.						
	•	nformation:				
	CPR/QTR number used;					
		una de mandiume de distantes en se	l (heldine time - i t			
			i (noiding time is not			
	Test temperature shall be sinternal surfaces and a cro ASTM G48. The complete performed for 5 min at 60 ° The acceptance criteria are - No pitting at 20x magnifi - The weight loss shall be One tensile and corrosion i Weld repair is not permitter When sour service requirer requirements of ISO 15156 <i>Hardness testing</i> Production hardness testin one length of pipe per lot. • proximity. The material shall be trace Finished pipes shall be pic The pipes shall be marked The material manufacturer requirements standard acc The inspection documents compliance with this specif The inspection documents - MPS identification or MC - Steel manufacturer; - Solution annealing temp applicable for pipes prod	 Test temperature shall be 50 °C (122 °F) and the exponinternal surfaces and a cross section surface in full wa ASTM G48. The complete specimen shall be pickled b performed for 5 min at 60 °C (140 °F) in a solution of 2 The acceptance criteria are: No pitting at 20x magnification; The weight loss shall be less than 4.0 g/m². One tensile and corrosion test shall be carried out for effective terms of ISO 15156 /NACE MR0175 or ISO 17 <i>Hardness testing</i> Production hardness testing shall be performed in accordance with ISO 15156 /NACE MR0175 or ISO 17 <i>Hardness testing</i> Production hardness testing shall be performed in accordance by the preximity. The material shall be traceable in accordance with ISO Finished pipes shall be pickled or bright annealed. The material manufacturer shall have a quality system requirements standard accepted by the purchaser. The inspection documents shall be in accordance with compliance with this specification. The inspection documents shall be in accordance with compliance with this specification. MPS identification or MCPR/QTR number used; Steel manufacturer; Solution annealing temperature, holding time and quapplicable for pipes produced hot finished and directure for the specification and the specification. 	Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The test shall internal surfaces and a cross section surface in full wall thickness. Cut edges shall be ASTM G48. The complete specimen shall be pickled before being weighed and test performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF. The acceptance criteria are: - No pitting at 20x magnification; - The weight loss shall be less than 4.0 g/m ² . One tensile and corrosion test shall be carried out for each heat and heat treatment Weld repair is not permitted. When sour service requirements are specified by the purchaser, the material shall c requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this <i>Hardness testing</i> Production hardness testing shall be performed in accordance with the requirements one length of pipe per lot. The maximum hardness shall be 35HRC from three readi proximity. The material shall be pickled or bright annealed. The pipes shall be marked to ensure full traceability to heat and heat treatment lot. The material manufacturer shall have a quality system certified in accordance with I requirements standard accepted by the purchaser. The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type compliance with this specification. MPS identification or MCPR/QTR number used; Steel manufacturer; Solution annealing temperature, holding time and quench medium shall be stated applicable for pipes produced hot finished and direct quenched).			



Material Data	Sheet	MDS No. IR112 /	IR112S ^a	Rev. 0′		
TYPE OF MATERIAL	: Austenitic Stainless Steel,	Туре 6Мо				
PRODUCT FORM	STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTAR REQUIREMENT					
Welded Pipes	ASTM A358	UNS S31254	Class 1, 3 and 5	ASTM A358 S3		
	ASTM A358	UNS N08367	Class 1, 3 and 5	ASTM A358 S3		
	ASTM A358	UNS N08926	Class 1, 3 and 5	ASTM A358 S3		
		Page 1 of 2				
Scope	This MDS defines applical specification.	ble options and/or requireme	ents that supplement or amend	the referenced standard		
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 b	by AOD or equivalent metho	d.			
Chemical Composition	PREN ≥ 40.0					
Welding	 The WPS shall be qualified in accordance with ASME BPVC Sec. IX or ISO 15614-1 and this MDS: A matching consumable with enhanced Mo or Cr content compared to the base material shall be used; the S content of the consumable shall not exceed 0.015 %. The welding procedure qualification shall be corrosion tested as specified below. The qualification shall be carried out on the same material grade (UNS number) as used in production. A change of specific make (brand name) of welding consumables requires requalification. 					
Heat Treatment	The pipes shall be solution annealed followed by rapid cooling. Pipes shall be placed in such a way as to ensure free circulation of heating and cooling media around each pipe during the heat treatment process including quenching. Post weld solution annealing is not required for pipes with nominal wall thickness up to 7.11 mm (0.28 in)					
Corrosion testing	 manufactured from solution annealed strip/plate material; such pipe shall be marked as stated in A358. Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and th exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface in fu wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO₃ + 5 % HF. The acceptance criteria are: No pitting at 20x magnification; The weight loss shall be less than 4.0 g/m². 					
Extent of Testing	One tensile and corrosion	test shall be carried out for	each lot as defined below:			
			um 60 m (197 ft) of pipes of the me size and heat treatment loa			
	- For continuous heat trea	atment, a lot is defined as m	aximum 60 m (197 ft) of pipes me size and which is heat treat	of the same heat, same		
Non-Destructive Testing	Eddy current testing accor less than 4.0 mm (0.16 in)		ptable as replacement for radio	ography for wall thickness		
	The weld of each examine Method of testing shall be	ed pipe shall be ground flush	y to the longitudinal weld ends for a length of 100 mm (4 in) p Article 6 and acceptance criter ed out after any calibration.	prior to penetrant testing.		
Repair of Defects	Weld repair of base mater	ial is not permitted.				
		quirements for production we	elding above shall apply to the	repair WPS. Repair weld		



Material Data SheetMDS No. IR112 / IR112S aRev. 01							
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo							
PRODUCT FORM	STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT						
Welded Pipes	ASTM A358	UNS S31254	Class 1, 3 and 5	ASTM A358 S3			
	ASTM A358	UNS N08367	Class 1, 3 and 5	ASTM A358 S3			
	ASTM A358	UNS N08926	Class 1, 3 and 5	ASTM A358 S3			
	-	Page 2 of 2		·			
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
manufacturing, testing and	Hardness testing						
certification requirements) ^ª	Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one length of pipe per lot. The maximum hardness of the base material, HAZ and weld metal shall be 35HRC from three readings taken in close proximity at each location.						
	The material shall be trace	eable in accordance with ISC	D 15156-3 /NACE MR0175-3 s	section 7.2 and this MDS.			
Surface Treatment and Finish	Finished pipes shall be pio	ckled or bright annealed.					
Marking	The pipes shall be marked	d to ensure full traceability to	heat and heat treatment lot.				
Certification	The material manufacture requirements standard ac	r shall have a quality system cepted by the purchaser.	certified in accordance with Is	SO 9001 or another quality			
	The inspection documents compliance with this speci		n ISO 10474 /EN 10204 Type 3	3.1 and shall confirm			
	The inspection documents	s shall include the following i	nformation:				
	- MPS identification or M	CPR/QTR number used;					
	 Steel manufacturer; 						
	- Solution annealing tem	perature, holding time and q	uench medium shall be stated				
	v suffix "S" shall be used to do uirements for sour service.	esignate a material delivered	d in accordance with the MDS	plus the additional			



Material Data	Sheet	MDS No. IR11	13 / IR113S ^a	Rev. 01			
TYPE OF MATERIAL	: Austenitic Stainless Stee	el, Type 6Mo					
PRODUCT FORM	STANDARD	SUPPLEMENTARY REQUIREMENT					
Wrought fittings	ASTM A403	UNS S31254	WP-S, WP-WX and WP- W	ASTM A960 S52			
	ASTM A403	UNS N08367	WP-S, WP-WX and WP- W	ASTM A960 S52			
	ASTM A403	UNS N08926	WP-S, WP-WX and WP- W	ASTM A960 S52			
		Page 1 of 2					
Scope	This MDS defines applic specification.	able options and/or requi	rements that supplement or amen	d the referenced standard			
Qualification		nanufacturing process sha testing shall meet the rec	all be qualified in accordance with quirements of this MDS.	ISO 17782 or NORSOK			
Metal Making	The melt shall be refined	d by AOD or equivalent m	ethod.				
Chemical Composition	PREN ≥ 40.0	PREN ≥ 40.0					
Welding	 A matching consumal S content of the cons The welding procedure The qualification shall 	 The welding procedure shall be qualified in accordance with ASME IX or ISO 15614-1 and this MDS: A matching consumable with enhanced Mo or Cr content compared to the base material shall be used; the S content of the consumable shall not exceed 0.015 %. The welding procedure qualification shall be corrosion tested as specified below. The qualification shall be carried out on the same material grade (UNS number) as used in production. A change of specific make (brand name) of welding consumables requires requalification. 					
Heat Treatment	The fittings shall be placed in such a way as to ensure free circulation of heating and cooling media around each fitting during the heat treatment process including quenching.						
Corrosion testing	Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF. The acceptance criteria are: - No pitting at 20x magnification; - The weight loss shall be less than 4.0 g/m ² .						
Extent of Testing	One tensile and corrosic	on test shall be carried out	t for each lot as defined below.				
		l fittings from the same he ere applicable, welded wi	eat and heat treatment load, with a th the same WPS.	a wall thickness range of			
Test Sampling	removal of specimens is	not possible due to the s	ens cut from a fitting, where dimer ize of the fitting, a prolongation or eat treatment load as the fittings i	a length of starting			



		MDS No. IR113 /		Rev. 0′		
TYPE OF MATERIAL	: Austenitic Stainless Steel	, Type 6Mo				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLA	SS SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A403	UNS S31254	WP-S, WP-WX and V W	VP- ASTM A960 S52		
	ASTM A403	UNS N08367	WP-S, WP-WX and V W	VP- ASTM A960 S52		
	ASTM A403	UNS N08926	WP-S, WP-WX and V W	VP- ASTM A960 S52		
		Page 2 of 2	I			
Non-Destructive	Liquid penetrant testing					
Testing		ary requirement S52 shall app	ly as amended by this	MDS:		
	NDE Requirement		Nominal Thickness			
		Seamless fittings		Welded fittings ^a		
	Frequency ^b	10 %		100 %		
	Method		ME BPVC Sec. V, Artic			
	Extent ^c	-	100 %			
	Acceptance criteria	ASME BPVC Sec. VIII, Div. 1, Appendix 8				
	NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be					
	pickled prior to the testing.					
	^a Welded fittings of size DN > 50 (NPS > 2).					
	^b Frequency of inspection 100 % means that each item shall be examined. When random examination					
	(10 %) is specified, a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing.					
	^c All accessible interr	al and external surfaces shall				
	cover the weld only (4 in) prior to peneti	and the weld of each examine	ed fitting shall be groun	d flush in a length of 100 mm		
Repair of Defects	Weld repair of base mate	rial is not permitted.				
		equirements for production we er the original production welc		to the repair WPS. Repair weld		
Sour Service (additional	When sour service requir requirements of ISO 1515	ements are specified by the p 56 /NACE MR0175 or ISO 179	urchaser, the material s 945 /NACE MR0103, ar	shall conform to the nd this MDS:		
metallurgical, manufacturing,	Hardness testing					
esting and ecrtification equirements) ^a Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 of fittings per lot. When only one fitting is produced, it shall be hardness tested as required. The maxim hardness of the base material, HAZ and weld metal shall be 35HRC from three readings taken in c						
requirements) ^a		erial, HAZ and weld metal sha		s required. The maximum		
	hardness of the base man proximity at each location	erial, HAŻ and weld metal sha	all be 35HRC from three	s required. The maximum		
requirements) ^ª Surface Treatment	hardness of the base man proximity at each location The material shall be trac	erial, HAŻ and weld metal sha	all be 35HRC from three 15156-3 /NACE MR01	s required. The maximum e readings taken in close		
requirements) ^a	hardness of the base main proximity at each location The material shall be track Finished fittings shall be p	erial, HAZ and weld metal sha eable in accordance with ISO	all be 35HRC from three 15156-3 /NACE MR01 o not require pickling.	s required. The maximum e readings taken in close 75-3 section 7.2 and this MDS.		
requirements) ^a Surface Treatment and Finish	hardness of the base main proximity at each location The material shall be track Finished fittings shall be mark The fittings shall be mark The material manufacture	erial, HAZ and weld metal sha eable in accordance with ISO bickled. Machined surfaces do ed to ensure full traceability to er shall have a quality system	all be 35HRC from three 15156-3 /NACE MR01 o not require pickling. o heat and heat treatme	s required. The maximum e readings taken in close 75-3 section 7.2 and this MDS.		
requirements) ^ª Surface Treatment and Finish Marking	hardness of the base main proximity at each location The material shall be track Finished fittings shall be mark The fittings shall be mark The material manufacture requirements standard ac	erial, HAZ and weld metal sha eable in accordance with ISO pickled. Machined surfaces do ed to ensure full traceability to er shall have a quality system cepted by the purchaser. s shall be in accordance with	all be 35HRC from three 15156-3 /NACE MR01 o not require pickling. o heat and heat treatme certified in accordance	s required. The maximum e readings taken in close 75-3 section 7.2 and this MDS. nt lot. with ISO 9001 or another quali		
requirements) ^ª Surface Treatment and Finish Marking	hardness of the base main proximity at each location The material shall be track Finished fittings shall be mark The fittings shall be mark The material manufacture requirements standard at The inspection document compliance with this spect	erial, HAZ and weld metal sha eable in accordance with ISO bickled. Machined surfaces do ed to ensure full traceability to er shall have a quality system ccepted by the purchaser. s shall be in accordance with cification. s shall include the following in	all be 35HRC from three 15156-3 /NACE MR01 o not require pickling. o heat and heat treatme certified in accordance ISO 10474 /EN 10204	s required. The maximum e readings taken in close 75-3 section 7.2 and this MDS. nt lot. with ISO 9001 or another quali		
requirements) ^ª Surface Treatment and Finish Marking	hardness of the base main proximity at each location The material shall be track Finished fittings shall be mark The fittings shall be mark The material manufacture requirements standard ac The inspection document compliance with this spect The inspection document – MPS identification or M	erial, HAZ and weld metal sha eable in accordance with ISO bickled. Machined surfaces do ed to ensure full traceability to er shall have a quality system ccepted by the purchaser. s shall be in accordance with cification. s shall include the following in	all be 35HRC from three 15156-3 /NACE MR01 o not require pickling. o heat and heat treatme certified in accordance ISO 10474 /EN 10204	s required. The maximum e readings taken in close 75-3 section 7.2 and this MDS. nt lot. with ISO 9001 or another quali		
requirements) ^ª Surface Treatment and Finish Marking	hardness of the base mail proximity at each location The material shall be track Finished fittings shall be mark The fittings shall be mark The material manufacture requirements standard ac The inspection document compliance with this spec The inspection document – MPS identification or M – Steel manufacturer;	erial, HAZ and weld metal sha eable in accordance with ISO bickled. Machined surfaces do ed to ensure full traceability to er shall have a quality system ccepted by the purchaser. s shall be in accordance with cification. s shall include the following in	all be 35HRC from three 15156-3 /NACE MR01 o not require pickling. o heat and heat treatme certified in accordance ISO 10474 /EN 10204	s required. The maximum e readings taken in close 75-3 section 7.2 and this MDS nt lot. with ISO 9001 or another qual Type 3.1 and shall confirm		



