International Association of Oil & Gas Producers

SPECIFICATION
S-563

December
2021

Material Data Sheets for Piping and Valve Components

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
3.0	December 2021	Third Edition
2.0	December 2018	Second Edition
1.0	December 2016	First Edition

Acknowledgements

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

Foreword

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

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

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

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

Table of Contents

List of Tables

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.

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

JIP33 Specification for Procurement Documents
Technical Specification

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 specification (QRS) and information requirements specification (IRS). 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, equipment IRS, equipment QRS);

d) this specification.

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 fluid service, Category D fluid service and High Pressure fluid service as defined in ASME B31.3.

NOTE The scope of IOGP S-563 is design 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, elevated temperature fluid service, high purity fluid service, severe cyclic conditions 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, type 321, type 347, type 321H, type 347H;
- Austenitic stainless steel 200-series: grade XM-19;
- Martensitic stainless steel: types 12Cr and 13Cr;
- Copper-Nickel alloys: type 90-10 and aluminium bronze;
- Nickel alloys: types 625 and 825;
- Nickel alloy bolting: types 625 and 718;
- Precipitation-hardened stainless steel: austenitic grade 660 and martensitic grade 630;
- Titanium grade 2;
- High strength, low alloy steels;
- Nickel-alloyed steel: type 3.5 % Ni;
- Cr-Mo alloyed steel: 1¼ Cr ½ Mo and 2¼ Cr 1 Mo grades.

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 publications are referred to in this document in such a way that some or all of their content constitutes requirements of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 Recommended Practice 934-A, *Materials and Fabrication of 2¼Cr-1Mo, 2¼Cr-1Mo-¼V, 3Cr-1Mo, and 3Cr-1Mo-¼V Steel Heavy Wall Pressure Vessels for High-temperature, High-pressure Hydrogen Service*

API Recommended Practice 934-C, *Materials and Fabrication of 1¼Cr-½Mo Steel Heavy Wall Pressure Vessels for High-pressure Hydrogen Service Operating at or Below 825 °F (440 °C)*

API Specification 5L, *Line Pipe*

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

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

ASME B31.3, *Process piping*

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

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

ASME *BPVC*, Section IX, *Welding, Brazing, and Fusing Qualifications*

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, *Personnel Qualification and Certification in Nondestructive Testing*

ASTM A20/A20M, *Standard Specification for General Requirements for Steel Plates for Pressure Vessels*

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 Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

ASTM A203/A203M, *Standard Specification for Pressure Vessel Plates, Alloy Steel, Nickel*

ASTM A216/A216M, *Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service*

ASTM A217/A217M, *Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable 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 A334/A334M, *Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service*

ASTM A335/A335M, *Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service*

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 A387/A387M, *Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum*

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 A479/A479M, *Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels*

ASTM A480/A480M, *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*

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

ASTM A494/A494M, *Standard Specification for Castings, Nickel and Nickel Alloy*

ASTM A516/A516M, *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service*

ASTM A564/A564M, *Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes*

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

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 A691/A691M, *Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures*

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

ASTM A696, *Standard Specification for Steel Bars, Carbon, Hot-Wrought or Cold-Finished, Special Quality, for Pressure Piping Components*

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

ASTM A705/705M, *Standard Specification for Age-Hardening Stainless Steel Forgings*

ASTM A739, *Standard Specification for Steel Bars, Alloy, Hot-Wrought, for Elevated Temperature or Pressure-Containing Parts, or Both*

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, *Standard 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 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 B124/B124M, *Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes*

ASTM B148, *Standard Specification for Aluminium-Bronze Sand Castings*

ASTM B150/B150M, *Standard Specification for Aluminum Bronze Rod, Bar, and Shapes*

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 B423, *Standard Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloy (UNS N08825, N08221, and N06845) Seamless Pipe and Tube*

ASTM B424, *Standard Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloys Plate, Sheet, and Strip*

ASTM B425, *Standard Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloys Rod and Bar*

ASTM B443, *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy and Nickel-Chromium-Molybdenum-Silicon Alloy 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 B462, *Standard Specification for Forged or Rolled Nickel Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service*

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 E10, *Standard Test Method for Brinell Hardness of Metallic Materials*

ASTM E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*

ASTM E165/E165M, *Standard Practice for Liquid Penetrant Examination for General Industry*

ASTM E384, *Standard Test Method for Microindentation Hardness of Materials*

ASTM E562, *Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count*

ASTM F467, *Standard Specification for Nonferrous Nuts for General Use*

ASTM F468, *Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use*

ASTM F788, *Standard Specification for Surface Discontinuities of Bolts, Screws, Studs, and Rivets, Inch and Metric Series*

ASTM F812 , *Standard Specification for Surface Discontinuities of Nuts, Inch and Metric Series*

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 G28, *Standard Test Methods for Detecting Susceptibility to Intergranular Corrosion in Wrought, Nickel-Rich, Chromium-Bearing Alloys*

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 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, *Steel and steel 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 ferritic/austenitic (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 manufacturers of special materials*

3 Terms, definitions, acronyms and abbreviations

3.1 Terms and definitions

3.1.1
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)

3.1.2
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

3.1.3
stainless steel
steel containing ≥ 10.5 % Cr (by mass), possibly with other elements added to secure special properties

3.1.4
austenitic stainless steel
stainless steel whose microstructure at room temperature consists predominantly of austenite

3.1.5
stainless steel types 304 and 316
austenitic stainless steel certified to meet both 304/304L or 316/316L properties

3.1.6
stainless steel type 6Mo
austenitic stainless steel alloys with 6 % Mo and PREN ≥ 40.0

3.1.7
stainless steel type 22Cr duplex
ferritic-austenitic stainless steel alloys with 30.0 ≤ PREN < 40.0 and Cr ≥ 19 % (by mass)

3.1.8
stainless steel type 25Cr duplex
ferritic-austenitic stainless steel alloys with 40.0 ≤ PREN < 48.0, often referred to as "super duplex"

3.1.9
martensitic stainless steel
stainless steel whose microstructure at room temperature consists predominantly of martensite

3.1.10
precipitation-hardened stainless steel
stainless steel with a high strength resulting from the precipitation of intermetallic compounds by a final heat treatment

3.1.11
nickel alloys
metallic material in which nickel is the major element

3.1.12
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

3.1.13
nominal pipe size
numerical designation of size in inches which is common to components in piping systems

3.1.14
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

3.1.15
nickel-alloyed steel
alloyed steel containing more than 1.5 % Ni

3.1.16
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)

3.1.17
manufacturer (material)
party, including subcontractors, which carries out operations (e.g. forming, heat treatment, welding) that affect the material properties of the finished product

3.2 Acronym, abbreviations and symbols

ACCP ASNT Central Certification Program

AOD argon oxygen decarburization

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 diamètre nominal (French for nominal diameter)

EBW electron beam welding

EDS element datasheet

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
HRB	Rockwell hardness, B scale
HRC	Rockwell hardness, C scale
HV	Vickers hardness
HVOF	high velocity oxygen fuel
LBW	laser beam welding
MDS	material data sheet
MCPR	manufacturing procedure conformity record
MPS	material process specification
MT	magnetic particle testing
NDE	non-destructive examination (equivalent to NDT)
NDT	non-destructive testing
NPS	nominal pipe size
OD	outer diameter
PREN	pitting resistance equivalent number (%Cr + 3.3 x % (Mo + 0.5W) + 16 x %N), with chemical element concentration expressed in mass fraction percent.
PSL	product specification level
PT	penetrant testing
PTAW	plasma transfer arc welding
PWHT	post weld 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

UNS unified numbering system

UT ultrasonic testing

VT visual testing

WC tungsten carbide

WPS welding procedure specification

4 Material and element data sheets

4.1 General

The material data sheets (MDSs) are collated in Annex A. They define applicable options and 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 or specification shall apply. The latest issue of the referenced standard or specification at the time of purchase shall apply.

NOTE ASTM standard designations comprising the "M" specification designation for SI units, appear in the MDSs in an abbreviated form, e.g. ASTM A105/A105M is referenced as ASTM A105 in the MDS.

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 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

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

L − nickel-alloyed steel

M − martensitic stainless steel

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

V − Cr and Cr-Mo alloyed steels

X − high strength low alloyed steels

The suffix identifies a material delivered in accordance with the MDS including the supplementary requirements for the following service:

S – sour service, excluding HIC testing

SH – sour service including HIC testing and UT examination, where applicable to the material and product form

K – hydrogen service at elevated temperature and pressure

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 practical.

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 steels 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 specification.

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 or manufacturer shall produce a pilot casting (see definition in 3.1.12) 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.

Table 1 — Pilot casting material qualification ranges

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
Nickel-alloyed steel	All grades of nickel-alloyed steel
Martensitic stainless steel	All grades of martensitic stainless steel
Austenitic stainless steel	All grades of austenitic stainless steel except 6Mo
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 and Ni-alloys
Nickel alloys	All grades of austenitic stainless steel including 6Mo and Ni-alloys
Titanium (un-alloyed)	All un-alloyed grades of titanium
Ni-Al bronze	All grades of Ni-Al bronze

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.

4.9 Low temperature and cryogenic service

4.9.1

Materials exposed to low temperature and cryogenic service shall be impact tested in accordance with the applicable design code, in addition to the requirement of the MDS.

4.9.2

Procedures for hard facing by overlay welding of parts exposed to low temperature and cryogenic service shall be impact tested at the design minimum temperature specified for the parent metal by the applicable design code with test sampling and location in accordance with the EDS.

4.10 High pressure service

4.10.1

Material for service designated as high pressure service shall comply with the requirements of ASME B31.3, Chapter IX, which amend the MDS, and the following provisions.

4.10.2

Sampling of impact test specimens for 22Cr and 25Cr duplex stainless steels wrought products shall comply with the MDS.

4.10.3

Location and orientation of impact test specimens for bars intended for machining of valve parts in high pressure service shall be in accordance with the MDS.

4.10.4

Acceptance criteria for 22Cr and 25Cr duplex stainless steels shall be according to ISO 17781 QL I.

Annex A
(normative)
Material data sheets

The material data sheets are listed in Table A.1 and compiled in this annex.