Material Data S	Sheet	MDS No. IR114 /	IR114S ^a	Rev. 01		
TYPE OF MATERIAL:	Austenitic Stainless Steel,	Туре 6Мо				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A182	F44 (UNS S31254)		ASTM A961 S56		
	ASTM A182	F62 (UNS N08367)		ASTM A961 S56		
	ASTM B462	UNS N08926	***************************************	ASME BPVC Code Case 2120-1		
	1	Page 1 of 2				
Scope	specification. Product covered by this M	DS is limited to a maximum t	nts that supplement or amen hickness of 200 mm (8 in). F ents shall be subject to agree	or thickness exceeding		
Qualification		anufacturing process shall be esting shall meet the requirer	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined b	by AOD or equivalent method	I.			
Chemical Composition	PREN ≥ 40.0					
Heat Treatment	The 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 component during the heat treatment process including quenching.					
Corrosion testing	exposure time 24 h. The te wall thickness. For forging section from surface to mi from surface to a depth of specimen shall be pickled (140 °F) in a solution of 20 The acceptance criteria ar	Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. For forgings with wall thickness less than 100 mm (4 in) the test specimen shall expose a cross section from surface to a depth of 50mm (2 in). Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF. The acceptance criteria are: - No pitting at 20x magnification;				
Extent of Testing	One tensile and corrosion	test shall be carried out for e	ach lot as defined below:			
	 A test lot shall include a (4 400 lb) for forgings w 	 One tensile and corrosion test shall be carried out for each lot as defined below: A test lot shall include all forgings from the same heat, heat treatment load and shall not exceed 2 000 kg (4 400 lb) for forgings with as forged weight 50 kg (110 lb), and 5 000 kg (11 000 lb) for forgings with as forged weight > 50 kg (110 lb). 				
		ngth shall be at least 50 mm	50 mm (2 in), the test specir (2 in) from any second surfa			
	 For forgings having maximum section thickness, T > 50 mm (2 in), the test specimens shall be tak least ¼T from the nearest surface and mid-length of test specimens at least T or 100 mm (4 in), w is less, from any second surface. 					
	 Sketches shall be established specimens. 	blished showing type, and siz	e of test samples and locatio	n for extraction of test		
Non-Destructive	Visual Inspection					
Testing			lance with the product standa nined surfaces shall be pickle			



Material Data	Sheet	MDS No. IR114	/ IR114S ^a	Rev. 01		
TYPE OF MATERIAL	: Austenitic Stainless Stee	l, Type 6Mo				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Forgings	ASTM A182	F44 (UNS S31254)		ASTM A961 S56		
	ASTM A182	F62 (UNS N08367)		ASTM A961 S56		
	ASTM B462	UNS N08926		ASME BPVC Code Case 2120-1		
		Page 2 of 2				
Non-Destructive	Liquid penetrant testing					
Testing	NDE Requirement		Forgings ^a			
	Frequency ^b		10 %			
	Method		ASME BPVC Sec. V, Article 6			
	Extent °		100 %			
	Acceptance criteria	ASM	E BPVC Sec. VIII, Div. 1, Apper	dix 8		
		ASIVI				
	 pickled prior to the testing. Parts of size DN > 50 (NPS > 2). For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined. 					
	<u>Valve forgings NDT</u> Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.					
Repair of Defects	Weld repair is not permit	ted.				
Sour Service (additional			e purchaser, the material shall of 17945 /NACE MR0103, and thi			
metallurgical,	Hardness testing					
manufacturing, testing and certification requirements) ^a	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two forgings per lot. When only one part is produced, it shall be hardness tested as required. The maximum hardness shall be 35HRC 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 forgings shall b	e pickled. Machined surface	es do not require pickling.			
Marking	The forgings shall be ma	rked to ensure full traceabi	lity to heat and heat treatment le	ot.		
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 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 MCPR/QTR number used; 					
	- Steel manufacturer;					
	- Solution annealing ter	nperature, holding time and	I quench medium shall be state	d.		
	y suffix "S" shall be used to quirements for sour service.	designate a material delive	red in accordance with the MDS	plus the additional		



Material Data S	Sheet	MDS No. IR115 /	IR115S ^a	Rev. 01		
TYPE OF MATERIAL:	Austenitic Stainless Steel,	Туре 6Мо				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Plates, sheets, strips	ASTM A240	UNS S31254				
	ASTM A240	UNS N08367				
	ASTM A240	UNS N08926				
		Page 1 of 2	·	·		
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard		
Manufacturing		nufacturing process shall be esting shall meet the requirer	qualified in accordance with nents of this MDS.	ISO 17782 or NORSOK		
Metal Making	The melt shall be refined b	by AOD or equivalent method	1.			
Chemical Composition	PREN ≥ 40.0					
Tensile Testing	Tensile test specimens sha	all be sampled in the transve	erse orientation to the direction	n of final rolling.		
Corrosion testing	Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF. The acceptance criteria are: - No pitting at 20x magnification; - Weight loss shall be less than 4.0 g/m ² .					
Extent of Testing	One tensile and corrosion	test shall be carried out for e	each heat of steel and heat tr	eatment lot.		
Non-Destructive Testing	Visual Inspection					
	VT shall be carried out on each plate 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.					
	Valve plate NDT					
	Inspection shall be accord the requirements in this M		pecification. If a QSL is not sp	pecified by the purchaser,		
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional motollurgical	When sour service require require requirements of ISO 1515	ments are specified by the p 6 /NACE MR0175 or ISO 17	ourchaser, the material shall o 945 /NACE MR0103, and this	conform to the s MDS.		
metallurgical, manufacturing,	Hardness testing					
testing and certification requirements) ^a	Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one plate per lot. For coil, tests shall be carried out at both ends of the coil. The maximum hardness shall be 35HRC from three readings taken in close proximity at each location.					
	The material shall be trace	eable in accordance with ISC	15156-3 /NACE MR0175-3	section 7.2 and this MDS.		
Surface Treatment and Finish	Finished plates, sheets an	d strips shall be pickled.				
Marking	The plates, sheets and str	ips shall be marked to ensur	e full traceability to heat and	heat treatment lot.		



Material Data Sheet		MDS No. IR11	MDS No. IR115 / IR115S ^a					
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo								
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Plates, sheets, strips	ASTM A240	UNS S31254						
	ASTM A240	UNS N08367						
	ASTM A240	UNS N08926						
		Page 2 of 2						
Certification		cturer shall have a quality sy rd accepted by the purchase	stem certified in accordance with	ISO 9001 or another quality				
	The inspection docur compliance with this		with ISO 10474 /EN 10204 Type	3.1 and shall confirm				
	The inspection docur	ments shall include the follow	ing information:					
	 MPS identification 	or MCPR/QTR number used	,					
	- Steel manufacturer;							
- Solution annealing temperature, holding time and quench medium shall be stated.								
	suffix "S" shall be used rements for sour servic		ered in accordance with the MDS	plus the additional				



Material Data	Sheet	MDS No. IR116	/ IR116S ^a	Rev. 01	
TYPE OF MATERIAL	: Austenitic Stainless S	teel, Type 6Mo			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Castings	ASTM A351	CK3MCuN (UNS J93254)		ASTM A351 S5, S6, ASTM A703 S20 ASTM A985 S20	
	ASTM A351	CN3MN (UNS J94651)		ASTM A351 S5, S6, ASTM A703 S20 ASTM A985 S20	
		Page 1 of 4	·		
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.				
	For castings produced apply.	by the investment casting proce	ess, the requirements of ASTI	M A985 and this MDS shall	
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		ned by AOD or equivalent method itted by ISO 17782 is regarded to			
Chemical Composition	P ≤ 0.030 % PREN ≥ 40.0				
Heat Treatment	Material shall be solut	ion annealed at temperature ≥ 1	225 °C (2 237 °F) followed b	y water/liquid quenching.	
	Castings shall be placed in such a way as to ensure free circulation of heating and cooling media around each pipe during the heat treatment process including quenching.				
Corrosion testing	exposure time 24 h. T wall thickness. Cut ed	ng to ASTM G48 Method A is re he test shall expose the external ges shall be prepared according and tested. Pickling may be per	and internal surfaces and a c to ASTM G48. The complete	cross section surface in full specimen shall be pickled	
	The acceptance criter	ia are:			
	- No pitting at 20x ma	•			
	- The weight loss sha	all be less than 4.0 g/m ² .			
Extent of Testing		sion test shall be carried out for a Il not exceed 5 000 kg (11 000 lb		eatment load (including any	



Material Data	Sheet	MDS No. IR116	5 / IR116S ^a	Rev. 01		
TYPE OF MATERIAL	.: Austenitic Stainless	Steel, Type 6Mo				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A351	CK3MCuN (UNS J93254)		ASTM A351 S5, S6, ASTM A703 S20 ASTM A985 S20		
	ASTM A351	CN3MN (UNS J94651)		ASTM A351 S5, S6, ASTM A703 S20 ASTM A985 S20		
		Page 2 of 4				
Test Sampling	Test blocks shall be integral or gated with the casting(s) they represent and shall accompany the castings through all heat treatment operations.					
	Thickness of the test block shall be equal to the thickest part of the casting represented. For flanged castings, the largest flange thickness is the ruling section.					
	Dimensions of test blocks and location of test specimens within the test blocks are shown in the figure below. The test specimens shall be taken within the cross hatched area and in a distance of T/4 from the ends.					
	During any PWHT the test block shall be tack welded onto the casting.					
	T/4 T/4 T/4 Integra Test Bl		T/4 T/4 T/4 T/2 T/2 Gated Test Block	T+X		

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Material Data			No. IF	R116 /	/ IR11	 6S ^a			Rev. 01
TYPE OF MATERIAL	.: Austenitic Stainless S	teel, Type 6Mo							
PRODUCT FORM	STANDARD	GRADE			ACCE	EPTANC	E CLASS		LEMENTARY JIREMENT
Castings	ASTM A351	CK3MCul J93254)	N (UNS					ASTM	A351 S5, S6, A703 S20 A985 S20
	ASTM A351	CN3MN (UNS J94	651)				ASTM	A351 S5, S6, A703 S20 A985 S20
	I	F	Page 3 of	4					
Non-Destructive	Radiographic testing								
Testing	ASTM A351 suppleme	entary requireme	ent S5 sha	all apply	as ame	nded by	this MDS	S:	
	NDE requirement	Pilot				Produc	tion cast	ting	
		casting (section 4.8)	Isting Valve castings ^a					Other pressure containing castings ^b	
	Frequency ^c	100 %	NPS DN	DN		Pressu	ire class		100 %
					≤ 300	600	900	≥ 1500	
			< 2	< 50	N/R	N/R	N/R	N/R	
			≥ 2	≥ 50	N/R	5 %	5 %	5 %	
			≥ 6	≥ 150	N/R	5 %	5 %	100 %	
			≥ 10	≥ 250	5 %	5 %	5 %	100 %	
			≥ 16	≥ 400	5 %	5 %	100 %	100 %	
			≥ 20	≥ 500	5 %	100 %	100 %	100 %	
	Method			ASI	ME BPV	C Sec. \	/, Article	2	L
	Extent	Areas defined by ASME B16.34 for special class valves, at abrupt changes in sections and at the junctions of risers, gates or feeders to the casting						100 % ^d	
	Acceptance criteria		A	SME BF	VC Sec	. VIII, Di	v. 1, App	endix 7	
	NOTE N/R means r	not required, unl	ess speci	fied othe	erwise b	y the pu	rchaser.		
	 ^a Production valve specified by the p ^b Production castin ^c Frequency of ins (5 %) is specified examined. 	casting, RT sha purchaser, the re- ing other than val pection 100 % m l, a minimum of o ng other than val nd/or applicable	Il be acco equirement ve casting heans that one item ve casting product	ording to nts in thi g. t each it per lot o g, inspec specifica	the app s table s em shal f each p ction sha ation or s	blicable v shall app I be exar battern in all includ	alve spea ly. mined. W any purc e other c	'hen randor chase order ritical areas	n examination shall be sas defined in the



Austenitic Stainless Steel,	Turna (111a						
	TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo						
STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
ASTM A351	CK3MCuN (UNS J93254)		ASTM A351 S5, S6, ASTM A703 S20 ASTM A985 S20				
ASTM A351	CN3MN (UNS J94651)		ASTM A351 S5, S6, ASTM A703 S20 ASTM A985 S20				
	Page 4 of 4						
			irs shall be documented in				
The repair welding procedu requirements:	ire shall be qualified in accor	dance with ASTM A488 or IS	SO 11970 and the following				
 Welding procedure shall 	be qualified on the same ca	st material grade (UNS numb	per) as used in production.				
base material; the S con	tent of the consumable shall	not exceed 0.015 %.					
 Change of specific make of filler metal (brand names) requires requalification for SMAW and FCAW processes. 							
 Corrosion test specimen shall include the weld zone. Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the specific descent and acceptance criteria shall be in accordance with the requirements of this MDS for 							
Post weld heat treatment is required after all weld repairs.							
If a minor cosmetic repair is required, heat treatment may be excluded providing the welding pr all the specified microstructural, mechanical and corrosion material requirements of this data sh welded condition.							
			onform to the requirements				
Hardness testina							
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 for CK3MCuN castings. The maximum hardness shall be 100HRB (22HRC) from three readings taken in close proximity.							
For other alloys the maxim	um hardness shall not excee	d 35HRC.					
The material shall be trace:	able in accordance with ISO	15156-3 /NACE MR0175-3 s	section 7.2 and this MDS.				
Finished castings shall be p	pickled. Machined surfaces of	lo not require pickling					
The castings shall be marked to ensure full traceability to heat and heat treatment load.							
		certified in accordance with IS	SO 9001 or another quality				
The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.							
The inspection documents	shall include the following in	formation:					
- MPS identification or MC	PR/QTR number used;						
- Steel manufacturer;							
 Solution annealing temp 	erature, holding time and qu	ench medium shall be stated					
	ASTM A351 Repairs as described in A3 accordance with A703 S20 The repair welding procedure requirements: - Welding procedure shall - Welding shall be carried base material; the S con - Change of specific make processes. - Corrosion test specimen - Testing methodology and the parent material. Examination of major repai Weld repairs are not accept Post weld heat treatment is If a minor cosmetic repair is all the specified microstruct welded condition. When sour service requirer of ISO 15156 /NACE MR01 Hardness testing Production hardness testing Production hardness testing The casting and one ca 100HRB (22HRC) from thre For other alloys the maximum The material shall be tracea Finished castings shall be gain The castings shall be mark The inspection documents compliance with this specifi The inspection documents - MPS identification or MC - Steel manufacturer; - Solution annealing temp	ASTM A351 CN3MN (UNS J94651) Page 4 of 4 Repairs as described in A351 section 10.2 shall be con accordance with A703 S20.2 or A985 S20, as applicabl The repair welding procedure shall be qualified on the same ca Welding procedure shall be qualified on the same ca Welding shall be carried out with Ni-based consumat base material; the S content of the consumable shall Change of specific make of filler metal (brand names processes. Corrosion test specimen shall include the weld zone. Testing methodology and acceptance criteria shall be the parent material. Examination of major repair welds on pressure containi Weld repairs are not acceptable for castings that leak d Post weld heat treatment is required after all weld repair all the specified microstructural, mechanical and corros welded condition. When sour service requirements are specified by the pu of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR Hardness testing Production hardness testing shall be performed in accor the pilot casting and one casting per lot thereafter for C 100HRB (22HRC) from three readings taken in close pr For other alloys the maximum hardness shall not excee The material shall be traceable in accordance with ISO Finished castings shall be pickled. Machined surfaces of The castings shall be pickled. Machined surfaces of The castings shall be marked to ensure full traceability The material manufacturer shall have a quality system of requirements standard accepted by the purchaser. The inspection documents shall be in accordance with ISO Finished castings shall be marked to ensure full traceability The material manufacturer shall have a quality system of requirements standard accepted by the purchaser. The inspection documents shall be in accordance with I compliance with this specification. The inspection documents shall include the following im - MPS identification or MCPR/QTR number used; - Steel manufacturer; - Solution annealing temperature, holding time and qu	ASTM A351 CN3MN (UNS J94651) Page 4 of 4 Repairs as described in A351 section 10.2 shall be considered major. All major reparacordance with A703 S20.2 or A985 S20, as applicable. The repair welding procedure shall be qualified in accordance with ASTM A488 or IS requirements: - Welding procedure shall be qualified on the same cast material grade (UNS numt) - Welding procedure shall be qualified on the same cast material grade (UNS numt) - Welding shall be carried out with Ni-based consumable shall not exceed 0.015 %. - Change of specific make of filler metal (brand names) requires requalification for Sprocesses. - Corrosion test specimen shall include the weld zone. - Testing methodology and acceptance criteria shall be in accordance with the require the parent material. Examination of major repair welds on pressure containing parts shall also include RT Weld repairs are not acceptable for castings that leak during pressure testing. Post weld heat treatment is required after all weld repairs. If a minor cosmetic repair is required after all weld repairs. If a minor cost erequirements are specified by the purchaser, the material shall co of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this MDS: Hardness testing Hardness testing shall be performed in accordance with the requirements the pilot casting and one casting per lot thereafter for CK3MCuN castings. The maxin 100HRB (22HRC) from three readings taken in close proximity.<				