Table A.1 — List of material data sheets per type of material

Type of material	Material standard and grade(s)	Product form	MDS No.	MDS rev.
Non-impact tested carbon steel	ASTM A106 Grade B	Seamless pipes	IC001	01
	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, WCC	Castings	IC006	02
	ASTM A696 Grade B, C	Bars	IC007	01
Impact tested carbon steel	ASTM A333 Grade 6	Seamless pipes	IC101	01
	ASTM A671 Grade CC60, CC65, CC70	Welded pipes	IC102	01
	ASTM A420 Grade WPL 6	Wrought fittings	IC103	01
	ASTM A350 Grade LF2, LF6	Forgings	IC104	01
	ASTM A516 Grade 60, 65, 70	Plates	IC105	01
	ASTM A352 Grade LCC	Castings	IC106	02
	ASTM A696 Grade B, C	Bars	IC107	01
Ferritic- austenitic stainless steel type 22Cr Duplex	ASTM A790 UNS S31803, UNS S32205	Seamless pipes	ID141	01
	ASTM A928 UNS S31803, UNS S32205	Welded pipes	ID142	01
	ASTM A815 UNS S31803, UNS S32205	Wrought fittings	ID143	01
	ASTM A182 Grade F51, F60	Forgings	ID144	01
	ASTM A240 UNS S31803, UNS S32205	Plates	ID145	01
	ASTM A995 Grade 4A (UNS J92205)	Castings	ID146	01
	ASTM A276 / ASTM A479 UNS S31803, UNS S32205	Bars	ID147	01
	ASTM A789 UNS S31803, UNS S32205	Tubes	ID148	01
	ASTM A988 UNS S31803, UNS S32205	HIP products	ID149	01

Table A.1 — List of material data sheets per type of material *(continued)*

Type of material	Material standard and grade(s)	Product form	MDS No.	MDS rev.
Ferritic- austenitic stainless steel type 25Cr Duplex	ASTM A790 UNS S32550, UNS S32750, UNS S32760	Seamless pipes	ID251	01
	ASTM A928 UNS S32550, UNS S32750, UNS S32760	Welded pipes	ID252	01
	ASTM A815 UNS S32550, UNS S32750, UNS S32760	Wrought fittings	ID253	01
	ASTM A182 Grade F53 (UNS S32750), Grade F55 (UNS S32760), Grade F61 (UNS S32550)	Forgings	ID254	02
	ASTM A240 UNS S32550, UNS S32750, UNS S32760	Plates	ID255	01
	ASTM A995 Grade 6A (UNS J93380), Grade 5A (UNS J93404)	Castings	ID256	01
	ASTM A276 / ASTM A479 UNS S32550, UNS S32750, UNS S32760	Bars	ID257	01
	ASTM A789 UNS S32550, UNS S32750, UNS S32760	Tubes	ID258	01
	ASTM A1082 (modified) UNS S32750, UNS S32760 (strain hardened)	Bolting	ID259	01
	ASTM A1082 UNS S32750, UNS S32760 (solution annealed)	Bolting	ID260	01
	ASTM A988 UNS S32750, UNS S32750, UNS S32505	HIP products	ID269	01
Copper- nickel 90-10	EEMUA 234 Grade 7060X	Seamless pipes and tubes	IK101	02
	EEMUA 234 Grade 7060X	Welded pipes	IK102	02
	EEMUA 234 Grade 7060X	Wrought fittings	IK103	02
	EEMUA 234 Grade 7060X	Flanges	IK104	02
	ASTM B171 UNS C70600	Plates and sheets	IK105	02
	ASTM B151 UNS C70600	Bars and rods	IK107	02
Aluminium - bronze	ASTM B148 UNS C95800	Castings	IK106	01
	ASTM B124 UNS C63000	Forgings	IK204	01
	ASTM B150 UNS C63200	Bars and rods	IK207	01
Nickel alloys	ASTM F467 UNS N06625 Grade 2	Nuts	IN100S [a]	01
	ASTM F468 UNS N06625	Studs, bolts, screws	IN100S [a]	01
	ASTM B705 UNS N06625	Welded pipes	IN102S [a]	01
	ASTM B366 UNS N06625	Wrought fittings	IN103S [a]	01
	ASTM B564 UNS N06625	Forgings	IN104S [a]	01
	ASTM B443 UNS N06625	Plates	IN105S [a]	01
	ASTM A494 Grade CW6MC, CX2MW	Castings	IN106S [a]	02

Table A.1 — List of material data sheets per type of material *(continued)*

Type of material	Material standard and grade(s)	Product form	MDS No.	MDS rev.
Nickel alloys *(continued)*	ASTM B446 UNS N06625	Bars	IN107S [a]	01
	ASTM B444 UNS N06625	Seamless pipes and tubes	IN111S [a]	01
	ASTM B834 UNS N06625 Grade 1	HIP products	IN119S [a]	01
	ASTM A962, API STD 6ACRA Grade 120K	Bolting	IN120S [a]	01
	ASTM B423 UNS N08825	Seamless pipes and tubes	IN201S [a]	01
	ASTM B705 UNS N08825	Welded pipes	IN202S [a]	01
	ASTM B366 UNS N08825	Wrought fittings	IN203S [a]	01
	ASTM B564 UNS N08825	Forgings	IN204S [a]	01
	ASTM B424 UNS N08825	Plates	IN205S [a]	01
	ASTM A494 Grade CU5MCuC	Castings	IN206S [a]	01
	ASTM B425 UNS N08825	Bars	IN207S [a]	01
Austenitic stainless steel type 6Mo	ASTM A312 UNS S31254, UNS N08367, UNS N08926	Seamless pipes	IR111	01
	ASTM A358 UNS S31254, UNS N08367, UNS N08926	Welded pipes	IR112	01
	ASTM A403 UNS S31254, UNS N08367, UNS N08926	Wrought fittings	IR113	01
	ASTM A182 Grade F44 (UNS S31254), F62 (UNS N08367), UNS N08926	Forgings	IR114	01
	ASTM A240 UNS S31254, UNS N08367, UNS N08926	Plates	IR115	02
	ASTM A351 Grade CK3MCuN, CN3MN	Castings	IR116	01
	ASTM A276 / ASTM A479 UNS S31254, UNS N08367, UNS N08926	Bars	IR117	01
	ASTM A269 UNS S31254, UNS N08367, UNS N08926	Tubes	IR118	01
	ASTM A988 UNS S31254, UNS N08367	HIP products	IR119	01
Austenitic stainless steel type 316	ASTM A312 Grade TP316	Seamless pipes	IS101	01
	ASTM A312 Grade TP316	Welded pipes	IS102	01
	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
	ASTM A276 / ASTM A479 Grade 316	Bars	IS107	01
	ASTM A269 Grade 316	Tubes	IS108	01
	ASTM A193 Grade B8M, B8M2, B8MA	Studs, bolts, screws	IS109	01
	ASTM A194 Grade 8M, 8MA	Nuts	IS109	01
	ASTM A320 Grade B8M, B8MA	Studs, bolts, screws	IS109	01

Table A.1 — List of material data sheets per type of material *(continued)*

Type of material	Material standard and grade(s)	Product form	MDS No.	MDS rev.
Austenitic stainless steel type 304	ASTM A312 Grade TP304	Seamless pipes	IS221	01
	ASTM A312 Grade TP304	Welded pipes	IS222	01
	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
	ASTM A276 / ASTM A479 Grade 304	Bars	IS227	01
	ASTM A269 Grade 304	Tubes	IS228	01
Austenitic stainless steel, stabilized grade	ASTM A312 Grade TP321, TP347	Seamless pipes	IS301	01
	ASTM A312 / ASTM A358 Grade TP321, TP347	Welded pipes	IS302	01
	ASTM A403 Grade WP321, WP347	Wrought fittings	IS303	01
	ASTM A182 Grade F321, F347	Forgings	IS304	01
	ASTM A240 Grade 321, 347	Plates	IS305	01
	ASTM A351 Grade CF8C	Castings	IS306	01
	ASTM A276 / ASTM A479 Grade 321, 347	Bars	IS307	01
	ASTM A269 Grade TP321, TP347	Tubes	IS308	01
	ASTM A312 Grade TP321H, TP347H	Seamless pipes	IS321	01
	ASTM A312 / ASTM A358 Grade TP321H, TP347H	Welded pipes	IS322	01
	ASTM A403 Grade WP321H, WP347H	Wrought fittings	IS323	01
	ASTM A182 Grade F347H, F321H	Forgings	IS324	01
	ASTM A240 Grade 321H, 347H	Plates	IS325	01
	ASTM A479 Grade 321H, 347H	Bars	IS327	01
Austenitic stainless steel, 200-series	ASTM A182 F XM-19 (UNS S20910)	Forgings	IS404	01
	ASTM A276 / ASTM A479 XM-19 (UNS S20910)	Bars	IS407	01
Martensitic stainless steel	ASTM A182 F6A	Forgings	IM104	01
	ASTM A217 CA15 (UNS J91150)	Castings	IM106	01
	ASTM A276 / ASTM A479 410 (UNS S41000)	Bars	IM107	01
	ASTM A276 420 (UNS S42000)	Bars	IM127	01
Martensitic stainless steel, precipitation-hardened	ASTM A705 Grade 630 (UNS S17400)	Forgings	IU604	01
	ASTM A564 Grade 630 (UNS S17400)	Bars	IU607	01

Table A.1 — List of material data sheets per type of material *(continued)*

Type of material	Material standard and grade(s)	Product form	MDS No.	MDS rev.
3.5% nickel alloyed steel	ASTM A333 Grade 3	Seamless pipes	IL101	01
	ASTM A671 CFE 70	Welded pipes	IL102	01
	ASTM A420 WPL3, WPL3W	Wrought fittings	IL103	01
	ASTM A350 LF3	Forgings	IL104	01
	ASTM A203 Grade D, E	Plate	IL105	01
	ASTM A352 LC3 (UNS J31550)	Castings	IL106	01
	ASTM A334 Grade 3	Tubes	IL108	01
Titanium Grade 2	ASTM B861 Grade 2	Seamless pipes	IT101	01
	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
	ASTM B348 Grade 2	Bars	IT107	01
	ASTM B338 Grade 2	Tubes	IT108	01
Precipitation -hardened stainless steel (austenitic)	ASTM A453 Grade 660 (UNS S66286)	Bolting	IU100	01
High strength low alloy steel	ASTM A320 Grade L7, L7M, L43	Studs, bolts, screws (HDG)	IX100	01
	ASTM A194 Grade 7, 7M, L43	Nuts (HDG)	IX100	01
	ASTM A320 Grade L7, L7M, L43	Studs, bolts, screws (black or uncoated)	IX109	01
	ASTM A194 Grade 7, 7M	Nuts (black or uncoated)	IX109	01
	ASTM A193 Grade B7, B7M	Studs, bolts, screws (black or uncoated)	IX110	01
	ASTM A194 Grade 2H, 2HM	Nuts (black or uncoated)	IX110	01
	ASTM A193 Grade B7, B7M	Studs, bolts, screws (HDG)	IX120	01
	ASTM A194 Grade 2H, 2HM	Nuts (HDG)	IX120	01
	ASTM A694 Grade F52, F60, F65	Forgings	IX124	01
	ASTM A29 Grade 4140, F52, F60, F65	Bars	IX127	01
1¼ Cr ½ Mo alloy steel	ASTM A335 P11	Seamless pipes	IV101	01
	ASTM A691 1¼ Cr	Welded pipes	IV102	01
	ASTM A234 WP11	Wrought fittings	IV103	01
	ASTM A182 F11	Forgings	IV104	01
	ASTM A387 Grade 11	Plate	IV105	01
	ASTM A217 WC6	Castings	IV106	01
	ASTM A739 B11	Bars	IV107	01

Table A.1 — List of material data sheets per type of material *(continued)*

Type of material	Material standard and grade(s)	Product form	MDS No.	MDS rev.
2¼ Cr 1 Mo alloy steel	ASTM A335 P22	Seamless pipes	IV201	01
	ASTM A691 2¼ Cr	Welded pipes	IV202	01
	ASTM A234 WP22	Wrought fittings	IV203	01
	ASTM A182 F22	Forgings	IV204	01
	ASTM A387 Grade 22	Plate	IV205	01
	ASTM A217 WC9	Castings	IV206	01
	ASTM A739 B22	Bars	IV207	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. Supplementary suffix "K" is added to the MDS designation to indicate a material delivered in accordance with the MDS including the additional supplementary requirements for hydrogen service.				
[a] MDSs for Ni-alloy are designated with supplementary suffix “S” only.				