MDS No. IR117 / IR117S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel. Type 6Mo PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Bars UNS S31254 ASTM A276 ASTM A276 **UNS N08367** ASTM A276 **UNS N08926** ASTM A479 UNS S31254 ASTM A479 UNS N08367 ASTM A479 UNS N08926 ASTM A182 F44 (UNS S31254) ASTM A182 F62 (UNS N08367) Page 1 of 3 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. This MDS includes additional requirements for valve parts DN 100 (NPS 4) and under manufactured from bars, when permitted by the valve specification. Product covered by this MDS is limited to a maximum thickness of 200 mm (8 in). For thickness exceeding 200 mm (8 in), qualification and specification requirements shall be subject to agreement. Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK Qualification M-650. The qualification testing shall meet the requirements of this MDS. Metal Making The melt shall be refined by AOD or equivalent method. Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 200 mm (8 in). Manufacturing NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted. Chemical PREN ≥ 40.0 Composition Tensile Testing 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. Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the Corrosion testing exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO3 + 5 % HF. The acceptance criteria are: No pitting at 20x magnification; The weight loss shall be less than 4.0 g/m². Extent of Testing Tensile and corrosion tests shall be carried out for each lot as defined in ASTM A484. The mid-length of axial (longitudinal) and tangential (transverse) tensile specimens shall be located at a Test Sampling distance equal to the bar outside diameter or minimum of 100 mm (4 in), whichever is the greater, from the end of the bar. The centreline of tensile specimen shall be located at a distance from the bar OD in accordance with ASTM A370 Annex A. Valve parts manufactured from bar For bars with outside diameter ≥ 100 mm (4 in) intended for machining of valve parts, tensile testing shall be

taken in both the longitudinal and transverse direction.



Material Data \$	Sheet	MDS No. IR117	′ / IR117S ^a	Rev. 0′		
TYPE OF MATERIAL:	Austenitic Stainless Stee	I, Туре 6Mo				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A276	UNS S31254				
	ASTM A276	UNS N08367				
	ASTM A276	UNS N08926				
	ASTM A479	UNS S31254				
	ASTM A479	UNS N08367				
	ASTM A479	UNS N08926				
	ASTM A182	F44 (UNS S31254)				
	ASTM A182	F62 (UNS N08367)				
		Page 2 of 3				
Testing	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. NDT valve parts manufactured from bar Inspection of valve parts manufactured from bar shall be according to the applicable valve specification. If a					
	QSL is not specified by the purchaser, the requirements in this MDS shall apply including liquid penetrant testing according to the following table.					
	NDE Requirement	Part manufactured from bar ^a				
	Frequency ^b	10 %				
	Method Extent ^c		ASME BPVC Sec. V, Article 6			
	Acceptance criteria	ASME	100 % BPVC Sec. VIII, Div. 1, Apper	odix 8		
	 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. ^a Part of size DN > 50 (NPS > 2). ^b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. ^c All accessible internal and external surfaces shall be examined. 					
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this MDS:					
metallurgical, manufacturing,	Hardness testing					
testing and certification requirements) ^a	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 35HRC from three readings taken in close proximity.					
	The material shall be trac	ceable in accordance with Is	SO 15156-3 /NACE MR0175-3	section 7.2 and this MDS.		
Surface Treatment and Finish	Finished product shall be	e white pickled.				
Marking	The bars shall be marked	d to ensure full traceability to	o heat and heat treatment lot.			



Material Data Sheet		MDS No. IR117	Rev. 01			
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A276	UNS S31254				
	ASTM A276	UNS N08367				
	ASTM A276	UNS N08926				
	ASTM A479	UNS S31254				
	ASTM A479	UNS N08367				
	ASTM A479	UNS N08926				
	ASTM A182	F44 (UNS S31254)				
	ASTM A182	F62 (UNS N08367)				
		Page 3 of 3				
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 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 MCPR/QTR number used; 					
	 Steel manufacturer; 					
	 Solution annealing ten 	nperature, holding time and	quench medium shall be state	d.		



Material Data	Sheet	MDS No. IR118 /	IR118S ^a	Rev. 01				
TYPE OF MATERIAL:	Austenitic Stainless Steel,	Туре 6Мо						
PRODUCT FORM	STANDARD	GRADE	GRADE ACCEPTANCE CLASS SUPPL					
Tubes	ASTM A269	UNS S31254						
	ASTM A269	UNS N08367						
	ASTM A269	UNS N08926						
		Page 1 of 2						
Scope	This MDS defines applicat specification.	ble options and/or requirement	nts that supplement or amen	d the referenced standard				
Qualification		nufacturing process shall be esting shall meet the requiren		ISO 17782 or NORSOK				
Metal Making	The melt shall be refined b	y AOD or equivalent method						
Chemical Composition	PREN ≥ 40.0							
Heat Treatment	The tubes shall be solution annealed followed by rapid cooling. Tubes shall be placed in such a way as to ensure free circulation of air and quenching medium around each tube during the heat treatment process including cooling.							
Tensile Testing	The following acceptance criteria shall apply. - UNS S31254: Rp _{0.2} ≥ 310 MPa (45 ksi); R _m ≥ 675 MPa (98 ksi); A ≥ 35 % - UNS N08367 Rp _{0.2} ≥ 310 MPa (45 ksi); R _m ≥ 690 MPa (100 ksi); A ≥ 35 % - UNS N08926 Rp _{0.2} ≥ 300 MPa (44 ksi); R _m ≥ 650 MPa (94 ksi); A ≥ 35 %							
Corrosion testing	Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface including weld zone in full wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO ₃ + 5 % HF. The acceptance criteria are:							
	- No pitting at 20x magnific							
Extent of Testing	-	 The weight loss shall be less than 4.0 g/m². One tensile test, one corrosion test shall be carried out for each lot as defined in the standard for mechanical tests. 						
Repair of Defects	Weld repair is not permitte	Weld repair is not permitted.						
Sour Service (additional		ements are specified by the p 6 /NACE MR0175 or ISO 179						
metallurgical, manufacturing, testing and certification	<u>Hardness testing</u> Production hardness testir	<u>Hardness testing</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A269.						
requirements) ^a	The material shall be trace	eable in accordance with ISO	15156-3 /NACE MR0175-3	section 7.2 and this MDS.				
Surface Treatment and Finish	Finished product shall be v	white pickled or bright anneal	ed.					
Marking	The tubes shall be marked	to ensure full traceability to	heat and heat treatment lot.					



Material Data Sheet		MDS No. IR11	MDS No. IR118 / IR118S ^a					
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo								
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT				
Tubes	ASTM A269	UNS S31254						
	ASTM A269	UNS N08367						
	ASTM A269	UNS N08926						
		Page 2 of 2						
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 in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.							
	The inspection docume	ents shall include the follow	ing information:					
	- MPS identification or	- MPS identification or MCPR/QTR number used;						
	- Steel manufacturer;							
	- Solution annealing ter	mperature, holding time an	d quench medium 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.								



MDS No. IR119 / IR119S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel. Type 6Mo PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT **HIP Products** ASTM A988 UNS S31254 **ASTM A988 S5** ASTM A988 UNS N08367 **ASTM A988 S5** Page 1 of 2 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 (8 in). For thickness exceeding 200 mm (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. Gas atomized powder made from AOD-refined metal. Powder blends shall be a homogenous mixture of Manufacturing powder heats in terms of composition, particle size and other properties. Chemical $PRFN \ge 40.0$ Composition Heat Treatment HIP product shall be solution annealed followed by water/liquid guenching. Products shall be placed in such a way as to ensure free circulation of heating and cooling media around each fitting during the heat treatment process including quenching. Corrosion test according to ASTM G48 Method A is required. Test temperature shall be 50 °C (122 °F) and the Corrosion testina exposure time 24 h. The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. Cut edges shall be prepared according to ASTM G48. The complete specimen shall be pickled before being weighed and tested. Pickling may be performed for 5 min at 60 °C (140 °F) in a solution of 20 % HNO₃ + 5 % HF. The acceptance criteria are: No pitting at 20x magnification; - The weight loss shall be less than 4.0 g/m². Extent of Testing One tensile and corrosion test shall be carried out for each lot as defined below. A lot shall consist of finished parts with the same dimensions made from the same powder blend consolidated in the same hot isostatic press using the same parameters and heat-treated in the same final heat-treatment load. Non-Destructive Visual inspection Testing VT shall be carried out on each item in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing ASTM A988 supplementary requirement S5 shall apply as amended by this MDS: **NDE Requirement** HIP product ^a Frequency ^b 10 % Method ASME BPVC Sec. V, Article 6 Extent ° 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing. Parts of size DN > 50 (NPS > 2). For random examination (10%), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined. Repair of Defects Weld repair is not permitted.



SUPPLEMENTARY

ACCEPTANCE CLASS

Rev. 01

MDS No. IR119 / IR119S^a **Material Data Sheet** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo PRODUCT FORM STANDARD GRADE

PRODUCTFORM	STANDARD	GRADE	ACCEPTANCE CLASS	REQUIREMENT				
HIP Products	ASTM A988	UNS S31254		ASTM A988 S5				
	ASTM A988	UNS N08367		ASTM A988 S5				
		Page 2 of 2						
Sour Service (additional metallurgical, manufacturing,			the purchaser, the material shall CE MR0103, and the following add					
testing and	Hardness testing							
certification requirements)	two parts per lot. Wh	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two parts per lot. When only one part is produced, it shall be hardness tested as required. The maximum hardness shall be 35HRC 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 components shall be pickled. Machined surfaces do not require pickling.							
Marking	The powder blend shall have a unique identity marked on the powder container and this identity shall be recorded and maintained throughout production of the product. The components 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 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 MCPR/QTR number used; 							
	- Manufacturer of the starting material (powder) for the finished product;							
	- Solution annealing	- Solution annealing temperature, holding time and quench medium shall be stated.						
	ry suffix "S" shall be used quirements for sour serv		vered in accordance with the MDS	S plus the additional				



MDS No. IS101 / IS101S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316 STANDARD GRADE SUPPLEMENTARY PRODUCT FORM ACCEPTANCE CLASS REQUIREMENT Seamless pipes **TP316** ASTM A312 Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. Chemical The chemical composition shall comply with UNS S31603 (dual certified 316/316L). Composition Repair of Defects Weld repair is not permitted. Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the requirements (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, testing and Hardness testing certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements)^a one length of pipe per lot. The maximum hardness shall be 22HRC 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 Finished pipes shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The pipes 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 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 conditions; - The inspection documents shall confirm compliance to both UNS S31603 and S31600. 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.



Material Data	Sheet	MDS No. IS10	2 / IS102S ^a	Rev. 0				
TYPE OF MATERIAL:	Austenitic Stainless Steel,	Туре 316						
PRODUCT FORM	STANDARD	SUPPLEMENTARY REQUIREMENT						
Welded pipes	ASTM A312	TP316						
	ASTM A358	316	Class 1, 3, 4 or 5					
		Page 1 of 1		1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.							
Chemical Composition	The chemical composition shall comply with UNS S31603 (dual certified 316/316L).							
Repair of Defects	Weld repair of base materi	al is not permitted.						
	For repair of welds, the requirements for production welding above shall apply to the repair WPS. Repair y shall be heat treated as per original production weld.							
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:							
manufacturing, testing and	Hardness testing							
certification requirements)ª	 Welding procedure qualification testing for manufacturing and any repair welding shall meet the requirements of NACE MR0175-2 /ISO 15156-3 section 6.2.2, with a maximum hardness of 70.8HR 15N or 250HV. 							
	 Production hardness testing shall be performed on one length of pipe per lot. The maximum hardness of the base material, HAZ and weld metal shall be 22HRC from three readings taken in close proximity at each location. 							
	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 pipes shall be pickled or bright annealed. Machined surfaces do not require pickling.							
Marking	The pipes 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 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							
	 The inspection documer 	nts shall confirm complia	ince to both UNS S31603 and S3	31600.				



Rev. 01

TYPE OF MATERIAL: Austenitic Stainless Steel. Type 316 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Wrought fittings ASTM A403 WP316 W or S or WX Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. The chemical composition shall comply with UNS S31603 (dual certified 316/316L). Chemical Composition During heat treatment fittings shall be placed in such a way as to ensure free circulation around each fittings Heat Treatment during the heat treatment process including possible quenching operation. Ultrasonic testing is not acceptable as replacement for radiography. Non-Destructive Testing Weld repair of base material is not acceptable. Repair of Defects For repair of welds, the requirements for production welding above shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld. When sour service requirements are specified by the purchaser, the material shall conform to the Sour Service (additional requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS: metallurgical. manufacturing, Hardness testing testing and certification - Seamless fittings: requirements)^a • Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one fitting per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity. Welded fittings · Welding procedure gualification testing for manufacturing and any repair welding shall meet the requirements of NACE MR0175-3 /ISO 15156-3 section 6.2.2 with a maximum hardness of 70.8HR 15N or 250HV. • Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one fitting per lot. The maximum hardness of the base material, HAZ and weld metal shall be 22HRC from three readings taken in close proximity at each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. Surface Treatment Finished fittings shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The fittings 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 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 conditions;

MDS No. IS103 / IS103S^a

The supplementary suffix "S" shall be used to designate a material delivered in accordance with the MDS plus the additional

- The inspection documents shall confirm compliance to both UNS S31603 and S31600.

supplementary requirements for sour service.



MDS No. IS104 / IS104S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316 STANDARD PRODUCT FORM GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT ASTM A182 F316 Forgings Page 1 of 1 Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. Chemical The chemical composition shall comply with F316L (dual certified F316/F316L). Composition Heat Treatment Forgings shall be supplied in the solution annealed conditions. Forgings shall be placed in such a way as to ensure free circulation around each forging during the heat treatment process including possible quenching operation. Non-Destructive Visual Inspection Testing VT shall be carried out on each forging or bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Valve forgings NDT Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Weld repair is not permitted. Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the (additional requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional metallurgical, requirements to the MDS: manufacturing, testing and Hardness testing certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements)^a one forging per lot. The maximum hardness shall be 22HRC 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 Finished forgings shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The forgings 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 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 conditions; - The inspection documents shall confirm compliance to both F316 and F316L. 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.



TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316									
PRODUCT FORM	STANDARD GRADE ACCEPTANCE CLASS SUPPLEMEN REQUIREMENT								
Plates, sheets, strips	ASTM A240	316							
		Page 1 of 1							
Scope	This MDS defines applicat specification.	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.							
Chemical Composition	The chemical composition	The chemical composition shall comply with UNS S31603 (dual certified 316/316L).							
Non-Destructive	Visual Inspection								
Testing	VT shall be carried out on each plate 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.								
	Valve plates NDT								
	Inspection of plates for valve parts shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.								
Repair of Defects	Weld repair is not permitted.								
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:								
manufacturing, testing and	Hardness testing								
certification requirements) ^a	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one plate per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity.								
	The material shall be trace	able in accordance with ISO	15156- 3/NACE MR0175-3	section 7.2 and this MDS.					
Surface Treatment and Finish	According to the requireme	According to the requirements in ASTM A480.							
Marking	The plates, sheets and stri	The plates, sheets and strips shall be marked to ensure full traceability to heat and heat treatment lot.							
Certification	The material manufacturer requirements standard acc		certified in accordance with I	SO 9001 or another qualit					
	The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1.								
	The inspection documents information:	The inspection documents shall confirm compliance with this specification and shall include the following information:							
	- Heat treatment condition	ns;							
	- The inspection docume	nts shall confirm compliance	to both UNS S31603 and S3	1600.					



Material Data	Sheet		MDS No. IS106 / I	51068	5	Rev. (
TYPE OF MATERIAL	: Austenitic Stainles	ss Steel,	Туре 316								
PRODUCT FORM	STANDARD		GRADE	TANCE CLASS	SUPPLEMENTARY REQUIREMENT						
Castings	ASTM A351		CF8M			ASTM A351 S5, S6, ASTM A703 S20					
	ASTM A351		CF3M			ASTM A351 S5, S6, ASTM A703 S20					
			Page 1 of 3			•					
Scope	This MDS defines specification.	applicat	le options and/or requirements	s that su	pplement or amen	d the referenced standard					
Extent of Testing	Tensile testing is	required	for each heat and heat treatme	ent lot in	cluding any PWHT						
Test Sampling	casting and shall During any PWH	accompa	ight of 250 kg (551 lb) or more, the test blocks shall be integrally cast or gated onto t mpany the castings through all heat treatment operations. test block shall be tack welded onto the casting.								
Testing	Visual inspection										
	NDE requirem	ent	Pilot casting (section 4.		oduction casting						
	Frequency		Each pilot casting		Each p	production casting					
	Method			ANSI/I	MSS SP-55						
	Extent		100 % of all acce	essible su	urfaces including w	velding ends					
	Acceptance crite	eria		MS	S SP-55						
	NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing.										
	NDE Requirement		y requirement S6 shall apply a Pilot casting (section 4.8)	as amen		ction casting ^a					
	Frequency ^b		100 %			100 %					
	Method		ASME BPVC Sec. V, Article 6		ASME BPVC Sec. V, Article 6						
	Extent ^c		100 %		100 %						
	Acceptance	ASME	BPVC Sec. VIII, Div. 1, Appen	ASME BPVC Se	c. VIII, Div. 1, Appendix						
	criteria				 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. ^a Production valve castings, PT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. ^b Frequency of inspection 100 % means that each item shall be examined. 						
	criteria NOTE The tes cleaned ^a Production specified by	d prior to valve cas the purc	the testing. tings, PT shall be according to haser, the requirements in this	the app table sh	licable valve speci nall apply.						



Material Data	Sneel		160	10. IC	6106 <i>1</i>	-1510	00			Rev.	
TYPE OF MATERIAL	: Austenitic Stainless	s Steel, Typ	316								
PRODUCT FORM	STANDARD	GF	ADE			ACC	EPTANC	CE CLAS		PPLEMENTARY QUIREMENT	
Castings	ASTM A351	CF	CF8M							M A351 S5, S6, M A703 S20	
	ASTM A351	CF	BM							M A351 S5, S6, M A703 S20	
	-		Р	age 2 c	of 3						
	Radiographic testir	-									
	ASTM A351 supple	-	uireme	nt S5 s	hall app	y as an		-			
	NDE requirement	Pilot casting	_					ion cast	ing		
		(section 4				Valve	castings	a		Other pressure containing castings ^b	
	Frequency ^c	100 %		NPS	DN		Pressu	ire class		100 %	
						≤ 300	600	900	≥ 1500		
				< 2	< 50	N/R	N/R	N/R	N/R		
				≥2	≥ 50	N/R	5 %	5 %	5 %		
				≥6	≥ 150	N/R	5%	5%	100 %		
				≥ 10	≥ 250	5%	5%	5%	100 %		
				≥ 16	≥ 400 ≥ 500	5 % 5 %	5 % 100 %	100 %	100 %		
				≥ 20				100 %	100 %		
	Method	A					C Sec. V,			unt 400 of d	
	Extent	changes ir			at the ju				at abrupt feeders to	rs to	
	Acceptance criteria			AS	ME BP	/C Sec.	VIII, Div	. 1, Appe	ndix 7		
	 ^a Production va specified by th ^b Production ca ^c Frequency of (5 %) is specified examined. ^d Production ca 	ne purchaser sting other th inspection 10 fied, a minim sting other th order and/or	RT shal the re an valv 00 % m um of c an valv applica	I be acc quireme ve casti leans th one item ve casti able pro	cording t ents in th ng. at each n per lot ng, insp duct spe	o the ap his table item sh of each ection s ecificatio	pplicable shall ap all be exa pattern i hall inclu	valve spo ply. amined. \ n any pu de other	ecification. When rand rchase ord critical are	If a QSL is not om examination ler shall be as as defined in the areas to be	
Repair of Defects	Repairs as described in A351 section 10.2 shall be considered major. All major repairs shall be documented in accordance with A703 S20.2.										
	, ,	The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS: - Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production:									
	 Testing methodo the parent mater 		ceptano	ce criter	ia shall	be in ac	cordance	e with the	e requireme	ents of this MDS fo	
	Weld repairs are no	•		-		• •		-			
	Solution annealing			•		•					
	If a minor cosmetic omitted provided th condition.										



Material Data Sheet		MDS No. IS	Rev. 01						
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316									
PRODUCT FORM	STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT REQUIREMENT REQUIREMENT REQUIREMENT								
Castings	ASTM A351	CF8M		ASTM A351 S5, S6, ASTM A703 S20					
	ASTM A351	CF3M		ASTM A351 S5, S6, ASTM A703 S20					
		Page 3 of	3						
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and this MDS:								
manufacturing, testing and certification requirements) ^a	 <u>Hardness testing</u> 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 on shall meet the requirements of NACE MR0175-2 /ISO 15156-3 section 6.2.6 with a maximum hardness of 70.8HR 15N or 250HV. 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 castings shall be pickled. Machined surfaces do not require pickling.								
Marking	The castings shall be m	arked to ensure full trac	eability to heat and heat treatment le	ot.					
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another qua requirements standard accepted by the purchaser.								
	The inspection documer compliance with this spe		ce with ISO 10474 /EN 10204 Type	3.1 and shall confirm					
	The inspection documer	nts shall include the follo	owing information:						
	- Heat treatment condit	tions.							
	/ suffix "S" shall be used to uirements for sour service.		elivered in accordance with the MDS	plus the additional					


MDS No. IS107 / IS107S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Bars ASTM A276 316 ASTM A479 316 Page 1 of 2 Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 in). Manufacturing NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted. Chemical The chemical composition shall comply with UNS S31603 (dual certified 316/316L). Composition Heat Treatment Bars shall be supplied in the solution annealing conditions. Bars shall be placed in such a way as to ensure free circulation around each component during the heat treatment process including possible quenching operation. **Tensile Testing** 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 mid-length of axial (longitudinal) and tangential (transverse) tensile specimens shall be located at a Test Sampling distance equal to the bar outside diameter or minimum of 100 mm (4 in), whichever is the greater, from the end of the bar. The centreline of tensile specimen shall be located at a distance from the bar surface in accordance with ASTM A370 Annex A. Valve parts manufactured from bar For bars with outside diameter ≥ 100 mm intended for machining of valve parts, tensile testing shall be taken in both the longitudinal and transverse direction. Non-Destructive Visual Inspection Testing 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. NDT valve parts manufactured from bar Inspection of valve parts manufactured from bar shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Weld repair is not permitted. When sour service requirements are specified by the purchaser, the material shall conform to the requirements Sour Service (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical. MDS: manufacturing, testing and Hardness testing certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements) the end surface of one bar per lot. The maximum hardness shall be 22HRC 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 Finished bars shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The bars shall be marked to ensure full traceability to heat and heat treatment lot.



Material Data	Sheet	MDS No. IS	107 / IS107S ^a	Rev. 01			
TYPE OF MATERIAL	: Austenitic Stainless	Steel, Type 316					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bars	ASTM A276	316					
	ASTM A479	316					
		Page 2 of 2	2				
Certification		cturer shall have a quality s rd accepted by the purchase	ystem certified in accordance with IS er.	SO 9001 or another quality			
	The inspection documents shall be 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 co 	nditions;					
	- The inspection do	cuments shall confirm comp	liance to both UNS S31603 and S3 ⁻	1600.			
	ry suffix "S" shall be use quirements for sour serv		livered in accordance with the MDS	plus the additional			



MDS No. IS108 / IS108S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316 GRADE PRODUCT FORM STANDARD ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Tubes ASTM A269 316 Page 1 of 1 Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. The chemical composition shall comply with UNS S31603 (dual certified 316/316L). Chemical Composition Tensile Testing The following acceptance criteria shall apply: $R_{p_{0.2}} \ge 207$ MPa (30 ksi); $R_m \ge 517$ MPa (75 ksi); $A \ge 35$ % Extent of Testing Tensile testing shall be carried out for each lot as defined in the standard for mechanical tests. Non-Destructive Welded tubes: non-destructive electric testing is required. Testing Repair of Defects Weld repair of base material is not permitted. For repair of welds, the requirements for production welding above shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld When sour service requirements are specified by the purchaser, the material shall conform to the requirements Sour Service (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, Hardness testing testing and certification Production hardness testing shall be performed in accordance with the requirements in ASTM A269. requirements)^a The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. Surface Treatment Finished tubes shall be pickled or bright annealed. and Finish Marking The tubes 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 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 conditions; The inspection documents shall confirm compliance to both UNS S31603 and S31600. 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.



MDS No. IS221 / IS221S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 304 STANDARD GRADE SUPPLEMENTARY PRODUCT FORM ACCEPTANCE CLASS REQUIREMENT Seamless pipes **TP304** ASTM A312 Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. Chemical The chemical composition shall comply with UNS S30403 (dual certified 304/304L). Composition Repair of Defects Weld repair is not permitted. Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the requirements (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, testing and Hardness testing certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements)^a one length of pipe per lot. The maximum hardness shall be 22HRC 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 Finished pipes shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The pipes 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 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 conditions; - The inspection documents shall confirm compliance to both UNS S30403 and S30400. 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.



MDS No. IS222 / IS222S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 304 STANDARD GRADE PRODUCT FORM ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Welded pipes **TP304** ASTM A312 ASTM A358 304 Class 1, 3, 4 or 5 Page 1 of 1 Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. Chemical The chemical composition shall comply with UNS S30403 (dual certified 304/304L). Composition **Repair of Defects** Weld repair of base material is not permitted. For repair of welds, the requirements for production welding above shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld. Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the requirements (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, testing and Hardness testing certification Welding procedure qualification testing for manufacturing and any repair welding shall meet the _ requirements)^a requirements of NACE MR0175-2 /ISO 15156-3 section 6.2.2, with a maximum hardness of 70.8HR 15N or 250HV. Production hardness testing shall be performed on one length of pipe per lot. The maximum hardness of the base material, HAZ and weld metal shall be 22HRC from three readings taken in close proximity at each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. Surface Treatment Finished pipes shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The pipes 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 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 conditions; The inspection documents shall confirm compliance to both UNS S30403 and S30400. 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.



MDS No. IS223 / IS223S^a

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Wrought fittings	ASTM A403	WP304	W or S or WX			
		Page 1 of	1			
Scope	This MDS defines applicat specification.	ble options and/or rec	uirements that supplement or am	end the referenced standard		
Chemical Composition	The chemical composition	shall comply with UN	IS S30403 (dual certified 304/304	L).		
Heat Treatment			such a way as to ensure free circles such a way as to ensure free circles suble quenching operation.	ulation around each fitting		
Non-Destructive Testing	Ultrasonic testing is not ac	ceptable as replacen	nent for radiography.			
Repair of Defects	Weld repair of base mater For repair of welds, the rea shall be heat treated as pe	quirements for produ	ction welding above shall apply to weld.	the repair WPS. Repair weld		
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 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS: <u>Hardness testing</u> Seamless fittings: Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 or fitting per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity. Welded fittings: Welding procedure qualification testing for manufacturing and any repair welding shall meet the requirements of NACE MR0175-3 /ISO 15156-3 section 6.2.2 with a maximum hardness of 70.8HR or 250HV. Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 or fitting per lot. The maximum hardness of the base material, HAZ and weld metal shall be 22HRC from three readings taken in close proximity at each location. 					
Surface Treatment and Finish	Finished fittings shall be pickled or bright annealed. Machined surfaces do not require pickling.					
Marking	The fittings 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 requirements standard accepted by the purchaser. The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and s compliance with this specification. The inspection documents shall include the following information: Heat treatment conditions;						
			pliance to both UNS S30403 and	S30400.		
^a The supplementar	y suffix "S" shall be used to de	osignata a material d		DS plue the additional		



MDS No. IS224 / IS224S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 304 STANDARD PRODUCT FORM GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT ASTM A182 F304 Forgings Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. The chemical composition shall comply with F304L (dual certified F304/F304L). Chemical Composition Heat Treatment Forgings shall be supplied in the solution annealed conditions. Forgings shall be placed in such a way as to ensure free circulation around each component during the heat treatment process including possible quenching operation. Non-Destructive Visual Inspection Testing VT shall be carried out on each forging or bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Valve forgings NDT Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Weld repair is not permitted. **Repair of Defects** When sour service requirements are specified by the purchaser, the material shall conform to the Sour Service requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional (additional requirements to the MDS: metallurgical, manufacturing, Hardness testing testing and certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements)^a one forging per lot. The maximum hardness shall be 22HRC 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 Finished forgings shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The forgings 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 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 conditions; - The inspection documents shall confirm compliance to both F304 and F304L. 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.