A.2 IOGP material data sheets

Table A.2 — MDS IC001 / IC001S

Material Data Sheet	**MDS No. IC001 / IC001S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A106	B	-	ASTM A106 S6
	API 5L	B	PSL1 or PSL2	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	API 5L Grade B PSL1 pipe steel shall be killed.			
Manufacturing	Cold-drawn pipes shall be heat treated after cold forming.			
Chemical composition	For ASTM A106 supplementary requirement, S6 applies with the following restrictions: C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. The following restrictions apply to API 5L pipes: C ≤ 0.23 %, CE ≤ 0.43 %.			
	Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.			
Repair of defects	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS.			
	Chemical composition 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 traceable in accordance with ISO 15156-2/NACE MR0175-2, 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 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.			

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

Table A.3 — MDS IC002 / IC002S

Material Data Sheet	**MDS No. IC002 / IC002S [a] / IC002SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon 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	B	PSL1 or PSL2	-

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	API 5L Grade B PSL1 pipe steel shall be killed and made according to fine grain practice.
Manufacturing	– The longitudinal weld shall be straight and made using the SAW process. – The weld metal shall be mild steel analysis A-No.1 as per ASME *BPVC,* Sec. IX, Table QW-442.
Chemical composition	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	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 weld seam.
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 meet the chemistry requirements of the original manufacturing weld.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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>*Chemical composition*</u> S ≤ 0.003 % Ni < 1.0 % for the weld metal <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. – 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. <u>*HIC testing and UT examination*</u> When suffix SU applies, one finished pipe per ASTM A672 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 A672, S11 shall apply. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.

Material Data Sheet	**MDS No. IC002 / IC002S [a] / IC002SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon 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	B	PSL1 or PSL2	-
Page 2 of 2				
Marking	The pipes 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.			

[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, but excluding HIC testing and UT examination.

[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.

Table A.4 — MDS IC003 / IC003S / IC003SH

Material Data Sheet	**MDS 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 ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately 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). All hot formed or forged fittings, including those manufactured by locally heating a portion of the fitting stock, shall be heat treated after manufacture.			
Tensile testing	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.			
Non-destructive testing	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 meet the chemistry requirements of the original manufacturing weld.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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. *Chemical composition* – 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* WPB fittings production hardness testing shall be performed in accordance with the requirements in ASTM A234. Hardness testing for WPBW fittings: – 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. – Production testing shall be performed in accordance with the requirements in ASTM A234 and shall include parent material, weld and HAZ. *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: • 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 testing 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.			

Material Data Sheet	**MDS 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 2 of 2				
Marking	The fittings 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.			

[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, but excluding HIC testing and UT examination.

[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.

Table A.5 — MDS IC004 / IC004S

Material Data Sheet	**MDS No. IC004 / IC004S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A105	-	-	ASTM A105 S2, S4
Page 1 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 ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately 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).
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 permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 A105. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Marking	The forgings 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.

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

Table A.6 — MDS IC005 / IC005S / IC005SH

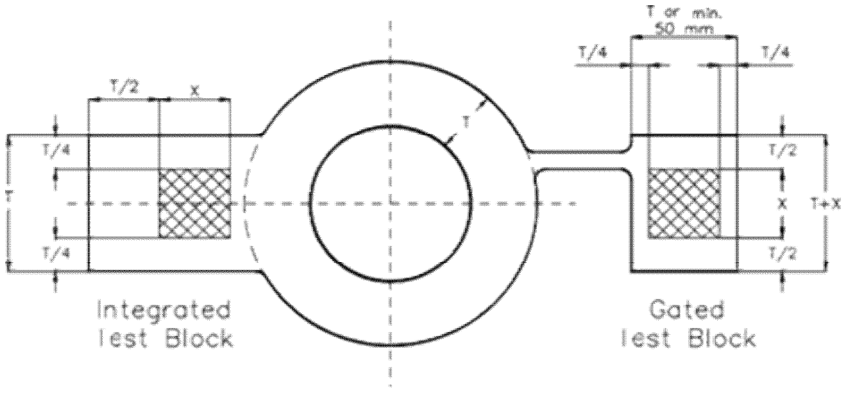
Material Data Sheet	**MDS No. IC005 / IC005S [a] / IC005SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A516	60	-	-
	ASTM A516	65	-	-
	ASTM A516	70	-	-
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. For Grade 60 plate 12.5 mm thick and thinner, C ≤ 0.21 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
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 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, b]	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. *Chemical composition* S ≤ 0.003 % *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. • 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 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 plates 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.

[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, but excluding HIC testing and UT examination.

[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.

Table A.7 — MDS IC006 / IC006S

Material Data Sheet	**MDS No. IC006 / IC006S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Non-impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A216	WCB	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20
	ASTM A216	WCC	-	ASTM A216 S4, S5, S50, 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 S50 and S52 apply with the following restrictions: C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.			
Heat treatment	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]	**Rev. 02**

TYPE OF MATERIAL: *Non-impact tested carbon steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A216	WCB	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20
	ASTM A216	WCC	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20

Non-destructive testing

Visual inspection

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each production casting
Method	ANSI/MSS SP-55	
Extent	100 % of all accessible surfaces including welding 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.		

Magnetic particle testing

ASTM A216 supplementary requirement S4 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC,* Sec. V, Article 7	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. 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 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 No. IC006 / IC006S** [a]	**Rev. 02**

TYPE OF MATERIAL: *Non-impact tested carbon steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A216	WCB	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20
	ASTM A216	WCC	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20

Non-destructive testing *(continued)*

Radiographic testing

ASTM A216 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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, sections 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 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.

Material Data Sheet	**MDS No. IC006 / IC006S** [a]	**Rev. 02**

TYPE OF MATERIAL: *Non-impact tested carbon steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A216	WCB	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20
	ASTM A216	WCC	-	ASTM A216 S4, S5, S50, S52 ASTM A703 S12, S14, S20 ASTM A985 S12, S14, S20

Sour service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. *Hardness testing* – 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 information: – Heat treatment condition. For tempered condition, tempering temperature shall be stated.

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

Table A.8 — MDS IC007 / IC007S

Material Data Sheet	**MDS No. IC007 / IC007S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A696	B	-	-
	ASTM A696	C	-	-
	ASTM A105	-	-	-
Page 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 (NPS 4) and under manufactured from bars, when permitted by the valve specification.			
Manufacturing	Bars shall be manufactured to the following requirements: – bar forgings as defined in ASTM A788 and certified to ASTM A105; 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 ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately 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	*Valve parts manufactured from bar* 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 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 permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. *Chemical composition* S ≤ 0.020 %, Ni < 1.0 % *Hardness testing* Production 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 15156-2/NACE MR0175-2, section 9 and this MDS.			

Material Data Sheet	**MDS No. IC007 / IC007S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Non-impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A696	B	-	-
	ASTM A696	C	-	-
	ASTM A105	-	-	-
Page 2 of 2				
Marking	The bars 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.			

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

Table A.9 — MDS IC101 / IC101S

Material Data Sheet	**MDS No. IC101 / IC101S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Impact tested carbon steel*				
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 composition	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	During the heat treatment process, 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 (1 148 °F).
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 permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. *Chemical composition* 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 traceable in accordance with ISO 15156-2/NACE MR0175-2, 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 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.

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

Table A.10 — MDS IC102 / IC102S / IC102SH

Material Data Sheet	**MDS No. IC102 / IC102S [a] / IC102SH [b]**			**Rev. 01**
TYPE 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 1 of 2

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Manufacturing	The longitudinal weld shall be straight and made using the SAW process. The weld metal shall be mild steel analysis A-No.1 per ASME *BPVC*, Sec. IX, Table QW-442.
Chemical composition	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	During the heat treatment process, 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 ≥ 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.
Extent of testing	For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F). Impact testing per ASTM A671 supplementary requirement S2, as modified by this MDS, shall also be carried out per lot (ASTM A671 supplementary requirement 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. Repairs to weld metal are acceptable in accordance with the standard specification and shall meet the chemistry requirements of the original manufacturing weld.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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>*Chemical composition*</u> S ≤ 0.003 % Ni < 1.0 % for the weld metal <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 250 HV. – 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 250 HV.

Material Data Sheet	**MDS No. IC102 / IC102S [a] / IC102SH [b]**			**Rev. 01**
TYPE 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

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b] *(continued)*	*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.
	The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, 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 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.

[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, but excluding HIC testing and UT examination.

[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.

Table A.11 — MDS IC103 / IC103S / IC103SH

Material Data Sheet	**MDS No. IC103 / IC103S [a] / IC103SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Impact tested carbon 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

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	During the heat treatment process, fittings shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation. All hot formed or forged fittings, including those manufactured by locally heating a portion of the fitting stock, shall be heat treated after manufacture. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °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	ASTM A960 supplementary requirement S57 shall apply with the following requirements: hardness testing shall be carried out on a minimum two fittings, including parent material, weld and HAZ, for each test lot, and shall not exceed 197 HBW.
Extent of testing	Impact testing shall also be carried out for each heat and heat treatment load.
Non-destructive testing	UT is not acceptable in lieu of RT. *Magnetic particle testing* ASTM A960 supplementary requirement S53 and S69 shall apply as amended by this MDS.

NDE requirement	**Nominal thickness**	
	< 12.7 mm (½ in)	**≥ 12.7 mm (½ 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 internal and external surfaces shall be examined.

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 meet the chemistry requirements of the original manufacturing weld.

Material Data Sheet	**MDS No. IC103 / IC103S [a] / IC103SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Impact tested carbon 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

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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. *Chemical composition* – S ≤ 0.010 % for WPL6 and WPL6W fittings made from products other than flat-rolled or forged – 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 ≤ 15 %, CTR ≤ 5 %, CSR ≤ 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 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.

[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, but excluding HIC testing and UT examination.

[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.

Table A.12 — MDS IC104 / IC104S

Material Data Sheet	**MDS No. IC104 / IC104S** [a]			**Rev. 01**
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 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 A350 S6 applies with the following restrictions: C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. LF2 forgings: microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	During the heat treatment process, forgings shall be placed in such a way as to ensure free circulation around each forging including any quenching operation. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °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	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] 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.

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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A350. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.

Material Data Sheet	**MDS No. IC104 / IC104S** [a]			**Rev. 01**
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 2				
Marking	The forgings 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.			

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

Table A.13 — MDS IC105 / IC105S / IC105SH

Material Data Sheet	**MDS No. IC105 / IC105S [a] / IC105SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Impact tested carbon 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 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. For Grade 60 plate 12,5 mm (½ in) thick and thinner, C ≤ 0.21 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	During the heat treatment process, components shall be placed in such a way as to ensure free circulation around each plate including any quenching operation.
Impact testing / toughness testing	Impact testing is required for thickness ≥ 6 mm (0.236 in). 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. The test specimen shall be taken in the longitudinal orientation to the final direction of rolling.
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 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, b]	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. *Chemical composition* S ≤ 0.003 % *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. • 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 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 plates shall be marked to ensure full traceability to melt and heat treatment lot.

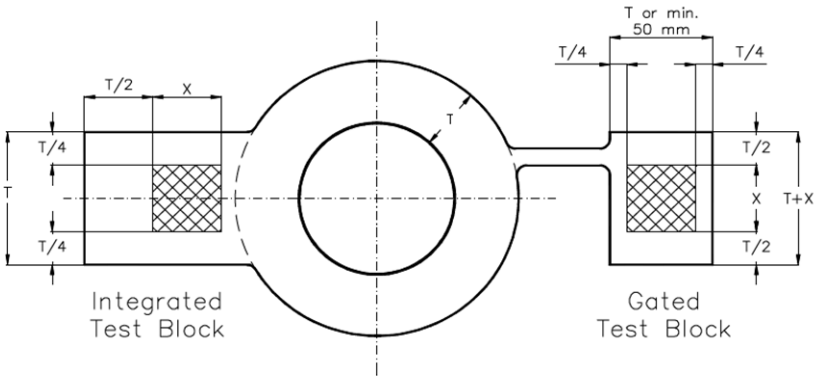
Material Data Sheet	**MDS No. IC105 / IC105S [a] / IC105SH [b]**			**Rev. 01**
TYPE OF MATERIAL: *Impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A516	60	-	ASTM A516 S5
	ASTM A516	65	-	ASTM A516 S5
	ASTM A516	70	-	ASTM A516 S5
Page 2 of 2				
Certification	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.			

[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, but excluding HIC testing and UT examination.

[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.

Table A.14 — MDS IC106 / IC106S

Material Data Sheet	**MDS No. IC106 / IC106S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S52 ASTM A703 S8, S14, S20
Page 1 of 3				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	Supplementary requirement S52 applies with the following restrictions: C ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 0.43 %. Microalloying elements (Nb, V, Ti, B) shall not be deliberately added.
Heat treatment	During the heat treatment process, castings shall be placed in such a way as to ensure free circulation around each casting including possible quenching operation. For products delivered in the tempered condition, the minimum tempering temperature shall be 620 °C (1 148 °F).
Impact testing / toughness testing	ASTM A703 supplementary requirement S8 shall apply. Impact testing shall be performed at a minimum temperature of -46 °C (-50 °F). Acceptance criteria shall be 27 J (20 ft lbf) average, 20 J (15 ft lbf) single.
Extent of testing	ASTM A703 supplementary requirement S14 shall apply.
Test sampling	Test blocks shall be integrally cast or gated onto the casting and shall accompany the castings through all heat treatment operations including any post weld stress relieving. Thickness of the test block shall be equal to the thickest part of the casting represented up to a maximum thickness of 100 mm (4 in). For flanged components, the largest flange thickness is the ruling section. Dimensions of test blocks and location of test specimens within the test blocks are shown in the figure below for integral and gated test block. The test specimens shall be taken within the cross hatched area. Distance from end of test specimen to end of test block shall minimum be T/4. 
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each production casting
Method	ANSI/MSS SP-55	
Extent	100 % of all accessible surfaces including welding 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.		

Material Data Sheet	**MDS No. IC106 / IC106S** [a]	**Rev. 02**

TYPE OF MATERIAL: *Impact tested carbon steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S52 ASTM A703 S8, S14, S20

Non-destructive testing *(continued)*

Magnetic particle testing

ASTM A352 supplementary requirement S4 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 7	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. 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 castings, MT 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.

Radiographic testing

ASTM A352 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IC106 / IC106S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A352	LCC	-	ASTM A352 S4, S5, S52 ASTM A703 S8, S14, S20
Page 3 of 3				

Repair of defects	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 ASTM 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]	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. *Hardness testing* – Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 22HRC from three readings taken in close proximity. – Welding procedure qualification testing for all repair welding shall meet the requirements of NACE MR0175 2/ISO 15156-2, section 7.3.3, using Vickers method, with a maximum hardness of 250HV. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Marking	The castings shall be marked to ensure full traceability to melt and heat treatment lot.
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Heat treatment condition. For tempered condition, tempering temperature shall be stated.

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

Table A.15 — MDS IC107 / IC107S

Material Data Sheet	**MDS No. IC107 / IC107S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Impact tested carbon steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A696	B	-	ASTM A696 S5
	ASTM A696	C	-	ASTM A696 S5
	ASTM A350	LF2	Class 1	
	ASTM A350	LF6	Class 1 or 2	
Page 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 (NPS 4) and under manufactured from bars, when permitted by the valve specification.			
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 ≤ 0.23 %, S ≤ 0.020 %, P ≤ 0.025 %, CE ≤ 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 each bar including any quenching operation.			
Impact testing / toughness testing	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	*Valve parts manufactured from bar* Sampling of test specimens for bars intended for machining of valve parts shall comply with the following requirements: – The mid-length of the axial tensile and impact test 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, 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 and impact test specimens 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. – The notch of the impact test specimen shall be located perpendicular to the bar surface. – For bar with outside diameter < 100 mm (4 in): one tensile and one set impact test specimens shall be taken. – For bar with outside diameter ≥ 100 mm (4 in): one tensile and set impact test specimens shall be taken in axial direction of the bar. In addition, one tensile test specimen and one set impact test specimens shall be taken in tangential direction of the bar; the centreline of the tensile test specimen shall be located a minimum of 100 mm (4 in) from the end of the bar. – The specified minimum tensile strength of the referenced standard and impact energies specified in this data sheet shall be met in both directions.			

Material Data Sheet	**MDS No. IC107 / IC107S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Impact tested carbon steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A696	B	-	ASTM A696 S5
	ASTM A696	C	-	ASTM A696 S5
	ASTM A350	LF2	Class 1	
	ASTM A350	LF6	Class 1 or 2	

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 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	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.

Repair of defects

Weld repair is not permitted.

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]

When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS.

Chemical composition

S ≤ 0.020 %, Ni < 1.0 %

Hardness testing

Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 22HRC from three readings taken in close 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 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.

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

Table A.16 — MDS ID141 / ID141S

Material Data Sheet	**MDS No. ID141 / ID141S** [a]			**Rev. 01**
TYPE OF MATERIAL: Ferritic-Austenitic stainless 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 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.
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 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 specimens, testing methodology and acceptance criteria shall comply with ISO 17781 QL II.
Hardness testing	Hardness testing shall be performed by the Rockwell C method.
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 specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781.
Extent of testing	One tensile, one set of impact tests, one corrosion test and one micrographic examination including ferrite measurements shall be carried out for each heat and heat treatment lot.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on one length of pipe per lot. The maximum hardness shall be 28HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished pipes shall 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 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 temperature, holding time and quenching medium shall be stated (holding time is not applicable for pipes produced hot finished and direct quenched).

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

Table A.17 — MDS ID142 / ID142S

Material Data Sheet	**MDS No. ID142 / ID142S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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

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.
Metal making	The melt shall be refined by AOD or equivalent method.
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, include the same examinations as for the production testing and 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 shall require 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.
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	Supplementary requirement S4 shall apply as modified by this MDS. 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	One tensile, one set of impact tests, one corrosion test and one micrographic examination 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 comply 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	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 8

NOTE The testing shall be carried out after any calibration, pickling/bright annealing and machining. The weld at each end of the examined pipe shall be ground flush in a length of 100 mm (4 in) prior to penetrant 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 external and accessible internal surfaces of the weld shall be examined.

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 the original production weld.

Material Data Sheet	**MDS No. ID142 / ID142S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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 2 of 2				
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. *Hardness testing* – 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 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. – Solution annealing temperature, holding time and 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.

Table A.18 — MDS ID143 / ID143S

Material Data Sheet	**MDS No. ID143 / ID143S** [a]			**Rev. 01**
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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
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 shall require requalification.			
Heat treatment	The fittings shall be solution annealed followed by water/liquid quenching. 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.			
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	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	One tensile, impact tests and corrosion test and one micrographic examination including ferrite measurement shall be carried out for each lot as defined below. A test lot shall include all fittings from the same heat and heat treatment load, with a wall thickness range of ±5 mm (±0.2 in) and, where applicable, welded with the same WPS. Production hardness testing in accordance with the requirements in ASTM A815 shall be carried out on two fittings per lot. When only one fitting is produced, it shall be hardness tested as required.			

Material Data Sheet	**MDS No. ID143 / ID143S** [a]	**Rev. 01**

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

Non-destructive testing

Ultrasonic testing is not acceptable as replacement for RT of fittings.

Liquid penetrant testing

ASTM A815 supplementary requirement S7 shall apply as amended by this MDS.

NDE requirement	**Nominal Thickness**	
	Seamless fittings	**Welded fittings** [a]
Frequency [b]	10 %	100 %
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 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 internal and external surfaces shall be examined. For welded fittings, the testing shall cover the weld only.

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. Repair welds shall be heat treated as per the original production 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.

Hardness testing

- 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.

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 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.
- Steel manufacturer of the starting material for the finished product.
- Solution annealing temperature, holding time and 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.

Table A.19 — MDS ID144 / ID144S

Material Data Sheet	**MDS No. ID144 / ID144S** [a]			**Rev. 01**
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 300 mm (12 in), qualification and specification requirements shall be subject to agreement.
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.
Metal making	The melt shall be refined by AOD or equivalent method.
Chemical composition	UNS S31803: N = 0.14 % - 0.20 %
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.
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	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 an area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.
Extent of testing	One tensile, impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each heat and heat treatment load. The testing shall be carried out on the forgings with heaviest wall thickness within the heat treatment load. A test lot shall not exceed 2 000 kg (4 400 lb) for forgings with as forged weight up to 50 kg (110 lb), and 5 000 kg (11 000 lb) for forgings with as forged weight > 50 kg (110 lb).
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* ASTM A961 supplementary requirement S56 shall apply as amended by this MDS.

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

NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing.

[a] Forgings 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.

Material Data Sheet	**MDS No. ID144 / ID144S** [a]			**Rev. 01**
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				
Non-destructive testing *(continued)*	<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 permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. <u>*Hardness testing*</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on two forgings per lot. 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 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: – The MPS identification or the MCPR/QTR number used. – Steel manufacturer. – 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.

Table A.20 — MDS ID145 / ID145S

Material Data 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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
Chemical composition	UNS S31803: N = 0.14 % - 0.20 %			
Heat treatment	The plates shall be solution annealed followed by water/liquid quenching. Plates shall be placed in such a way as to ensure free circulation of heating and cooling media around each plate during the heat treatment process including quenching.			
Tensile testing	Tensile test specimens shall be sampled in the transverse orientation to the direction of final rolling.			
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	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	One tensile, one set of impact tests, one corrosion test and one micrographic examination including ferrite measurement shall be carried out for each heat of steel and heat treatment 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 of plate 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, 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. *Hardness testing* 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 traceable in accordance with ISO 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 strips shall be marked to ensure full traceability to heat and heat treatment lot.			

Material Data 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 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. – Solution annealing temperature, holding time and 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.

Table A.21 — MDS ID146 / ID146S

Material Data Sheet	**MDS No. ID146 / ID146S** [a]			**Rev. 01**
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

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.
Metal making	The melt shall be refined by AOD or equivalent method. Induction melting of AOD refined ingot or equally refined scrap as permitted by ISO 17782 is regarded to be equivalent to AOD refined materials.
Chemical composition	N = 0.14 % - 0.30 %
Heat treatment	The castings shall be solution annealed followed by water/liquid quenching. Castings shall be placed in such a way as to ensure free circulation of heating and cooling media around each casting during the heat treatment process including quenching.
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	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	One tensile, one set of impact tests, one 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	The test blocks shall be in compliance with ISO 17781.
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 cleaned prior to the testing.		