MDS No. IS225 / IS225S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 304 STANDARD GRADE PRODUCT FORM ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Plates, sheets, ASTM A240 304 strips Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope specification. Chemical The chemical composition shall comply with UNS S30403 (dual certified 304/304L). Composition Non-Destructive Visual Inspection Testing VT shall be carried out on each plate 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. Valve plate NDT Inspection of plates for valve parts shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. **Repair of Defects** Weld repair is not permitted. Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the requirements (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, testing and Hardness testing certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements)^a one plate per lot. The maximum hardness shall be 22HRC 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 According to the requirements in ASTM A480. and Finish Marking The plates, sheets and strips 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 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 conditions; - The inspection documents shall confirm compliance to both UNS S30403 and S30400. 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.



Material Data	Sneet	MDS No. IS2	26/15226	5	Rev. 0 [°]			
TYPE OF MATERIAL	: Austenitic Stainless	Steel, Type 304						
PRODUCT FORM	STANDARD	GRADE	GRADE ACCEPTANCE CLASS SUPPLEMENTA REQUIREMENT					
Castings	ASTM A351	CF8			ASTM A351 S5, S6, ASTM A703 S20			
	ASTM A351	CF3			ASTM A351 S5, S6, ASTM A703 S20			
		Page 1 of 3	3					
Scope	This MDS defines a specification.	pplicable options and/or req	uirements that su	upplement or amen	d the referenced standard			
Extent of Testing	Tensile testing is re	quired for each heat and hea	at treatment lot ir	cluding any PWHT				
Test Sampling	casting and shall ac	weight of 250 kg (551 lb) or i company the castings through	gh all heat treatm	nent operations.	ally cast or gated onto the			
		he test block shall be tack w		asung.				
Non-Destructive Testing	Visual inspection							
5	NDE requiremen	9.			oduction casting			
	Frequency	Each pilot c	Each pilot casting ANSI/M		production casting			
	Method	100 % a	volding ondo					
	Extent 100 % of all accessible surfaces including welding ends Acceptance criteria MSS SP-55							
	NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing.							
	Liquid penetrant testing							
	ASTM A351 Supple	mentary requirement S6 sha	all apply as amer	nded by this MDS:				
	NDE Requirement	Pilot casting (secti	on 4.8)	Produ	ction casting ^a			
	Frequency ^b	100 %			100 %			
	Method	ASME BPVC Sec. V,	Article 6	ASME BP	VC Sec. V, Article 6			
	Extent ^c	100 %			100 %			
	Acceptance criteria	ASME BPVC Sec. VIII, Div.	ASME BPVC Sec. VIII, Div. 1, Appendix 7 ASME BPVC Sec. VIII					
	NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing.							
	 ^a Production valve castings, PT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. ^b Frequency of inspection 100 % means that each item shall be examined. ^c All accessible internal and external surfaces shall be examined. 							



Material Data	Sheet	MDS N						Rev. 0	
TYPE OF MATERIAL	: Austenitic Stainless St	teel, Type 304							
PRODUCT FORM	STANDARD	GRADE		A	CCEPT	ANCE C	LASS		EMENTARY PEMENT
Castings	ASTM A351	ASTM A351 CF8 ASTM A3 ASTM A351					351 S5, S6, 703 S20		
	ASTM A351	CF3						ASTM A ASTM A	351 S5, S6, 703 S20
		Pa	ige 2 of 3						
	Radiographic testing ASTM A351 suppleme	entary requiremen	it S5 shall a	apply as	amende	ed by this	s MDS:		
	NDE requirement	Pilot			Pro	oductior	n casting	I	
		casting (section 4.8)			Valve c	astings	a		Other pressure containing castings ^b
	Frequency ^c	100 %	NPS	DN		Pressu	ire class		100 %
					≤ 300	600	900	≥ 1500	
			< 2	< 50	N/R	N/R	N/R	N/R	
			≥ 2	≥ 50	N/R	5 %	5 %	5 %	
			≥ 6	≥ 150	N/R	5%	5%	100 %	
			≥ 10 ≥ 16	≥ 250 ≥ 400	5 % 5 %	5 % 5 %	5 % 100 %	100 % 100 %	
			≥ 20	≥ 500	5%	100 %	100 %	100 %	
	Method			ASME E	BPVC S	ec. V, Ar	ticle 2	11	
	Extent		defined by ASME B16.34 for special class valves, at abrupt in sections and at the junctions of risers, gates or feeders to the casting					100 % ^d	
	Acceptance criteria		ASME BPVC Sec. VIII, Div. 1, Appendix 7						
	 NOTE N/R means r ^a Production valve specified by the p ^b Production castin ^c Frequency of insp (5 %) is specified examined. ^d Production castin the purchase ordutested shall be estimated. 	casting, RT shall purchaser, the req g other than valve pection 100 % me , a minimum of or g other than valve er and/or applicat	be accordi juirements e casting. eans that ea he item per e casting, in ble product	ng to the in this ta ach item lot of ea nspectio specific	e applica able shal shall be ach patte n shall in ation or	able valve II apply. e examin ern in an nclude o	e specific ed. Wher y purchas ther critic	n random e se order sh al areas a:	examination nall be s defined in
Repair of Defects	 Repairs as described i accordance with A703 The repair welding proc - welding procedure s production; testing methodology the parent material. Weld repairs are not a Solution annealing hea If a minor cosmetic rep omitted provided the w condition. 	S20.2. becedure shall be q shall be qualified of y and acceptance acceptable for cas at treatment is rec pair is required to	ualified in a on casting criteria sha tings that le quired after a semi-fini	accordan or plate all be in eak durir all majo shed or	nce with of the sa accorda ng press or weld re finished	ASTM A ame cast ince with ure testil epairs. cast con	A488 or IS t material the requ ng. nponent,	SO 11970 grade as irements c heat treatr	and this MDS used in f this MDS for nent may be



Material Data	Sheet	MDS No. IS2	26 / IS226S ^a	Rev. 01		
TYPE OF MATERIAL	: Austenitic Stainless Ste	eel, Type 304				
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Castings	ASTM A351	CF8		ASTM A351 S5, S6, ASTM A703 S20		
	ASTM A351	CF3		ASTM A351 S5, S6, ASTM A703 S20		
		Page 3 of 3	}			
Sour Service (additional metallurgical,			y the purchaser, the material shall on CE MR0103, and the following add			
manufacturing, testing and	Hardness testing					
certification requirements) ^ª	 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 on shall meet the requirements of NACE MR0175-2 /ISO 15156-3, 6.2.6 with a maximum hardness of 70.8HR 15N or 250HV. 					
	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 castings shall be pickled. Machined surfaces do not require pickling.					
Marking	The castings 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 qualit requirements standard accepted by the purchaser.					
	The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.					
	The inspection docume	ents shall include the follo	wing information:			
	 Heat treatment cond 	itions.				
	y suffix "S" shall be used to use to use to use to use to use to use the use the use to use the uset		livered in accordance with the MDS	S plus the additional		



Material Data	SheetMDS No. IS227 / IS227S aRev. 0						
TYPE OF MATERIAL	: Austenitic Stainless Steel, 1	Гуре 304					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bars	ASTM A276	304					
	ASTM A479	304					
		Page 1 of 2					
Scope	This MDS defines applicable specification.	e options and/or requirements	s that supplement or amend	the referenced standard			
Manufacturing	Bars shall be hot or cold finis	shed cylindrical shaped with	maximum diameter of 300 n	nm (12 in).			
		be restricted to turning, grind ning is not permitted.	ing or polishing (singly or in	combination); cold			
Chemical Composition	The chemical composition s	hall comply with UNS S3040	3 (dual certified 304/304L).				
Heat Treatment	Bars shall be supplied in the	solution annealing condition	S.				
	Bars shall be placed in such process including possible q	a way as to ensure free circl uenching operation.	ulation around each bar dur	ing the heat treatment			
Tensile Testing		n directions is required by this standard specification in both		meet the specified			
Test Sampling	The mid-length of axial (longitudinal) and tangential (transverse) tensile specimens shall be located at a distance equal to the bar outside diameter or minimum of 100 mm (4 in), whichever is the greater, from the end of the bar.						
	The centreline of tensile specimen shall be located at a distance from the bar surface in accordance with ASTM A370 Annex A.						
	Valve parts manufactured from bar						
	For bars with outside diamet taken in both the longitudina	ter ≥ 100 mm (4 in) intended Il and transverse direction.	for machining of valve parts	s, tensile testing shall be			
Non-Destructive	Visual Inspection						
Testing		ach bar in accordance with the, and non-machined surface					
	NDT valve parts manufactured from bar						
		nufactured from bar shall be burchaser, the requirements i		valve specification. If a			
Repair of Defects	Weld repair is not permitted.						
Sour Service (additional metallurgical, monufacturing	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
manufacturing, testing and	Hardness testing						
certification requirements) ^ª	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 22HRC 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 bars shall be pickle	ed or bright annealed. Machin	ed surfaces do not require	pickling.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.						



Material Data	Sheet	MDS No. IS:	227 / IS227S ^a	Rev. 01			
TYPE OF MATERIAL	: Austenitic Stainless	Steel, Type 304					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bars	ASTM A276	304					
	ASTM A479	304					
		Page 2 of 2					
Certification		cturer shall have a quality s rd accepted by the purchase	ystem certified in accordance with IS er.	SO 9001 or another quality			
	The inspection documents shall be in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.						
	The inspection docu	wing information:					
	 Heat treatment co 	nditions;					
	- The inspection do	cuments shall confirm comp	liance to both UNS S30403 and S30	0400.			
	y suffix "S" shall be use quirements for sour serv		livered in accordance with the MDS	plus the additional			



MDS No. IS228 / IS228S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Austenitic Stainless Steel, Type 304 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Tubes ASTM A269 304 Page 1 of 1 Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. The chemical composition shall comply with UNS S30403 (dual certified 304/304L). Chemical Composition Tensile Testing The following acceptance criteria shall apply: $R_{p_{0,2}} \ge 207 \text{ MPa}$ (30 ksi); $R_m \ge 517 \text{ MPa}$ (75 ksi); $A \ge 35 \%$ Extent of Testing Tensile testing shall be carried out for each lot as defined in the standard for mechanical tests. Non-Destructive Welded tubes: non-destructive electric testing is required. Testing Repair of Defects Weld repair of base material is not permitted. For repair of welds, the requirements for production welding above shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld. When sour service requirements are specified by the purchaser, the material shall conform to the requirements Sour Service (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, Hardness testing testing and certification Production hardness testing shall be performed in accordance with the requirements in ASTM A269. requirements)^a The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. Surface Treatment Finished tubes shall be pickled or bright annealed. Machined surfaces do not require pickling. and Finish Marking The tubes 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 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 conditions; - The inspection documents shall confirm compliance to both UNS S30403 and S30400. 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.



MDS No. IT101 / IT101S^a

Rev. 01

TYPE OF MATERIAL: Titanium Grade 2 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Seamless pipes ASTM B861 2 (UNS R50400) Page 1 of 1 This MDS defines applicable options and/or requirements that supplement or amend the referenced standard Scope 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. **Repair of Defects** Repair welding is not permitted. Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the requirements (additional of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the metallurgical, MDS: manufacturing, Hardness testing testing and certification Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on requirements)^a one length of pipe per lot. The maximum hardness shall be 100HRB from three readings taken in close proximity at each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. 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: - MPS identification or MCPR/QTR number used. 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.



MDS No. IT102 / IT102S^a

Rev. 01

TYPE OF MATERIAL: Titanium Grade 2

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Welded pipes	ASTM B862	2 (UNS R50400)		ASTM B862 S1.1			
		Page 1 of 1					
Scope	This MDS defines applica specification.	ble options and/or requir	ements that supplement or amen	d the referenced standard			
Qualification	Manufacturers and the ma M-650. The qualification to		II be qualified in accordance with uirements of this MDS.	ISO 17782 or NORSOK			
Welding	Welding procedures shall	be qualified in accordance	ce with ASME BPVC Sec. IX or IS	SO 15614-5.			
Non-Destructive Testing	Method and acceptance of B862 supplementary requ		ng shall be to ASME BPVC Sec.	VIII, Div. 1, Appendix 8.			
Repair of Defects	Repair welding of base material is not permitted. For repair of welds, the requirements for production welding shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld (if applicable).						
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirement of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
manufacturing, testing and	Hardness testing						
certification requirements) ^ª	 Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one length of pipe per lot. The maximum hardness of the base material, HAZ and weld metal shall be 100HRB from three readings taken in close proximity at each location. 						
	 Welding procedure qualification testing for manufacturing and any repair welding shall meet the requirements of NACE MR0175-3 /ISO 15156-3 section 6.2.2, with a maximum hardness of 70.8HR 15N of 250HV. 						
	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS						
Certification	The material manufacture requirements standard ac		tem certified in accordance with	SO 9001 or another qualit			
	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:							
	MDC identification on M	CPR/QTR number used					



MDS No. IT103 / IT103S^a

Rev. 01

TYPE OF MATERIAL: Titanium Grade 2 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Wrought fittings WPT2 / WPT2W (UNS ASTM B363 S1 ASTM B363 R50400) Page 1 of 2 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 Annealed condition unless the tensile properties in the referenced standard can be achieved in the as formed condition. Extent of Testing Tensile test specimens shall be taken from each heat and heat treatment lot, for each type and size. Non-Destructive Liquid penetrant testing Testing ASTM B363 Supplementary requirement S1 shall apply as amended by this MDS: **NDE Requirement Nominal Thickness** Welded fittings ^a Seamless fittings 100 % Frequency ^b 10 % Method ASME BPVC Sec. V, Article 6 Extent ° 100 % ASME BPVC Sec. VIII, Div. 1, Appendix 8 Acceptance criteria The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be NOTE cleaned prior to the testing. Welded fittings of size DN > 50 (NPS > 2). Frequency of inspection 100 % means that each item shall be examined. When random examination (10%) is specified, a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined. Repair welding of base material is not permitted. Repair of Defects For repair of welds, the requirements for production welding shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld (if applicable) Sour Service When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the (additional metallurgical, MDS: manufacturing, testing and Hardness testing certification Seamless fittings: requirements)^a · Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one fitting per lot. The maximum hardness shall be 100HRB from three readings taken in close proximity. Welded fittings: · Welding procedure qualification testing for manufacturing and any repair welding shall meet the requirements of NACE MR0175-3 /ISO 15156-3 section 6.2.2 with a maximum hardness of 70.8HR 15N or 250HV. Production testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one fitting per lot. The maximum hardness of the base material, HAZ and weld metal shall be 100HRB from three readings taken in close proximity at each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.



MDS No. IT103 / IT103S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Titanium Grade 2 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT WPT2 / WPT2W (UNS ASTM B363 S1 Wrought fittings ASTM B363 R50400) Page 2 of 2 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: - MPS identification or MCPR/QTR number used. а 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.