Material Data Sheet	**MDS No. ID146 / ID146S** [a]	**Rev. 01**

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

Non-destructive testing *(continued)*

Liquid penetrant testing

ASTM A995 supplementary requirement S6 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7	

NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be 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.
[c] All accessible internal and external surfaces shall be examined.

Radiographic testing

ASTM A995 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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.

Material Data Sheet	**MDS No. ID146 / ID146S** [a]	**Rev. 01**

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

Repair of defects	All major repairs as defined by ASTM A995 shall be documented in accordance with ASTM A703 supplementary requirement S20.2. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and the following: – 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. – Microstructure examination, ferrite measurement, Charpy V-notch and corrosion tests shall be carried out in accordance with ISO 17781. 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, 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. *Hardness testing* − Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 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, 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 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 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 melting and refining practice. – 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.

Table A.22 — MDS ID147 / ID147S

Material Data 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 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 (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 300 mm (12 in). For thickness exceeding 300 mm (12 in), qualification and specification requirements shall be subject to agreement.			
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.			
Metal making	The melt shall be refined by AOD or equivalent method.			
Manufacturing	Bars shall be manufactured to the following requirements: – bar forgings as defined in ASTM A788 and certified to ASTM A182; or – hot or cold finished cylindrical shaped bar manufactured to ASTM A276 or A479 with maximum diameter of 300 mm (12 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	UNS S31803: N = 0.14 % - 0.20 %			
Heat treatment	Bars shall be solution annealed followed by water/liquid quenching. Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including quenching.			
Tensile testing	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 MDS, sampling and acceptance criteria shall comply with ISO 17781 QL II. Where impact testing in the tangential direction is required by this MDS, the acceptance criteria shall be 45 J (33 ft lbf) average, 35 J (26 ft lbf) minimum single.			
Corrosion testing	The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the centre of the bar.			
Micrographic examination	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the centre of the bar and sample an area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.			
Extent of testing	Tensile, impact tests and corrosion tests, and one micrographic examination including ferrite measurements shall be carried out for each lot as defined in ASTM A484.			
Test sampling	The mid-length of axial (longitudinal) and tangential (transverse) specimens shall be located at a distance equal to the bar outside diameter or minimum of 100 mm (4 in) , whichever is the greater, from the end of the 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.			

Material Data 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)	-	-

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 including liquid penetrant testing according to the following table.

NDE requirement	**Part manufactured from bar** [a]
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 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 metallurgical, manufacturing, testing and certification requirements)

When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on the end surface of one bar per lot. The maximum hardness shall be 28HRC from three readings taken in close proximity.

The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.

Surface treatment and finish

Finished product shall be white pickled.

Marking

The bars shall be marked to ensure full traceability to heat and heat treatment lot.

Certification

The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.

The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.

The inspection documents shall include the following information:

– The MPS identification or the MCPR/QTR number used.
– Steel manufacturer of starting material.
– 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.

Table A.23 — MDS ID148 / ID148S

Material Data Sheet	**MDS No. ID148 / ID148S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
Chemical composition	UNS S31803: N = 0.14 % - 0.20 %			
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 heating and cooling media around each tube during the heat treatment process including rapid cooling.			
Impact testing / toughness testing	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.			
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	Tensile testing, one set of impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each lot as defined in the standard for mechanical tests.			
Repair of defects	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. <u>*Hardness testing*</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one tube per lot. The maximum hardness shall be 28HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished tubes shall be pickled or bright annealed.			
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. – Solution annealing temperature, holding time and 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.

Table A.24 — MDS ID149 / ID149S

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

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced ASTM standard specification. Product covered by this MDS is limited to a maximum thickness of 300 mm (12 in). For thickness exceeding 300 mm (12 in), 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	Gas atomized powder made from AOD-refined metal. Powder blends shall be a homogenous mixture of powder heats in terms of composition, particle size and other properties.
Chemical composition	UNS S31803: N = 0.14 % - 0.20 %
Heat treatment	The HIP product shall be solution annealed followed by 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 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	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements 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 and shall sample an area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.
Extent of testing	One tensile, one set of impact tests, one 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	*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	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 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.

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
Page 2 of 2				
Repair of defects	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on two parts per lot. When only one part is produced, it shall be hardness tested as required. The maximum 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 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 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 (powder) for the finished product. – Solution annealing temperature, holding time and 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.

Table A.25 — MDS ID251 / ID251S

Material Data 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 applicable options and/or requirements that supplement or amend the referenced ASTM 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.
Metal making	The melt shall be refined by AOD or equivalent method.
Chemical composition	PREN ≥ 40.0
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.
Impact testing / toughness testing	The sampling of test specimens, testing methodology and acceptance criteria shall comply with ISO 17781 QL II.
Hardness testing	Hardness testing shall be performed by the Rockwell C method.
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 specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781.
Extent of testing	One tensile, one set of impact tests, one corrosion test and one microstructure examination including ferrite measurement shall be carried out for each heat and heat treatment lot.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on one length of pipe per lot. The maximum hardness shall be 32HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished pipes shall 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 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 temperature, holding time and quench medium shall be stated (holding time is not applicable for pipes produced hot finished and direct quenched).

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

Table A.26 — MDS ID252 / ID252S

Material Data Sheet	**MDS No. ID252 / ID252S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*				
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

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.
Metal making	The melt shall be refined by AOD or equivalent method.
Chemical composition	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 shall require 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.
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	Supplementary requirement S4 shall apply as modified by this MDS. 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	One tensile, one set of impact tests, one corrosion test and one microstructure examination 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 comply with the product standards.
Non-destructive testing	<u>*Liquid penetrant testing*</u> 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	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 8

NOTE The testing shall be carried out after any calibration, pickling/bright annealing and machining. The weld at each end of the examined pipe shall be ground flush in a length of 100 mm (4 in) prior to penetrant 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 external and accessible internal surfaces of the weld shall be examined.

Material Data Sheet	**MDS No. ID252 / ID252S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*				
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

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 (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. *Hardness testing* − 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	Finished pipes shall 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 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. – Solution annealing temperature, holding time and 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.

Table A.27 — MDS ID253 / ID253S

Material Data Sheet	**MDS No. ID253 / ID253S** [a]		**Rev. 01**	
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
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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
Chemical composition	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 shall require requalification.			
Heat treatment	The fittings shall be solution annealed followed by water/liquid quenching. 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.			
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	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	One tensile, impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each lot as defined below. A test lot shall include all fittings from the same heat and heat treatment load, with a wall thickness range of ±5 mm (±0.2 in) and, where applicable, welded with the same WPS. Production hardness testing in accordance with the requirements in ASTM A815 shall be carried out on two fittings per lot. When only one fitting is produced, it shall be hardness tested as required.			

Material Data Sheet	**MDS No. ID253 / ID253S** [a]	**Rev. 01**

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

Non-destructive testing

Ultrasonic testing is not acceptable as replacement for RT of fittings.

Liquid penetrant testing

ASTM A815 supplementary requirement S7 shall apply as amended by this MDS.

NDE requirement	**Nominal thickness**	
	Seamless fittings	**Welded fittings** [a]
Frequency [b]	10 %	100 %
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 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 internal and external surfaces shall be examined. For welded fittings, the testing shall cover the weld only.

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. Repair welds shall be heat treated as per the original production 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.

Hardness testing

- 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 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 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.
- Steel manufacturer of the starting material for the finished product.
- Solution annealing temperature, holding time and 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.

Table A.28 — MDS ID254 / ID254S

Material Data Sheet	**MDS No. ID254 / ID254S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F53 (UNS S32750)	-	ASTM A961 S56
	ASTM A182	F55 (UNS S32760)	-	ASTM A961 S56
	ASTM A182	F61 (UNS S32550)	-	ASTM A961 S56

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced ASTM 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.
Metal making	The melt shall be refined by AOD or equivalent method.
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 forging during the heat treatment process including quenching.
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	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 an area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.
Extent of testing	One tensile, impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each heat and heat treatment load. The testing shall be carried out on the forging with heaviest wall thickness within the heat treatment load. A test lot shall not exceed 2 000 kg (4 400 lb) for forgings with as forged weight up to 50 kg (110 lb), and 5 000 kg (11 000 lb) for forgings with as forged weight > 50 kg (110 lb).
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 pickled prior to the testing.

Liquid penetrant testing

ASTM A961 supplementary requirement S56 shall apply as amended by this MDS.

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
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.

Material Data Sheet	**MDS No. ID254 / ID254S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F53 (UNS S32750)	-	ASTM 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 *(continued)*	*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 (additional metallurgical, manufacturing, testing and certification requirements) [a]	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 on 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.			
Surface treatment and finish	Finished forgings shall be pickled. Machined surfaces do not require pickling.			
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 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 of starting material for the finished product. – 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.

Table A.29 — MDS ID255 / ID255S

Material Data Sheet	**MDS No. ID255 / ID255S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
Chemical composition	PREN ≥ 40.0			
Heat treatment	The plates shall be solution annealed followed by water/liquid quenching. Plates shall be placed in such a way as to ensure free circulation of heating and cooling media around each plate during the heat treatment process including quenching.			
Tensile testing	Tensile test specimens shall be sampled in the transverse orientation to the direction of final rolling.			
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	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	One tensile, one set of impact tests, one corrosion test and one micrographic examination including ferrite measurement shall be carried out for each heat and heat treatment 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 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, 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.			
	Hardness testing 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 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	Finished plates, sheets and strips shall be pickled.			
Marking	The plates, sheets and strips shall be marked to ensure full traceability to heat and heat treatment lot.			

Material Data Sheet	**MDS No. ID255 / ID255S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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 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 and 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.

Table A.30 — MDS ID256 / ID256S

Material Data Sheet	**MDS No. ID256 / ID256S** [a]			**Rev. 01**
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, 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 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.
Metal making	The melt shall be refined by AOD or equivalent method. Induction melting of AOD refined ingot or equally refined scrap as permitted by ISO 17782 is regarded to be equivalent to AOD refined materials.
Chemical composition	PREN ≥ 40.0
Heat treatment	The castings shall be solution annealed followed by water/liquid quenching. Castings shall be placed in such a way as to ensure free circulation of heating and cooling media around each casting during the heat treatment process including quenching.
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	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	One tensile, one set of impact tests, one 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	The test blocks shall be in compliance with ISO 17781.
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 cleaned prior to the testing.

Material Data Sheet	MDS No. ID256 / ID256S [a]	Rev. 01

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, S11 ASTM A703 S20
	ASTM A995	6A (UNS J93380)	-	ASTM A995 S5, S6, S11 ASTM A703 S20

Non-destructive testing *(continued)*

Liquid penetrant testing

ASTM A995 supplementary requirement S6 shall apply as amended by this MDS.

NDE requirement	Pilot casting (section 4.8)	Production casting [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7	

NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be 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.
[c] All accessible internal and external surfaces shall be examined.

Radiographic testing

ASTM A995 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	Pilot casting (section 4.8)	Production casting	
		Valve castings [a]	Other pressure containing castings [b]
Frequency [c]	100 %	<table><tr><th>NPS</th><th>DN</th><th colspan="4">Pressure class</th></tr><tr><th></th><th></th><th>≤ 300</th><th>600</th><th>900</th><th>≥ 1500</th></tr><tr><td>< 2</td><td>< 50</td><td>N/R</td><td>N/R</td><td>N/R</td><td>N/R</td></tr><tr><td>≥ 2</td><td>≥ 50</td><td>N/R</td><td>5 %</td><td>5 %</td><td>5 %</td></tr><tr><td>≥ 6</td><td>≥ 150</td><td>N/R</td><td>5 %</td><td>5 %</td><td>100 %</td></tr><tr><td>≥ 10</td><td>≥ 250</td><td>5 %</td><td>5 %</td><td>5 %</td><td>100 %</td></tr><tr><td>≥ 16</td><td>≥ 400</td><td>5 %</td><td>5 %</td><td>100 %</td><td>100 %</td></tr><tr><td>≥ 20</td><td>≥ 500</td><td>5 %</td><td>100 %</td><td>100 %</td><td>100 %</td></tr></table>	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

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.

Material Data Sheet	**MDS No. ID256 / ID256S** [a]			**Rev. 01**
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, S11 ASTM A703 S20
	ASTM A995	6A (UNS J93380)	-	ASTM A995 S5, S6, S11 ASTM A703 S20
Page 3 of 3				
Repair of defects	All major repairs as defined by A995 shall be documented in accordance with ASTM A703 supplementary requirement S20.2. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this data sheet. – 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. – Microstructure examination, ferrite measurement, Charpy V-notch and corrosion tests shall be carried out in accordance with ISO 17781. 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, 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> − 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 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 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 melting and refining practice. − 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.

Table A.31 — MDS ID257 / ID257S

Material Data Sheet	**MDS No. ID257 / ID257S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*				
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)	-	-

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced ASTM standard 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.
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 manufactured to the following requirements: – bar forgings as defined in ASTM A788 and certified to ASTM A182; or – hot or cold finished cylindrical shaped bar manufactured to ASTM A276 or A479 with maximum diameter of 200 mm (8 in). NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted.
Chemical composition	PREN ≥ 40.0
Heat treatment	The bars shall be solution annealed followed by water/liquid quenching. Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including quenching.
Tensile testing	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	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements shall be in accordance with ISO 17781. Test specimens shall be taken from the surface and the centre of the bar and sample an area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.
Extent of testing	Tensile, impact tests and corrosion tests, and one micrographic examination including ferrite measurements shall be carried out for each lot as defined in ASTM A484.

Material Data Sheet	**MDS No. ID257 / ID257S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*

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)	-	-

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 the 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

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 including liquid penetrant testing according to the following table.

NDE requirement	**Part manufactured from bar** [a]
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 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 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.

Hardness testing

Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 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.

Surface treatment and finish

Finished product shall be white pickled.

Marking

The bars shall be marked to ensure full traceability to heat and heat treatment lot.

Material Data Sheet	**MDS No. ID257 / ID257S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Ferritic-Austenitic stainless steel type 25Cr duplex*

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)	-	-

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 melting and refining practice. – 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.

Table A.32 — MDS ID258 / ID258S

Material Data Sheet	**MDS No. ID258 / ID258S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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 applicable options and/or requirements that supplement or amend the referenced ASTM 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.
Metal making	The melt shall be refined by 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 heating and cooling media around each tube during the heat treatment process including rapid cooling.
Impact testing / toughness testing	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	Tensile testing, one set of impact tests and corrosion test, and one micrographic examination including ferrite measurement shall be carried out for each lot as defined in the standard for mechanical tests.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on one tube per lot. The maximum hardness shall be 32HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished tubes shall be pickled or bright annealed.
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: – MPS identification or MCPR/QTR number used. – Steel heat and refining practice. – Solution annealing temperature, holding time and 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.

Table A.33 — MDS ID259 / ID259S

Material Data Sheet	**MDS No. ID259 / ID259S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
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 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 strain hardened bar and bolting shall be permitted.
Tensile testing	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	Impact testing of bolting shall be carried out in accordance with the requirements in ASTM A962 on a sample representing the finished bolting. Charpy V-notch tests shall be carried out at -46 °C (-50 °F) and the acceptance criteria shall be 45 J (33 ft lbf) average of three specimens, 35 J (26 ft lbf) minimum single specimen.
Hardness testing	Maximum hardness of the strain hardened bar shall not exceed the values in ASTM A276 for the specified grades supplied in Condition S. Hardness may be measured at bar outer surface before threading or in area not affected by the thread rolling operation.
Proof load testing	ASTM A1082 S5 shall apply to at least one nut per test lot. The load shall comply with A194 Grade 7. Alternatively, ASTM A1082 S6 may be applied as substitute to proof load testing for nuts with size M36 (1½ in) or above; the hardness shall not exceed the values specified in ASTM A276 Condition S for the specified grades.
Corrosion testing	Testing shall be carried out on a sample representing the finished bolting. The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with the principles in ISO 17781.
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, one 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	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.

Material Data Sheet	**MDS No. ID259 / ID259S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	Material covered by this MDS is not referenced in ISO 15156/NACE MR0175 or 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 studs/bolts shall be M50 (2 in).
Marking	ASTM A962 S66 shall apply.
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 (for bar and/or bolting as appropriate). – Bar manufacturer. – Heat treatment condition including solution annealing temperature, holding time and quenching medium for pre-material shall be stated.

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

Table A.34 — MDS ID260 / ID260S

Material Data Sheet	**MDS No. ID260 / ID260S** [a]			**Rev. 01**
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

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced ASTM standard specification.
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 by AOD or equivalent method.
Manufacturing	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	Impact testing of bolting shall be carried out in accordance with the requirements in ASTM A962 on a sample representing the finished bolting. Charpy V-notch tests shall be carried out at -46 °C (-50 °F) and the acceptance criteria shall be 45 J (33 ft lbf) average of three specimens, 35 J (26 ft lbf) minimum single specimen.
Proof load testing	ASTM A1082 S5 shall apply to at least one nut per test lot - the load shall comply with A194 Grade 7M. Alternatively, ASTM A1082 S6 may be applied as alternative to proof load testing for nuts with size M36 (1 ½ in) or above; the hardness shall not exceed the values specified in ASTM A1082 for the specified grades.
Corrosion testing	Testing shall be carried out on a sample representing the finished bolting. The sampling of test specimens, testing methodology and acceptance criteria shall be in accordance with the principles in ISO 17781.
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, one 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	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 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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A1082. 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.

Material Data Sheet	**MDS No. ID260 / ID260S** [a]			**Rev. 01**
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				
Marking	ASTM A962 S66 shall apply.			
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 (for bar and/or bolting as appropriate). – Bar manufacturer. – 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.

Table A.35 — MDS ID269 / ID269S

Material Data Sheet	**MDS No. ID269 / ID269S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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

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.
Metal making	Gas atomized powder made from AOD-refined metal. Powder blends shall be a homogenous mixture of powder heats in terms of composition, particle size and other properties.
Chemical composition	PREN ≥ 40.0
Heat treatment	The HIP product shall be solution annealed followed by 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 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	The sampling of test specimens, testing methodology and acceptance criteria for microstructural examination including ferrite measurements 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 and shall sample an area of 10 mm (0.4 in) by 10 mm (0.4 in) minimum.
Extent of testing	One tensile, one set of impact tests, one 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	*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	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 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.

Material Data Sheet	**MDS No. ID269 / ID269S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Ferritic-Austenitic stainless 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 permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. *Hardness testing* 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 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 lot as defined in 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 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 (powder) for the finished product. – Solution annealing temperature, holding time and 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.

Table A.36 — MDS IK101

Material Data Sheet	**MDS No. IK101**			**Rev. 02**
TYPE OF MATERIAL: *Copper-Nickel 90-10*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes and tubes	EEMUA 234	7060X	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
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.			
Test sampling	Test samples may be cut from the products themselves, from prolongations or from sacrificial pipe and tube.			
Repair of defects	Weld repair is not permitted.			
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.			

Table A.37 — MDS IK102

Material Data Sheet	**MDS No. IK102**			**Rev. 02**
TYPE OF MATERIAL: *Copper-Nickel 90-10*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	EEMUA 234	7060X	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
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	Hot formed pipes: pipes 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 pipes: annealed. Welded pipes: annealed or as-welded from annealed materials.			
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 pipes.			
Non-destructive testing	*Radiographic testing* – SCH 10S: Welds shall be spot radiographed in accordance with the requirements of ASME *BPVC*, Sec. VIII, Div. 1, Paragraph UW-52. – Other schedules: Welds shall be 100 % radiographed in accordance with the requirements of ASME *BPVC*, Sec. VIII, Div. 1, Paragraph UW-51.			
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.			
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.			

Table A.38 — MDS IK103

Material Data Sheet	**MDS No. IK103**			**Rev. 02**
TYPE OF MATERIAL: *Copper-Nickel 90-10*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Fittings	EEMUA 234	7060X	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
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	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	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 fittings.			
Non-destructive testing	*Radiographic testing* – SCH 10S: Welds shall be spot radiographed in accordance with the requirements of ASME *BPVC*, Sec. VIII, Div. 1, Paragraph UW-52. – Other schedules: Welds shall be 100 % radiographed in accordance with the requirements of ASME *BPVC*, Sec. VIII, Div. 1, Paragraph UW-51.			
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.			
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.			

Table A.39 — MDS IK104

Material Data Sheet	**MDS No. IK104**			**Rev. 02**
TYPE OF MATERIAL: *Copper-Nickel 90-10*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Flanges	EEMUA 234	7060X	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	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 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 permitted.			
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.			

Table A.40 — MDS IK105

Material Data Sheet	**MDS No. IK105**			**Rev. 02**
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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Chemical composition	According to EEMUA 234 grade 7060X.			
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 permitted.			
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.			

Table A.41 — MDS IK107

Material Data Sheet	**MDS No. IK107**			**Rev. 02**
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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Chemical composition	According to EEMUA 234 grade 7060X.			
Manufacturing	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.			
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.			

Table A.42 — MDS IK106

Material Data Sheet	**MDS No. IK106**			**Rev. 01**
TYPE OF MATERIAL: *Aluminium bronze*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM B148	UNS C95800	-	-
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard 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 testing	*Visual inspection* 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

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7	

NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be 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.
[c] All accessible internal and external surfaces shall be examined.

Radiographic testing

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	<table><tr><th rowspan="2">NPS</th><th rowspan="2">DN</th><th colspan="2">Pressure class</th></tr><tr><th>≤ 150</th><th>300</th></tr><tr><td>< 10</td><td>< 250</td><td>N/R</td><td>N/R</td></tr><tr><td>≥ 10</td><td>≥ 250</td><td>5 %</td><td>5 %</td></tr></table>	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

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.

Material Data Sheet	**MDS No. IK106**			**Rev. 01**
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	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 (annealing temperature).			

Table A.43 — MDS IK204

Material Data Sheet	**MDS No. IK204**			**Rev. 01**
TYPE OF MATERIAL: *Aluminium bronze*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM B124	UNS C63000	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Hot working shall be used.			
Heat treatment	Forgings shall be hot worked and supplied in O61- Annealed condition.			
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 material heat and heat treatment load.			
Test sampling	Test samples may be cut from the products themselves, from prolongations or from sacrificial forging.			
Non-destructive testing	*Valve forgings NDT* Inspection shall be according to the applicable valve specification.			
Repair of defects	Weld repair is not permitted.			
Marking	The forging shall be marked to ensure full traceability to cast 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.			