MDS No. IT104 / IT104S^a

Rev. 01

TYPE OF MATERIAL: Titanium Grade 2

requirements) one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this N Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another 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.	PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Scope This MDS defines applicable options and/or requirements that supplement or amend the referenced star specification. Qualification Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORS M-850. The qualification testing shall meet the requirements of this MDS. Extent of Testing Tensile test specimens shall be taken from each heat and heat treatment lot, with a maximum deviation the test block thickness of ±10mm (±0.4 in). Non-Destructive Visual Inspection VT shall be carried out on each forging in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Iguid penetrant testing NDE Requirement Forgings Frequency ° 10 % Method ASME BPVC Sec. V, Article 6 Extent * 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE To readom aximitation (10 %), a minimum of one item per lot in any purchase order shall be examined. * Parts of size DN > 50 (NPS > 2). * For grings inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair welding is not permitted.	Forgings	ASTM B381	F2 (UNS R50400)					
specification. Qualification Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORS Me50. The qualification testing shall meet the requirements of this MDS. Extent of Testing Tensile test specimens shall be taken from each heat and heat treatment lot, with a maximum deviation the test block thickness of ±10mm (±0.4 in). Non-Destructive Testing <u>Visual Inspection</u> VT shall be carried out on each forging in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing NDE Requirement Forgings Frequency ^b 10 % Method ASME BPVC Sec. V, Article 6 Extent ⁶ 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. * Parts of size DN > 50 (NPS > 2). * For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as adefined for mechanical. Zave forgings inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair of Defects Repair we			Page 1 of 1					
M-650. The qualification testing shall meet the requirements of this MDS. Extent of Testing Tensile test specimens shall be taken from each heat and heat treatment lot, with a maximum deviation the test block thickness of ±10mm (±0.4 in). Non-Destructive Testing Visual Inspection VT shall be carried out on each forging in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing NDE Requirement Forgings Prequency b 10 % Method ASME BPVC Sec. V, Article 6 Extent ^c 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be adefined for mechanical testing. ^a Parts of size DN > 50 (NPS > 2). ^b For random examination (10 %), an inimum of one item per lot in any purchase order shall be examined. Valve forgings NDT Valve forgings INDT Valve forgings NDT Valve forgings NDT Valve forgings NDT Valve forgings Inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair of Defects	Scope		ble options and/or require	ements that supplement or amen	d the referenced standard			
the test block thickness of ±10mm (±0.4 in). Non-Destructive Testing Visual Inspection VT shall be carried out on each forging in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing NDE Requirement Forgings Frequency ^b 10 % Method ASME BPVC Sec. V. Article 6 Extent ^c 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. a Parts of size DN > 50 (NPS > 2). b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair welding is not permitted. Sour Service fadditional metallurgical, manufacturing, testing and certification requirements) ^a When sour service requirements are specified by the purchaser, the material shall conform to the require of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements in ASTM A370/A10 ne forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be tra	Qualification							
Testing VT shall be carried out on each forging in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be pickled prior to the testing. Liquid penetrant testing NDE Requirement Forgings Frequency b 10 % Method ASME BPVC Sec. V, Article 6 Extent c 100% Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. * Parts of size DN > 50 (NPS > 2). * For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair welding is not permitted. Sour Service (additional metaling and condance stating and condance with the requirements in ASTM A370/A1C one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximinech location. Hardness testing Production hardness testing shall be performed in accordance with ISO 10475-3 section 7.2 and this 1 Certification The material shall be traceable in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. </td <td>Extent of Testing</td> <td></td> <td></td> <td>eat and heat treatment lot, with a</td> <td>maximum deviation from</td>	Extent of Testing			eat and heat treatment lot, with a	maximum deviation from			
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Method ASME BPVC Sec. V, Article 6 Extent ° 100 % Acceptance criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8 NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. a Parts of size DN > 50 (NPS > 2). b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. c All accessible internal and external surfaces shall be examined Valve forgings inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair welding 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 in MST M A370/A10 or of forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximicach location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this 1 Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another requirements standard accepted by the purchaser.		NDE Requirement		Forgings				
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NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be cleaned prior to the testing. * Parts of size DN > 50 (NPS > 2). * For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. * All accessible internal and external surfaces shall be examined Valve forgings NDT Valve forgings INDT Valve forgings inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair welding 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 in MDS: Hardness testing Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A10 one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this N Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another 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		Extent ^c		100 %				
cleaned prior to the testing. a Parts of size DN > 50 (NPS > 2). b For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. c All accessible internal and external surfaces shall be examined. Valve forgings INDT Valve forgings inspection shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply. Repair of Defects Repair welding is not permitted. Sour Service (additional medicaturing, testing and certification are specified by the purchaser, the material shall conform to the requirements multicaturing, testing and certification are examined. Hardness testing Hardness testing shall be performed in accordance with the requirements in ASTM A370/A10 one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this Nore forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be traceable in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.		Acceptance criteria	criteria ASME BPVC Sec. VIII, Div. 1, Appendix 8					
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 require of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements MDS: <u>Hardness testing</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A10 one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this N The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another 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.		For random examination (10 %), a minimum of one item per lot in any purchase order shall be examined. The test lot shall be as defined for mechanical testing. All accessible internal and external surfaces shall be examined <u>Valve forgings NDT</u> Valve forgings inspection shall be according to the applicable valve specification.						
(additional metallurgical, manufacturing, testing and certification requirements) ^a of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements MDS: Hardness testing Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A10 one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximi each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this M Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another 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.	Repair of Defects	Repair welding is not permitted.						
requirements) ^a Production hardness testing shall be performed in accordance with the requirements in ASTM ASTMATONATO one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximities each location. The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this N Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another 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.	(additional metallurgical, manufacturing, testing and	of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirement MDS:						
Certification The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another 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.	certification	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 or one forging per lot. The maximum hardness shall be 100HRB from three readings taken in close proximity at each location.						
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 material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.						
confirm compliance with this specification.	Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.						
		confirm compliance with t	his specification.		4 Type 3.1 and shall			
 MPS identification or MCPR/QTR number used. 		The inspection documents shall include the following information:						



MDS No. IT105 / IT105S^a

Rev. 01

TYPE OF MATERIAL: Titanium Grade 2

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Plates, sheets, strips	ASTM B265	2 (UNS R50400)					
		Page 1 of 1					
Scope	This MDS defines app specification.	blicable options and/or requir	ements that supplement or amen	d the referenced standard			
Qualification		e manufacturing process sha on testing shall meet the req	II be qualified in accordance with uirements of this MDS.	ISO 17782 or NORSOK			
Repair of Defects	Repair welding is not	permitted.					
Sour Service (additional metallurgical, manufacturing,	When sour service requirements are specified by the purchaser, the material shall conform to the requirement of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:						
<i>testing and</i> <i>certification</i> <i>requirements</i>) ^a <i>Hardness testing</i> Production hardness testing shall be performed in accordance with the requirements in ASTM A3 one plate per lot. The maximum hardness shall be 100HRB from three readings taken in close pro- each location.							
	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS.						
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another qual requirements standard accepted by the purchaser.						
The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 an confirm compliance with this specification.							
	The inspection docum	ents shall include the followi	ng information:				
	- MPS identification	or MCPR/QTR number used					
	y suffix "S" shall be used quirements for sour servic		ered in accordance with the MDS	S plus the additional			



MDS No. IT106 / IT106S^a

TYPE OF MATERIAL	IAL: Titanium Grade 2							
PRODUCT FORM	STANDARD	GRADE	ACCEPT	ANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Castings	ASTM B367	C2 (UNS R52550)			ASTM B367 S1, S2, S5, S7			
	I	Page 1 of 3						
Scope	This MDS defines ap specification.	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	All castings shall be	subject to hot isostatic pressir	g (HIP).					
Heat Treatment		ue to size limitations cannot be tion is applied, this shall be in			adiographed.			
Test Sampling	 150 kg (331 lb) and a Size of the test block T = 22 mm (0.86 ii T = 50 mm (2 in) f T = 75 mm (3 in) f NOTE t = section (a thickness.) Test samples shall a 	 Samples for production testing shall be cut from the gating system of the casting. For castings with weight 150 kg (331 lb) and above, the test blocks shall be integrally cast with the casting. Size of the test block shall be 140 mm (5.5 in) in length and 80 mm (3 in) in height with thickness (T): T = 22 mm (0.86 in) for t ≤ 30 mm (1.18 in) T = 50 mm (2 in) for 30 mm (1.18 in) < t ≤ 60 mm (2.36 in) T = 75 mm (3 in) for t > 60 mm (2.36 in) NOTE t = section (shell) thickness of castings; for flanged castings, the largest flange thickness is the rut thickness. 						
Non-Destructive	Visual inspection							
Testing	NDE requirement	NDE requirement Pilot casting (section 4.8) Production casting						
	Frequency	Each pilot cas	ing	Each p	production casting			
	Method ANSI/MSS SP-55							
	Extent 100 % of all accessible surfaces including welding ends							
	Acceptance criteria MSS SP-55							
	NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing.							
	Liquid penetrant test	ing						
	NDE Requirement	Pilot casting (section	on 4.8)	Prod	uction casting ^a			
	Frequency ^b	100 %			100 %			
	Method	ASME BPVC Sec. V,	Article 6	ASME BF	PVC Sec. V, Article 6			
	Extent ^c	100 %			100 %			
	Acceptance criteria	ASME BPVC Sec. VIII, Div. 1, Appendix 7 ASME BPVC Sec. VIII, Div.						
	 a Production valve specified by the b Frequency of in 	 pickled prior to the testing. ^a Production valve castings, PT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. ^b Frequency of inspection 100 % means that each item shall be examined. 						



MDS No. IT106 / IT106S a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Titanium Grade 2 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Castings C2 (UNS R52550) ASTM B367 S1, S2, S5, ASTM B367 **S7** Page 2 of 3 Radiographic testing Non-Destructive Testing NDE requirement Pilot **Production casting** casting Valve castings ^a Other pressure (section 4.8) containing castings Frequency ^c 100 % 100 % NPS DN Pressure class ≤ 150 300 < 250 N/R N/R < 10 ≥ 250 5 % ≥ 10 5% Method ASME BPVC Sec. V, Article 2 Areas defined by ASME B16.34 for special class valves, at Extent 100 % ^d abrupt changes in sections and at the junctions of risers, gates or feeders to the casting ASME BPVC Sec. VIII, Div. 1, Appendix 7 Acceptance criteria NOTE N/R means not required, unless specified otherwise by the purchaser. Production valve casting, RT shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this table shall apply. Production casting other than valve casting. Frequency of inspection 100 % means that each item shall be examined. When random examination (5%) is specified, a minimum of one item per lot of each pattern in any purchase order shall be examined. Production casting other than valve casting, inspection shall include other critical areas as defined in the purchase order and/or applicable product specification or standard. Sketches of the areas to be tested shall be established and agreed with the purchaser. Repair of Defects All major repairs shall be documented, where a major repair is defined as excavations exceeding 20 % of the casting section or wall thickness, and/or 4 % of the casting surface area. Weld repairs are not acceptable for castings that leak during pressure testing. The repair welding procedure shall be qualified in accordance with ASME IX or ISO 15614-5 and this MDS. Sour Service Material covered by this MDS is not referenced in ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103. (additional Use of this material in sour service shall require separate qualification according to ISO 15156-3 /NACE metallurgical, MR0175-3 or ISO 17945 /NACE MR0103, as applicable. manufacturing, testing and The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS. certification The inspection documents required in this MDS shall also include the qualification test reports. requirements)^a Surface Treatment For castings manufactured to this MDS alfa-case in the casting surface shall be completely removed at the and Finish foundry from the following locations: All surfaces, which shall be machined. - All weld bevels including an area of 20 mm (0.8 in) on each side of the bevel. - All highly stressed areas including areas prone to fatigue.



MDS No. IT106 / IT106S^a **Material Data Sheet Rev. 01** TYPE OF MATERIAL: Titanium Grade 2 PRODUCT FORM STANDARD GRADE ACCEPTANCE CLASS SUPPLEMENTARY REQUIREMENT Castings ASTM B367 C2 (UNS R52550) ASTM B367 S1, S2, S5, S7 Page 3 of 3 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: - MPS identification or MCPR/QTR number used. а 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.



MDS No. IT107 / IT1078 a

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT			
Bars	ASTM B348	2 (UNS R50400)					
		Page 1 of 1					
Scope	This MDS defines applicat specification.	ble options and/or requirem	ents that supplement or amend	the referenced standard			
Qualification		nufacturing process shall b esting shall meet the require	e qualified in accordance with lements of this MDS.	SO 17782 or NORSOK			
Extent of Testing	Tensile test specimens sha	all be taken from each heat	and heat treatment lot.				
Non-Destructive Testing	Visual Inspection VT shall be carried out on each bar in accordance with the product standard. The testing shall be performed after machining, if applicable, and non-machined surfaces shall be cleaned prior to the testing. NDT valve parts manufactured from bar Inspection of valve parts manufactured from bar shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.						
Repair of Defects	Repair welding is not perm	nitted.					
Sour Service (additional metallurgical,	When sour service require of ISO 15156 /NACE MR0 MDS:	ments are specified by the 175 or ISO 17945 /NACE N	purchaser, the material shall co IR0103, and the following addi	onform to the requirement tional requirements to the			
manufacturing, testing and	Hardness testing						
<i>certification</i> <i>requirements</i>) ^a Production hardness testing shall be performed in accordance with the requirements in AST the end surface of one bar per lot. The maximum hardness shall be 100HRB from three reactions of the proximity.							
	The material shall be trace	The material shall be traceable in accordance with ISO 15156-3 /NACE MR0175-3 section 7.2 and this MDS					
Certification	The material manufacturer requirements standard acc		n certified in accordance with Is	SO 9001 or another quality			
	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 M0 	CPR/QTR number used.					



MDS No. IT108 / IT108S^a

Rev. 01

TYPE OF MATERIAL: Titanium Grade 2

PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Tubes	ASTM B338	2 (UNS R50400)			
		Page 1 of 1			
Scope	This MDS defines ap specification.	plicable options and/or requ	irements that supplement or amen	d the referenced standard	
Qualification		e manufacturing process sl ion testing shall meet the re	hall be qualified in accordance with equirements of this MDS.	ISO 17782 or NORSOK	
Non-Destructive Testing	Method and acceptar	nce criteria for penetrant tes	ting shall be to ASME VIII, Div. 1, A	Appendix 8.	
Repair of Defects	Repair welding of bas	se material is not permitted.			
	For repair of welds, the requirements for production welding shall apply to the repair WPS. Repair welds shall be heat treated as per original production weld (if applicable)				
Sour Service (additional metallurgical,	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:				
manufacturing, testing and	Hardness testing				
certification requirements) ^a	Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one tube per lot. The maximum hardness shall be 100HRB from three readings taken in close proximity.				
	The material shall be	traceable in accordance wi	th ISO 15156-3 /NACE MR0175-3	section 7.2 and this MDS.	
Certification		cturer shall have a quality s d accepted by the purchase	ystem certified in accordance with er.	SO 9001 or another qualit	
	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:				
		or MCPR/QTR number use			



MDS No. IU100 / IU100S^a

TYPE OF MATERIAL: Precipitation-Hardened Stainless Steel					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bolting	ASTM A453	Grade 660 (UNS S66286)	Class D	-	
		Page 1 of 1	I	l	
Scope	This MDS defines applicat specification.	ble options and/or requirement	s that supplement or amen	d the referenced standard	
Manufacturing	Threading of studs, bolts a heat treatment.	and screws may be done by m	achining or rolling. Thread	rolling shall be done after	
	Threads in nuts shall be m	achined.			
Heat Treatment	Heat treatment shall be ca	rried out after the final hot forr	ning operation.		
Impact Testing/ Toughness testing		ried out at minus 101 °C (-150 J (15 ft lbf) single, the lateral e			
Proof Load Testing	Proof load testing shall be according to ASTM A962 and the load shall comply with ASTM A194 Grade 7.				
Non-Destructive Testing	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.				
Repair of Defects	Weld repair is not permitte	d.			
Sour Service (additional metallurgical,		When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 or ISO 17945 /NACE MR0103, and the following additional requirements to the MDS:			
manufacturing, testing and	Hardness testing				
certification requirements) ^a	Production hardness testing shall be performed in accordance with the requirements in ASTM A453. The maximum hardness shall be 35HRC 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.				
Marking	Each bolt and nut shall be	marked on the end/head to er	nsure full traceability to hea	t 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 info	ormation:		
	- Heat treatment condition	n (solution annealing and anne	ealing temperature) shall be	e 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.				