Table A.44 — MDS IK207

Material Data Sheet	**MDS No. IK207**			**Rev. 01**
TYPE OF MATERIAL: *Aluminium bronze*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Rods and bars	ASTM B150	UNS C63200	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Hot rolling or hot forging may be used.			
Heat treatment	Temper annealed for all diameters or thickness to condition O20 or O25.			
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 material heat and heat treatment load.			
Test sampling	Test samples may be cut from the products themselves, from prolongations or from sacrificial rods or bars.			
Repair of defects	Weld repair is not permitted.			
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.			

Table A.45 — MDS IN100S

Material Data Sheet	**MDS No. IN100S** [a]			**Rev. 01**
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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.			
Manufacturing	Threading of studs, bolts and screws may be done by machining or rolling. Thread rolling shall be done after heat treatment. Threads in nuts shall be machined.			
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 metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103 and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Marking	Each bolt and nut shall be marked on the end/head to ensure full traceability to heat and heat treatment lot.			
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 documents of the bar material shall be included in the documentation.			

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

Table A.46 — MDS IN102S

Material Data Sheet	**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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.			
Welding	Welding procedures shall be qualified in accordance with ASME *BPVC*, Sec. IX or ISO 15614-1 using the same material grade (UNS number) as used in production.			
Heat treatment	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 any rapid cooling/quenching			
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, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished 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 condition (annealing temperature shall be stated).			

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

Table A.47 — MDS IN103S

Material Data Sheet	**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 Cl. S, WP Cl. W, WP Cl. WX	ASTM B366 S3
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.
Welding	Welding procedures shall be qualified in accordance with ASME *BPVC*, Sec. IX or ISO 15614-1 using the same material grade (UNS number) as used in production. A change of filler metal classification requires requalification.
Heat treatment	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 any rapid cooling/quenching.
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	Supplementary requirement 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 material is not permitted. For repair of welds, the requirements for production welding shall apply to the repair WPS.
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 MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished fittings shall be pickled. 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 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature shall be stated).

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

Table A.48 — MDS IN104S

<table>
<tr><td colspan="2">Material Data Sheet MDS No. IN104S [a] Rev. 01</td></tr>
<tr><td colspan="2">TYPE OF MATERIAL: Nickel alloy type 625</td></tr>
<tr><td colspan="2">
<table>
<tr><th>PRODUCT FORM</th><th>STANDARD</th><th>GRADE</th><th>ACCEPTANCE CLASS</th><th>SUPPLEMENTARY REQUIREMENT</th></tr>
<tr><td>Forgings</td><td>ASTM B564</td><td>UNS N06625</td><td>-</td><td>ASTM B564 S5.3</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Page 1 of 2</td></tr>
<tr><td>Scope</td><td>This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.</td></tr>
<tr><td>Metal making</td><td>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.</td></tr>
<tr><td>Heat treatment</td><td>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.</td></tr>
<tr><td>Extent of testing</td><td>A lot shall consist of all forgings of the same type, size, and wall thickness, manufactured from one heat of material.</td></tr>
<tr><td>Non-destructive testing</td><td><u>Visual inspection</u>
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.

<u>Liquid penetrant testing</u>
ASTM B564 supplementary requirement S5.3 shall apply as amended by this MDS.
<table>
<tr><th>NDE requirement</th><th>Forgings</th></tr>
<tr><td>Frequency [b]</td><td>10 %</td></tr>
<tr><td>Method</td><td>ASME BPVC, Sec. V, Article 6</td></tr>
<tr><td>Extent [c]</td><td>100 %</td></tr>
<tr><td>Acceptance criteria</td><td>ASME BPVC, Sec. VIII, Div. 1, Appendix 8</td></tr>
<tr><td colspan="2">NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing.</td></tr>
<tr><td colspan="2">[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.</td></tr>
</table>
<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.</td></tr>
<tr><td>Repair of defects</td><td>Weld repair is not permitted.</td></tr>
<tr><td>Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]</td><td>The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103 and this MDS.

The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.</td></tr>
<tr><td>Surface treatment and finish</td><td>Finished components shall be pickled. Machined surfaces do not require pickling.</td></tr>
<tr><td>Marking</td><td>The component shall be marked to ensure full traceability to heat and heat treatment lot.</td></tr>
</table>

Material Data Sheet	**MDS No. IN104S** [a]			**Rev. 01**
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 ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature shall be stated).			

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

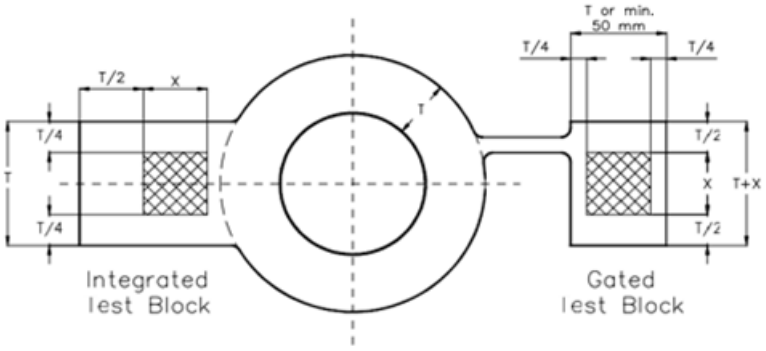
Table A.49 — MDS IN105S

Material Data Sheet	**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 applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by ESR (electro slag remelting) or VAR (vacuum arc remelting) 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	Plates, sheets and strips 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.
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 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, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished components shall be pickled.
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 issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature shall be stated).

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

Table A.50 — MDS IN106S

Material Data Sheet	**MDS No. IN106S** [a]			**Rev. 02**
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 1 of 4				
Scope	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 apply.			
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	Castings shall be placed in such a way as to ensure free circulation of heating and cooling media around each casting during the heat treatment process including quenching.			
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 shall be 24 hours. 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 minutes 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/m^2.			
Extent of testing	Tensile test and corrosion test shall be made for each heat and heat treatment load (including any PWHT). A test lot shall not exceed 5 000 kg (11 000 lb).			
Test sampling	Test blocks shall be integral or gated with the casting(s) they represent castings through all heat treatment operations. Thickness of the test block shall be equal to the thickest part of the casting 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. Distance from end of test specimen to end of test block shall minimum be T/4. During any PWHT the test block shall be tack welded onto the casting.  For investment casting, test sampling shall be according to A957. Test blocks shall accompany the castings through all heat treatment operations including any post weld stress relieving.			

Material Data Sheet	**MDS No. IN106S** [a]	**Rev. 02**

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

Non-destructive testing *(continued)*

Visual inspection

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 testing

ASTM A494 supplementary requirement S3 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC,* Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC,* Sec. 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 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 No. IN106S [a]	Rev. 02

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

Non-destructive testing *(continued)*

Radiographic testing

ASTM A494 supplementary requirement S2 shall apply as amended by this MDS.

NDE requirement	Pilot casting (section 4.8)	Production casting	
		Valve castings [a]	Other pressure containing castings [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7		

NPS	DN	Pressure class			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IN106S** [a]	**Rev. 02**

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

Repair of defects	All major repairs as defined by ASTM A494 shall be documented in accordance with ASTM A781 S16 or ASTM A957 S16, as applicable. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and as follows: – 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 MDS 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 MR0103, and this MDS. 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: – Heat treatment condition (annealing temperature and holding time shall be stated). – Melting and refining process. – MPS identification or MCPR/QTR number used.

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

Table A.51 — MDS IN107S

Material Data Sheet	**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 applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.
Heat treatment	Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including any rapid cooling/quenching.
Non-destructive testing	*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 including liquid penetrant testing according to the following table.

NDE requirement	**Part manufactured from bar** [a]
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 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 metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished components shall be pickled.
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature shall be stated).

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

Table A.52 — MDS IN111S

Material Data Sheet	**MDS No. IN111S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 625*				
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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD followed by electro slag remelting (ESR) or vacuum arc remelting (VAR) or equivalent multiple refining methods. In alternative, vacuum induction melting (VIM) can be followed by single refining method such as ESR or VAR.			
Heat treatment	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 metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished 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	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature shall be stated).			

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

Table A.53 — MDS IN119S

Material Data Sheet	**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

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.
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 around each component during the heat treatment process including any rapid cooling/quenching.
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*

NDE requirement	**HIP product** [a]
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 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 permitted.
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 MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished components shall be pickled. Machined surfaces do not require pickling.
Marking	The 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 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: – Manufacturer of the starting material (powder) for the finished product. – Heat treatment condition (annealing temperature shall be stated). – MPS identification or MCPR/QTR number used.

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

Table A.54 — MDS IN120S

Material Data Sheet	**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 applicable options and/or requirements that supplement or amend the referenced standard specification.
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.
Manufacturing	Manufacturing general requirements shall be according to ASTM A962 as amended by this MDS. Threads on studs and bolts shall be made by cold rolling after precipitation hardening. Threads in nuts shall be machined.
Heat treatment	Solution annealing and ageing heat treatment shall be carried out after the final hot forming operation.
Impact testing / toughness testing	The impact testing requirements of API 6ACRA shall apply.
Hardness testing	Maximum hardness 40HRC. Hardness shall not be tested in the threaded area.
Macro etch / micrographic examination	Bolting shall be examined in accordance with API 6ACRA 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	*Visual inspection* 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. *Liquid penetrant testing* Liquid penetrant testing shall be according to ASTM A962. Supplementary requirement S56 shall apply to 10 % of the bolting.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	White pickled.
Marking	Each bolting 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: – The MPS identification or the MCPR/QTR number used. – Steel manufacturer, melting and refining practice. – Heat treatment condition. Solution annealing temperature, quenching medium, ageing temperature and holding time shall be stated.

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

Table A.55 — MDS IN201S

Material Data Sheet	**MDS No. IN201S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 825*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes and tubes	ASTM B423	UNS N08825	-	-
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD.
Chemical composition	PREN ≥ 32
Heat treatment	Cold-worked annealed. 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.
Corrosion testing	Corrosion test according to ASTM G28 Method A is required per lot. Acceptance criteria: – Corrosion rate ≤ 0.5 mm/y; – No intergranular attack visible at 50 times magnification.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished pipes and tubes shall be pickled or bright annealed.
Marking	The pipes and 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 issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Heat treatment condition (annealing temperature and holding time shall be stated).

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

Table A.56 — MDS IN202S

Material Data Sheet	**MDS No. IN202S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 825*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM B705	UNS N00825	Class 2	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD.			
Chemical composition	PREN ≥ 32			
Corrosion testing	Corrosion test according to ASTM G28 Method A is required per lot. Test specimen shall include the weld. Acceptance criteria: – Corrosion rate ≤ 0.5 mm/y. – No intergranular attack visible at 50 times magnification.			
Welding	Welding procedures shall be qualified in accordance with ASME *BPVC,* Sec. IX or ISO 15614-1 using the same material grade (UNS number) as used in production.			
Heat treatment	Annealed. 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 any rapid cooling/quenching			
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, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished pipes shall be pickled or bright annealed.			
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 condition (annealing temperature and holding time shall be stated).			