Material Data S	Sheet	MDS No. IX100 /	IX100S ^a	Rev. 01
TYPE OF MATERIAL:	Low alloyed steel fasteners	s (HDG)		
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT
Bolting	ASTM A320	L7, L7M, L43		-
	ASTM A194	7 or 7M		ASTM A194 S3, S4, S5
		Page 1 of 1		
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard
Manufacturing	Threading of studs and bo treatment.	Its may be done by machinin	g or rolling. Thread rolling sh	nall be done after heat
	Threads in nuts shall be m	achined.		
Impact Testing/ Toughness testing	Nuts to A194: S3 shall app	bly.		
Proof Load Testing	Nuts to A194: S4 shall app	bly.		
Non-Destructive Testing	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.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	When sour service is specified by the purchaser, only Grade L7M/7M is acceptable. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2 section 9 and this MDS.			
Surface Treatment and Finish		vashers shall be hot dip spun Is shall not be subject to cutt		
Dimensional Tolerances	 Studs and bolts: Threading shall be in accordance with ASME B1.1, class 2A fit for diameters 1 in and smaller (UNC series) and 8 pitch thread series for 1 ¹/₈ in and larger. Nuts: Nuts shall be ASME heavy HEX-series, double chamfered. Nut threads shall be oversized to fit studs/bolts dependent of specified coating. 			
Certification	 The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. S5 shall apply for nuts to ASTM A194. 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: Steel manufacturer of starting material; Heat treatment condition. 			
	suffix "S" shall be used to de irements for sour service.	esignate a material delivered	in accordance with the MDS	plus the additional



Material Data S	Sheet	MDS No. IX109 /	IX109S ^a	Rev. 01		
TYPE OF MATERIAL:	TYPE OF MATERIAL: Low alloyed steel fasteners (black/uncoated)					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bolting	ASTM A320	L7, L7M, L43		-		
	ASTM A194	7 or 7M		ASTM A194 S3, S4, S5		
		Page 1 of 1				
Scope	This MDS defines applicat specification.	ble options and/or requireme	nts that supplement or amen	d the referenced standard		
Manufacturing	Threading of studs and bo treatment.	Its may be done by machinin	g or rolling. Thread rolling sh	all be done after heat		
	Threads in nuts shall be m	achined.				
Impact Testing/ Toughness testing	Nuts to A194: S3 shall app	bly.				
Proof Load Testing	Nuts to A194: S4 shall app	bly .				
Non-Destructive Testing	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.					
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	When sour service is specified by the purchaser, only Grade L7M/7M is acceptable. The material shall be traceable in accordance with ISO 15156-2 /NACE MR0175-2 section 9 and this MDS.					
Dimensional Tolerances	 Studs and bolts: Threading shall be in accordance with ASME B1.1, class 2A fit for diameters 1 in and smaller (UNC series) and 8 pitch thread series for 1 ¹/₈ in and larger. Nuts: Nuts shall be ASME heavy HEX-series, double chamfered; Nut threads shall be oversized to fit studs/bolts dependent of specified coating. 					
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. S5 shall apply for nuts to ASTM A194 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:					
	 Steel manufacturer of st Heat treatment condition 	tarting material;				
11 ,	suffix "S" shall be used to de irements for sour service.	esignate a material delivered	in accordance with the MDS	plus the additional		



Material Data			110 / IX110S ^a	Rev. 01	
PRODUCT FORM	STANDARD	eners (black/uncoated) GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY	
				REQUIREMENT	
Bolting	ASTM A193	B7, B7M		-	
	ASTM A194	2H, 2HM		-	
		Page 1 of	1		
Scope	This MDS defines ap specification.	plicable options and/or red	quirements that supplement or amen	d the referenced standard	
Manufacturing	treatment.	Threading of studs and bolts may be done by machining or rolling. Thread rolling shall be done after heat treatment.			
	Threads in nuts shall	Threads in nuts shall be machined.			
Non-Destructive Testing		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.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a		When sour service is specified by the purchaser, only Grade B7M/2HM is acceptable. The material shall be traceable in accordance with ISO 15156-2 /NACE MR0175-2 section 9 and this MDS.			
Dimensional	Studs and bolts:				
Tolerances	 Threading shall be and 8 pitch thread 	 Threading shall be in accordance with ASME B1.1, class 2A fit for diameters 1 in and smaller (UNC series) and 8 pitch thread series for 1 ¹/₈ in and larger. 			
	Nuts:				
	 Nuts shall be ASME heavy HEX-series, double chamfered. 				
Certification		cturer shall have a quality d accepted by the purcha	system certified in accordance with ser.	ISO 9001 or another quality	
	The inspection docum	nents shall be issued in ad	ccordance with ISO 10474 /EN 1020	4 Type 2.2 as minimum.	
	y suffix "S" shall be used quirements for sour servio		elivered in accordance with the MDS	plus the additional	



Material Data S		MDS No. IX120 /		Rev. 01	
TYPE OF MATERIAL:	Low alloyed steel fasteners	s (HDG)			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Bolting	ASTM A193	B7, B7M		-	
	ASTM A194	2H, 2HM		-	
		Page 1 of 1			
Scope	This MDS defines applicat specification.	ble options and/or requirement	nts that supplement or amen	d the referenced standard	
Manufacturing	Threading of studs and bo treatment. Threads in nuts shall be m	lts may be done by machinin achined.	g or rolling. Thread rolling sł	all be done after heat	
Non-Destructive Testing		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.			
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	When sour service is specified by the purchaser, only Grade B7M/2HM is acceptable. The material shall be traceable in accordance with ISO 15156-2 /NACE MR0175-2 section 9 and this MDS.				
Surface Treatment and Finish	All studs, bolts, nuts and washers shall be hot dip spun galvanized according to ASTM F2329 or ISO 10684. The zinc coating on threads shall not be subject to cutting, rolling or finishing tool operation. Nuts may be tapped after galvanizing.				
Dimensional Tolerances	 Studs and bolts: Threading shall be in accordance with ASME B1.1, class 2A fit for diameters 1 in and smaller (UNC series) and 8 pitch thread series for 1 ¹/₈ in and larger. Nuts: Nuts shall be ASME heavy HEX-series, double chamfered; Nut threads shall be oversized to fit studs/bolts dependent of specified coating. 				
Certification	requirements standard acc S5 shall apply for nuts to A	STM A194.			
	The inspection documents				



Material Data	Sheet	MDS No. IX124 /	IX124S ^a	Rev. 01	
TYPE OF MATERIAL	: High strength low alloy ste	eel			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Forgings	ASTM A694	F52	-	-	
	ASTM A694	F60	-	-	
	ASTM A694	F65	-	-	
		Page 1 of 2			
Scope	specification.	ble options and/or requireme	ents that supplement or amena	d the referenced standard	
Chemical Composition	C ≤ 0.20 %, S ≤ 0.020 %, I	P ≤ 0.025 %, Ti ≤ 0.05 %, N	$b \le 0.04$ %, (V + Nb + Ti) ≤ 0.04	.10 %, CE ≤ 0.43 %	
Heat Treatment	For products delivered in t 620 °C (1 148 °F).	he quenched and tempered	condition the minimum tempe	ering temperature shall be	
		Forgings shall be placed in such a way that free circulation around each forging is ensured during the heat treatment process, including quenching.			
Impact Testing/ Toughness testing					
Extent of Testing	Impact test, tensile test, hardness test and micrographic examination shall be carried out for each heat, nominal thickness and heat treatment load. For heat treatment in continuous furnace a heat treatment load is defined as all plates heat treated continuously in the same furnace, of the same heat and nominal thickness. A test lot shall not exceed 2 000 kg (4 400 lb) for forgings with as forged weight ≤ 50 kg (110 lb), and 5 000 kg (11 000 lb) for forgings with as forged weight > 50 kg (110 lb).				
Non-Destructive	Visual Inspection				
Testing			dance with the product standa hined surfaces shall be clean		
	Inspection of pressure controlling parts of valves shall be according to the applicable valve specification. If a QSL is not specified by the purchaser, the requirements in this MDS shall apply.				
Repair of Defects	Weld repair is not permitte	d.			
Sour Service (additional metallurgical,	<i>ur Service</i> <i>ditional</i> <i>ditional</i> <i>tallurgical,</i> <i>nufacturing,</i> <i>ting and</i> <i>Chemical composition</i>				
testing and certification					
requirements) ^a	Ni < 1.0 %				
	<u>Hardness testing</u> Production bardpass testin	a chall he norfermed in	ordonoo with the requirement		
	two forgings per lot. When		ordance with the requirements t shall be hardness tested as a close proximity.		
	The material shall be trace	eable in accordance with ISC	0 15156-2 /NACE MR0175-2 s	section 9 and this MDS.	
Marking	The forgings shall be mark	ed to ensure full traceability	to melt and heat treatment lo	·t.	



Material Data	rial Data Sheet		MDS No. IX124 / IX124S ^a		
TYPE OF MATERIAL: High strength low alloy steel					
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT	
Forgings	ASTM A694	F52	-	-	
	ASTM A694	F60	-	-	
	ASTM A694	F65	-	-	
		Page 2 of	2		
Certification		acturer shall have a quality ard accepted by the purcha	system certified in accordance with I ser.	SO 9001 or another quality	
	The inspection documents shall be in accordance with EN 10204 /ISO 10474 Type 3.1, unless specified otherwise by the purchaser. The inspection documents shall include the following information:				
	 Steel manufacturer, melting and refining practice; 				
	- Heat treatment co	ondition. For tempered con	dition, tempering temperature and ho	Iding time shall be stated.	
	ry suffix "S" shall be use quirements for sour serv		elivered in accordance with the MDS	plus the additional	



Material Data	Sheet	MDS No. IX127 /	IX127S ^a	Rev. 01		
TYPE OF MATERIAL: High strength low alloy steel						
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A29	4140	-	-		
	ASTM A694	F52	-	-		
	ASTM A694	F60	-	-		
	ASTM A694	F65	-	-		
		Page 1 of 2				
Scope	standard specification.	ble options and/or requireme				
Manufacturing	 bar forgings as defined hot rolled/wrought bars All bars shall be supplie NOTE Cold finishing sha 	 Bars shall be manufactured to the following requirements: bar forgings as defined in ASTM A788 and certified to ASTM A694; or hot rolled/wrought bars with a maximum outside diameter 250 mm (10 in); or All bars shall be supplied in heat treatment condition as specified below. NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted. 				
Chemical Composition	Grade 4140: S ≤ 0.020 %, P ≤ 0.025 % Grade F52, F60, F65: C ≤ 0.20 %, S ≤ 0.020 %, P ≤ 0.025 %, Ti ≤ 0.05 %, Nb ≤ 0.04 %, (V + Nb + Ti) ≤ 0.10 %, CE ≤ 0.43					
Heat Treatment	 Grade 4140: for products delivered in quenched and tempered condition the minimum tempering temperature shall be 650 °C (1 202 °F). Grade F52, F60, F65: for products delivered in the quenched and tempered condition the minimum tempering temperature shall be 620 °C (1 148 °F). Bars shall be placed in such a way that free circulation around each bar is ensured during the heat treatment process, including quenching. 					
Tensile Testing	Grade 4140: - Minimum yield strength: ≥ 515 MPa (75 ksi) - Minimum tensile strength: ≥ 690 MPa (100 ksi) - Minimum elongation: ≥ 15 %					
Impact Testing/ Toughness testing	 Impact testing shall be carried out at -46 °C (-50 °F). One set of three samples shall be tested. Acceptance criteria: Grade 4140, minimum 45 J (33 ft lbf) average and 35 J (26 ft lbf) single for full size specimens; Grade F52, F60, F65, minimum 27 J (22 ft lbf) average and 20 J (15 ft lbf) single for full size specimens. 					
Extent of Testing	Impact test, tensile test and hardness test shall be carried out for each heat, nominal thickness and heat treatment load. For heat treatment in continuous furnace a heat treatment load is defined as all bars heat treated continuously in the same furnace, of the same heat and nominal thickness. A test lot shall not exceed 2 000 kg (4 400 lb) for bars with weight \leq 50 kg (110 lb), and 5 000 kg (11 000 lb) for forgings with weight $>$ 50 kg (110 lb).					
Test Sampling	 (NPS 4) and under shall condition The mid-length of the audiameter or minimum of of the specimen shall be 	ns for bars intended for mach omply with the following requ xial tensile test specimen sha i 100 mm (4 in), whichever is e located at a minimum dista	all be located at a distance e the greater, from the end of nce of OD/4 from the surface	qual to the bar outside the bar, and the centreline e.		
	the surface and the mid	ngential tensile test specime -point of the specimens at a	minimum of 100 mm (4 in) fi	rom the end of the bar.		
	 The notch of the impact 	test specimen shall be locat	ed perpendicular to the bar	surface.		



Material Data Sheet MDS No. IX127 / IX127S ^a Rev. 0						
TYPE OF MATERIAL	: High strength low alloy ste	eel	1			
PRODUCT FORM	STANDARD	GRADE	ACCEPTANCE CLASS	SUPPLEMENTARY REQUIREMENT		
Bars	ASTM A29	4140	-	-		
	ASTM A694	F52	-	-		
	ASTM A694	F60	-	-		
	ASTM A694	F65	-	-		
		Page 2 of 2				
Test Sampling	taken. - For bar with outside dia in axial direction of the t be taken in tangential di	- For bar with outside diameter < 100 mm (4 in): one tensile and one set impact test specimens shall be				
		eet shall be met in both dire		and impact energies		
Non-Destructive Testing			the product standard. The to ces shall be cleaned prior to			
	<u>NDT of valve parts manufactured from bar</u> Inspection of valve parts manufactured from bar shall be according to the applicable valve spe QSL is not specified by the purchaser, the requirements in this MDS shall apply.					
Repair of Defects	Weld repair is not permitted.					
Sour Service (additional metallurgical, manufacturing, testing and certification requirements) ^a	Grade 4140 bar Grade 4140 material is not referenced in ISO 15156 /NACE MR0175 nor ISO 17945 /NACE MR0103. NOTE Use of Grade 4140 in sour service shall require separate qualification according to ISO 15156-2/NACE MR0175-2 or ISO 17945/NACE MR0103, as applicable. The inspection documents required in this MDS shall also include the qualification test reports. Grade F52, F60, F65 bar When sour service requirements are specified by the purchaser, Grade F52, F60, F65 bar material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS: Chemical composition Ni < 1.0 %					
	proximity. The material shall be traceable in accordance with ISO 15156-2 /NACE MR0175-2 section 9 and this MDS.					
Marking	The bars shall be marked	to ensure full traceability to r	melt and heat treatment lot.			
Certification		The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another qualit requirements standard accepted by the purchaser.				
	The inspection documents otherwise by the purchase		EN 10204 /ISO 10474 Type	3.1, unless specified		
	•	shall include the following in	nformation:			
	 Steel manufacturer, melting and refining practice; Heat treatment condition. For tempered condition, tempering temperature and holding time shall be stated. 					



Annex B (normative) Element Data Sheets

B.1 List of element data sheets

The element data sheets listed in Table 3 cover requirements for special processes, where the process shall be qualified and controlled as specified in the applicable EDS to ensure products are manufactured consistently to the appropriate quality.

Table 3 - List of element data sheets

Special process description	EDS No.	EDS Rev.
Hard facing by overlay welding	IH001	01
Hard facing by thermal spraying of tungsten carbide		01
Electroless nickel coating	IH004	01
Solid tungsten carbide material		01
Alloy 625 corrosion resistant overlay welding	IO001	01



B.2 IOGP element data sheets

Element Data Sheet EDS No. IH001 **Rev. 01** Type of Special process: Hard facing by overlay welding Page 1 of 2 This EDS specifies requirements for hard facing by overlay welding of piping and valve parts. Scope Welding Weldina process 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). Welding Consumable For general and hydrocarbon service the welding consumables shall be of type E/ERCoCr-A (UNS R30006) e.g. Stellite 6 or equivalent, or type 13Cr (ER410). For other services, except for seawater service the use of E/ERCoCr-B (UNS R30012) or E/ERCoCr-E (UNS R30021) should be considered subject to purchaser approval. For seawater service, the consumable shall be subject to agreement with the purchaser. Procedure General Qualification Testing The hard facing shall be carried out using welding procedures qualified in accordance with ASME IX or ISO 15614-7 modified as follows: The test plate dimensions shall be the minimum required by the welding standard sufficient to allow all required tests to be carried out. The minimum qualified parent material thickness shall be the thickness of the test plate. The qualification shall be carried out on base material of same specification and grade as used in production. - The testing shall be carried out according to ASME IX or ISO 15614-7 and the requirements in this EDS. A stringer bead technique is recommended. If weaving is used, the width shall be within the qualified range taking into consideration the risk of overheating of the material and cracking. The temperature of the components shall be checked during welding. The interpass temperature during hard facing of duplex stainless steels shall not exceed 150 °C (302 °F). The thickness of the hard facing shall be measured and be minimum 1.6 mm (0.06 in) after final machining. Hardness testing Hardness testing shall be carried out on base material, heat affected zone and weld metal. Vickers hardness HV5 or HV10 shall be used. The examination of the HAZ shall be carried out with maximum 0.5 mm (0.02 in) distance between the indentations from fusion line, through HAZ into the unaffected base material. The hardness for HAZ and unaffected base material shall not exceed the maximum values specified in ISO 15156 /MR0175 or ISO 17945 /NACE MR0103 and for type 22Cr and 25Cr duplex base materials the hardness shall not exceed 310HV average, 320HV individual single value. Metallographic examination Metallographic examination shall be carried out for the following materials: 22Cr and 25Cr duplex, type 6Mo austenitic stainless steels and Alloy 625. For type 22Cr and 25Cr duplex the ferrite content in the heat affected zone shall be determined in accordance with ASTM E562 and shall be in the range of 30 % to 70 %. Corrosion testing Corrosion testing shall be carried out for 25Cr duplex, Super austenitic materials (UNS S34565 or equivalent), Alloy 625 and 6Mo 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. Macro sectior The macro section for the qualification shall show no cracking and complete fusion between base material and the hard facing layer.



Element Data SI	heet EDS No. IH001 Rev. 01
Type of Special process	s: Hard facing by overlay welding
	Page 2 of 2
Procedure Qualification Testing	Impact testing 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.
Heat Treatment	 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 or ISO 17945 /NACE MR0103, as applicable. Overlaying low alloy steels and martensitic stainless steels (13% Cr, 13% Cr 4% Ni) shall be followed by stress relieving at a minimum temperature of 620 °C (1 148 °F).
<i>Non-Destructive Testing</i>	<u>Visual Inspection</u> 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. Liquid penetrant testing All deposited surfaces shall, after final machining, be penetrant tested in accordance with ASME V Article 6 with acceptance criteria according to ASME VIII, Div. 1, Appendix 8, except on sealing surfaces where no indication is acceptable (actual sealing surface areas to be defined by purchaser).
Repair of Defects	 Repairs may be local or total when non-conforming conditions are found. Defects in excess of acceptance standard shall be removed by reducing weld overlay thickness and shall be repaired by re-welding. All excavations shall be dye penetrant inspected prior to the start of repair welding in order to confirm the complete removal of defects. Repair by re-welding shall be performed in accordance with a written procedure. The following information must be given in these procedures: Method of removing defects; Requirements related to the shape of the excavation; Inspection of repair prior to re-welding; Applicable welding procedure and qualification tests; Inspection after welding.



Element Data Sheet

EDS No. IH002

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 piping and valve parts.			
Process	General			
	The hard facing shall be carried out using high velocity oxygen fuel (HVOF) or equivalent process.			
	Coating composition			
	The coating shall be of cermet type based on tungsten carbide (WC) and a metallic binder. The binder shall be based on Co and/or Ni which shall be alloyed with Cr or Cr and Mo. Pure Co or Ni binders are not accepted.			
	Coating thickness			
	The coating thickness shall be in the range 0.15 mm to 0.25 mm (0.006 in to 0.01 in) after grinding and lapping, unless specified otherwise by the purchaser.			
	Surface preparation			
	The components shall be cleaned for removal of oil by a cleaning agent (acetone or similar) before grit blasting with aluminium oxide. The surface roughness before spraying shall be within the range 4 μ m to 8 μ m (160 μ in to 320 μ in) Ra. All edges shall be chamfered or rounded.			
	Balls shall be spherical within 0.05 mm (0.002 in).			
	The components shall be at a temperature minimum 10 °C (50 °F) above dew point and be immediately grit blasted in warm condition. Any oil, dust or particles shall be removed by suitable means before spraying.			
	Thermal spraying			
	The component shall be coated immediately after grit blasting, while the component still is at a temperature above the dew point.			
	All thermal spraying shall be carried out under optimal conditions and accordance with established and qualified procedures to ensure that the coating on all areas fulfil the specified requirements.			
	For valves all seating area shall be coated. For ball valves the complete spherical part of the ball shall be coated. For gate valves all surfaces sliding against the seats during valve opening and closing shall be coated.			
	Sealing			
	All coated surfaces shall be sealed 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.			
	<u>Finishing</u>			
	All coated parts shall be ground and lapped to a mirror like finish and maximum roughness of Ra = 0.15 μ m (6 μ in).			
Procedure	<u>General</u>			
Qualification Testing	The thermal spray procedure shall be supported by a qualification test and the following essential variables shall apply to each procedure:			
	 the type of equipment used; 			
	- nozzle length;			
	 fuel and gas flow rate, ±5 %; 			
	- spray distance, ±5 %;			
	 spray rate, ±5 %; 			
	 grade of powder; 			
	- powder supplier;			
	- sealer type (if used).			
	The procedure shall be re-qualified if any of the above is changed outside given allowable range.			
	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.			



Element Data Sheet

EDS No. IH002

Type of Special proce	Type of Special process: Hard facing by thermal spraying of tungsten carbide				
Page 2 of 2					
Procedure Qualification Testing	Bonding test				
	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.				
	Acceptance criteria: minimum bond strength shall be 60 MPa (8.7 ksi).				
	Bending test				
	Three coupons, with size 20 mm x 100 mm x minimum 1.5 mm shall be tested. The coupons shall be bent 90° over a mandrel with diameter 25 mm (1.0 in).				
	Acceptance criteria: no spalling is acceptable. However, cracking in the coating and chipping on the edge of the test specimen is acceptable.				
	Hardness test				
	A minimum of 3 indentations shall be made on a cross section for metallographic examination.				
	Acceptance criteria: The average hardness shall be minimum 1000HV0.3 with minimum single value not lower than 900HV0.3.				
	Porosity test				
	One piece shall be prepared for cross section metallographic examination. An area of minimum 1.0 mm ² shall be examined.				
	Acceptance criteria: the porosity shall be less than 1 % by area.				
	Surface finish test				
	The surface roughness of the finished component shall be tested.				
	Acceptance criteria: The roughness value shall be Ra \leq 0.15 μ m (6 μ in).				
Production Testing	Finished polished hard facing thickness and surface roughness of all parts shall be tested and shall fulfil the requirements specified above.				
	Production testing shall be carried out on regular basis as minimum twice per week and on every new batch of powder or on changing grade of powder. The test shall be similar to a procedure qualification test and the applicable testing shall consist of hardness and porosity test according to the requirements stated above in the EDS.				



Element Data S	Sheet EDS No. IH004 Rev. 0			
Type of Special process: Electroless Nickel Coating				
	Page 1 of 1			
Scope	This EDS specifies additional requirements to the referenced standard for hard facing for electroless nickel coating for valve trim components intended for severe service and wear applications.			
Reference Standard	ASTM B733			
	The coating shall comply with type V (10 % P), service condition SC4 and heat treatment Class 2.			
Process	General			
	Stabilizers used in the plating bath shall be basically organic stabilisers and shall be free of cadmium, bismuth and sulphur. Lead may be present but at a maximum concentration of 2 mg/kg (2 ppm by mass).			
	Peening shall not be applied.			
	Surface preparation			
	The support surface shall be prepared by abrasive blasting to SA 3. The roughness shall be:			
	– For round shape surfaces: Rt \leq 2 µm (79 µin) and Ra \leq 0.4 µm (16 µin).			
	− For other surfaces: Rt ≤ 60 μ m (2360 μ in) and Ra ≤ 12.5 μ m (490 μ in).			
Heat Treatment	Heat treatment to Class 2 shall be applied in inert atmosphere.			
Production Testing	Hardness test			
	The hardness of the plating shall be measured using the Knoop method in accordance with ASTM B578. The hardness shall be within the range of 800HK100 to 900HK100.			
	Adhesion tests			
	To ensure satisfactory adhesion of the coating a bend tests to ASTM B733 and B571 and an impact test to B733 shall be carried out.			
	Alloy composition			
	A chemical analysis shall be carried out to verify the composition of the coating. The phosphorus content shall be within 9 % to 11 % by mass balanced with nickel and maximum 0.05 % other elements.			
	Porosity			
	A ferroxyl test to B733 shall be carried out. The coating shall be free of pores, cracks or other through- thickness imperfections.			
Test Sampling	Sampling for non-destructive testing shall be carried out in accordance with ASTM B602, Table 1, Level I.			
	Sampling for destructive testing shall be carried out in accordance with ASTM B602, Table 4.			
	Test coupons of the base material plated simultaneously in the same bath may be used as an alternative t testing of actual article to comply with the required tests.			
Non-Destructive Testing	Acceptance requirements for coating as applied to articles shall comply with ASTM B733 section 7. The sampling for testing shall as specified above.			
	Visual Inspection			
	All components shall be examined. Coating shall be smooth, adherent and free from visible blisters, pits, nodules, porosity and other defects. Slight discoloration resulting from heat treatment shall not be cause for rejection.			
	Thickness			
	Plating thickness shall be checked by the magnetic method as described in ASTM B499 (this method is on suitable for use with magnetic substrates).			

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Type of Special process: Solid tungsten carbide material Page 1 of 1 Scope This EDS specifies requirements for solid tungsten carbide for use in piping and valves parts. Composition The binder shall be of Co or Ni base. Co base materials shall be alloyed with Cr and Ni or Cr, Ni and Mo to be corrosion resistant in well stream service. Ni base materials shall be alloyed with Cr or Cr and Mo. Ceramic materials may be used subject to purchaser approval. Process The material shall be produced by sintering with a subsequent hot isostatic pressing (HIP) or produced by a combined sinter/HIP process. The manufacturer shall establish detailed manufacturing procedure to ensure that the requirements of this EDS are satisfied. The manufacturing procedures shall include tolerances on all essential variables. Production Testing Hardness test The minimum hardness shall be 1600HV30, measured by the Vickers method according to ISO 3878. Fracture toughness The fracture toughness shall be minimum W = 9.5 MNm^{-3/2} measured by the Palmqvist (Vickers indentation – crack length) method according to ISO 28079. Metallographic examination The WC grain size shall be of type "Fine" or smaller measured according to ISO 4499-2. The carbides shall be homogeneously distributed in the binder phase. No eta-phase (η -phase) shall be present, and porosity/uncombined carbon levels shall be $\leq A02/B00/C00$ according to ISO 4499-4. Extent of Testing Testing shall be performed on one sample per powder batch and HIP batch. Non-Destructive Visual Inspection Testing All components shall be examined and be free from visible porosity, cracks and other defects. Liquid penetrant testing

accessible internal and external surfaces shall be examined.

Fluorescent penetrant testing shall be performed according to ISO 3452 or ASTM E165 on each component after final grinding/polishing to confirm that the material is free from any surface indication. 100 % of all

Element Data Sheet

EDS No. IH005



Element Data Sheet

EDS No. IO001

Type of Special process: Alloy 625 corrosion resistant overlay welding			
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Scope	This EDS specifies requirements for corrosion resistant overlay welding for piping and valve parts.		
Welding	Welding process Slag-forming welding processes are not permitted for overlay welding of sealing surfaces. A minimum of two layers of weld metal shall be deposited for all processes, while only one layer is acceptable for the electro slag weld process. Thickness of the overlay deposit for corrosion protection after final machining shall be minimum 3.0 mm or as required on applicable design drawing. Welding Consumable The welding consumable for the weld overlay shall comply with UNS N06625. Welders, operators qualification The welder or welding operators shall be qualified to ASME IX, ISO 9606 or ISO 14732.		
Procedure Qualification Testing	General 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. Chemical composition 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. Hardness testing Hardness testing shall be carried out on base material, heat affected zone and weld metal. Vickers hardness HV5 or HV10 shall be used. The examination of the HAZ shall be carried out with maximum 0.5 mm (0.02 in) distance between the indentations from fusion line, through HAZ into 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 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 or ISO 17945 /NACE MR0103. The hardness of finished machined overlay surface shall not exceed 35 HRC for Alloy 625.		
Heat Treatment	Heat treatment after overlay welding shall be carried out, as necessary, to meet specified properties		
Non-Destructive Testing	Visual Inspection 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. Liquid penetrant testing All deposited surfaces shall, after final machining, be penetrant tested in accordance with ASME V Article 6 with acceptance criteria according to ASME VIII, Div. 1, Appendix 8, except on sealing surfaces where no indication is acceptable. Thickness of weld overlay		
	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.		



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Type of Special process: Alloy 625 corrosion resistant overlay welding						
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Repair of Defects	Repairs may be local or total when non-conforming conditions are found. Defects in e standard shall be removed by reducing weld overlay thickness and shall be repaired					
	All excavations shall be dye penetrant inspected prior to the start of repair welding in complete removal of defects.	order to confirm the				
	Repair by re-welding shall be performed in accordance with a written procedure. The fol must be given in these procedures:					
	- Method of removing defects;					
	- Requirements related to the shape of the excavation;					
	- Inspection of repair prior to re-welding;					
	 Applicable welding procedure and qualification tests; 					
	- Inspection after welding.					



Bibliography

[1] ASME B31.3, Process Piping

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