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

Table A.57 — MDS IN203S

Material Data Sheet	**MDS No. IN203S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 825*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM B366	UNS N08825	WP Cl. S, WP Cl. W, WP Cl. WX	ASTM B366 S3
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD.			
Chemical composition	PREN ≥ 32			
Welding	Welding procedures shall be qualified in accordance with ASME *BPVC,* Sec. IX or ISO 15614-1 using the same material grade (UNS number) as used in production. A change of filler metal classification requires requalification.			
Heat treatment	Fittings 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.			
Tensile testing	Seamless fitting made from seamless pipe shall comply with the tensile testing requirements for cold-worked annealed seamless pipe.			
Corrosion testing	Corrosion test according to ASTM G28 Method A is required. Test specimen for welded fitting shall include the weld. Acceptance criteria: – Corrosion rate ≤ 0.5 mm/y. – No intergranular attack visible at 50 times magnification.			
Extent of testing	Testing shall be per lot and per furnace charge. 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	Supplementary requirement S3 shall apply to the weld end area of 10 % of seamless fittings from each lot and 100 % of welded fittings above DN 50 (NPS 2). For welded fittings, the testing shall cover the weld only. Acceptance criteria shall be according to ASME *BPVC,* Sec. VIII, Div. 1, Appendix 8.			
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, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished 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 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: – Heat treatment condition (annealing temperature and holding time shall be stated).			

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

Table A.58 — MDS IN204S

Material Data Sheet	**MDS No. IN204S a**			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 825*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM B564	UNS N08825	-	ASTM B564 S5.3
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD.
Chemical composition	PREN ≥ 32
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.
Corrosion testing	Corrosion test according to ASTM G28 Method A is required. Acceptance criteria: – Corrosion rate ≤ 0.5 mm/y. – No intergranular attack visible at 50 times magnification.
Extent of testing	Testing shall be per lot and per furnace charge. A lot shall consist of all forgings of the same type, size, and wall thickness, manufactured from one heat of material.
Non-destructive testing	*Liquid penetrant testing* ASTM B564 supplementary requirement S5.3 shall apply as amended by this MDS.

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 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.	

	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 (additional metallurgical, manufacturing, testing and certification requirements) [a]	The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103 and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished components shall be pickled or bright anneal. Machined surfaces do not require pickling.
Marking	The component shall be marked to ensure full traceability to heat and heat treatment lot.

Material Data Sheet	**MDS No. IN204S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 825*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM B564	UNS N08825	-	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 ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature and holding time shall be stated).			

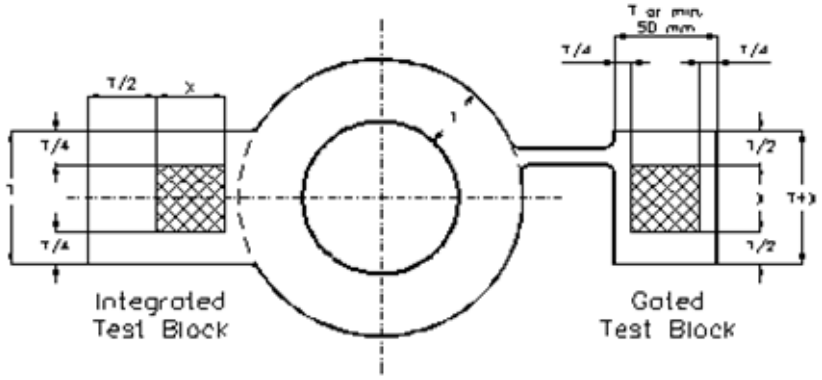
[a] The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

Table A.59 — MDS IN205S

Material Data Sheet	**MDS No. IN205S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Nickel alloy type 825*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates, sheets, strips	ASTM B424	UNS N08825	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	Basic electric furnace (EF) melt shall be refined by AOD or VOD.			
Chemical composition	PREN ≥ 32			
Heat treatment	Plates, sheets and strips 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.			
Corrosion testing	Corrosion test according to ASTM G28 Method A is required per lot. Acceptance criteria: – Corrosion rate ≤ 0.5 mm/y. – No intergranular attack visible at 50 times magnification.			
Non-destructive 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 permitted.			
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 MR0103, and this MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished components shall be pickled or bright annealed.			
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 issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (annealing temperature and holding time shall be stated).			

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

Table A.60 — MDS IN206S

Material Data Sheet	**MDS No. IN206S** [a]			**Rev. 02**
TYPE OF MATERIAL: *Nickel alloy*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A494	Grade CU5MCuC (UNS N08826)	-	ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16
Page 1 of 4				
Scope	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 apply.			
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.			
Chemical composition	PREN ≥ 32			
Heat treatment	Castings shall be placed in such a way as to ensure free circulation of heating and cooling media around each casting during the heat treatment process including quenching.			
Corrosion testing	Corrosion test according to ASTM G28 Method A is required. Acceptance criteria: – Corrosion rate ≤ 0.5 mm/y. – No intergranular attack visible at 50 times magnification.			
Extent of testing	Tensile test and corrosion test shall be made for each heat and heat treatment load (including any PWHT). A test lot shall not exceed 5 000 kg (11 000 lb).			
Test sampling	Test blocks shall be integral or gated with the casting(s) they represent castings through all heat treatment operations. Thickness of the test block shall be equal to the thickest part of the casting 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. Distance from end of test specimen to end of test block shall minimum be T/4. During any PWHT the test block shall be tack welded onto the casting.  For investment casting, test sampling shall be according to ASTM A957. Test blocks shall accompany the castings through all heat treatment operations including any post weld stress relieving.			

Material Data Sheet	**MDS No. IN206S** [a]	**Rev. 02**

TYPE OF MATERIAL: *Nickel alloy*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A494	Grade CU5MCuC (UNS N08826)	-	ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16

Non-destructive testing

Visual inspection

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 testing

ASTM A494 supplementary requirement S3 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC,* Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC,* Sec. 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 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 No. IN206S** [a]	**Rev. 02**

TYPE OF MATERIAL: *Nickel alloy*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A494	Grade CU5MCuC (UNS N08826)	-	ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16

Non-destructive testing *(continued)*

Radiographic testing

ASTM A494 supplementary requirement S2 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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

All major repairs as defined by ASTM A494 shall be documented in accordance with ASTM A781 S16 or ASTM A957 S16, as applicable.

The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and as follows:

- 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.

Material Data Sheet	**MDS No. IN206S** [a]	**Rev. 02**

TYPE OF MATERIAL: *Nickel alloy*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A494	Grade CU5MCuC (UNS N08826)	-	ASTM A494 S2, S3 ASTM A781 S16 ASTM A957 S16

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 MR0103, and this MDS. 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: − Heat treatment condition (solution annealing and stabilization temperatures and holding times shall be stated). − Melting and refining process.

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

Table A.61 — MDS IN207S

<table>
<tr><td colspan="2">Material Data Sheet MDS No. IN207S [a] Rev. 01</td></tr>
<tr><td colspan="2">TYPE OF MATERIAL: Nickel alloy type 825</td></tr>
<tr><td colspan="2">
<table>
<tr><th>PRODUCT FORM</th><th>STANDARD</th><th>GRADE</th><th>ACCEPTANCE CLASS</th><th>SUPPLEMENTARY REQUIREMENT</th></tr>
<tr><td>Bars and rods</td><td>ASTM B425</td><td>UNS N08825</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Page 1 of 1</td></tr>
<tr><td>Scope</td><td>This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.</td></tr>
<tr><td>Metal making</td><td>Basic electric furnace (EF) melt shall be refined by AOD or VOD.</td></tr>
<tr><td>Chemical composition</td><td>PREN ≥ 32</td></tr>
<tr><td>Heat treatment</td><td>Bars shall be placed in such a way as to ensure free circulation of heating and cooling media around each bar during the heat treatment process including any rapid cooling/quenching.</td></tr>
<tr><td>Corrosion testing</td><td>Corrosion test according to ASTM G28 Method A is required.
Acceptance criteria:
– Corrosion rate ≤ 0.5 mm/y.
– No intergranular attack visible at 50 times magnification.</td></tr>
<tr><td>Extent of testing</td><td>Corrosion test shall be made for each lot as defined for mechanical testing.</td></tr>
<tr><td>Non-destructive testing</td><td><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.
<table>
<tr><th>NDE requirement</th><th>Part manufactured from bar [a]</th></tr>
<tr><td>Frequency [b]</td><td>10 %</td></tr>
<tr><td>Method</td><td>ASME BPVC, Sec. V, Article 6</td></tr>
<tr><td>Extent [c]</td><td>100 %</td></tr>
<tr><td>Acceptance criteria</td><td>ASME BPVC, Sec. VIII, Div. 1, Appendix 8</td></tr>
<tr><td colspan="2">NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be pickled prior to the testing.</td></tr>
<tr><td colspan="2">[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.</td></tr>
</table>
</td></tr>
<tr><td>Repair of defects</td><td>Weld repair is not permitted.</td></tr>
<tr><td>Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]</td><td>The material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS.
The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.</td></tr>
<tr><td>Surface treatment and finish</td><td>Finished bars shall be pickled. Machined or peeled surfaces do not require pickling.</td></tr>
<tr><td>Marking</td><td>The bars shall be marked to ensure full traceability to heat and heat treatment lot.</td></tr>
<tr><td>Certification</td><td>The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.
The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification.
The inspection documents shall include the following information:
− Heat treatment condition (annealing temperature and holding time shall be stated).</td></tr>
<tr><td colspan="2">[a] The supplementary suffix “S” designates a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.</td></tr>
</table>

Table A.62 — MDS IR111 / IR111S

Material Data Sheet	**MDS No. IR111 / IR111S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 6Mo*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A312	UNS S31254	-	-
	ASTM A312	UNS N08367	-	-
	ASTM A312	UNS N08926	-	-
Page 1 of 1				

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.
Metal making	The melt shall be refined by AOD or equivalent method.
Chemical composition	PREN ≥ 40.0
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.
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 % HNO3 + 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 corrosion test shall be carried out for each heat and heat treatment lot.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. *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 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 pipes shall 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 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 temperature, holding time and quench medium shall be stated (holding time is not applicable for pipes produced hot finished and direct quenched).

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

Table A.63 — MDS IR112 / IR112S

Material Data Sheet	**MDS No. IR112 / IR112S** [a]			**Rev. 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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
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 shall require 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) manufactured from solution annealed strip/plate material; such pipe shall be marked as stated in A358.			
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 % HNO3 + 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 corrosion test shall be carried out for each lot as defined below: – For batch heat treatment, a lot is defined as maximum 60 m (197 ft) of pipes of the same heat, same processing conditions including weld procedure, same size and heat treatment load. – For continuous heat treatment, a lot is defined as maximum 60 m (197 ft) of pipes of the same heat, same processing conditions including weld procedure, same size and which is heat treated the same day.			
Non-destructive testing	Eddy current testing according to ASTM A450 is acceptable as replacement for radiography for wall thickness less than 4.0 mm (0.16 in). ASTM A358 supplementary requirement S3 shall apply to the longitudinal weld ends of 10 % of pipes per lot. The weld of each examined pipe shall be ground flush for a length of 100 mm (4 in) prior to penetrant testing. Method of testing shall be according to ASME *BPVC,* Sec. V Article 6 and acceptance criteria shall be to ASME *BPVC*, Sec. VIII, Div. 1, Appendix 8. The testing shall be carried out after any calibration.			
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.			

Material Data Sheet	**MDS No. IR112 / IR112S** [a]			**Rev. 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

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. *Hardness testing* 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 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 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. – Steel manufacturer. – Solution annealing temperature, holding time and 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.

Table A.64 — MDS IR113 / IR113S

Material Data Sheet	**MDS No. IR113 / IR113S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 6Mo*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
Chemical composition	PREN ≥ 40.0			
Welding	The welding procedure shall be qualified in accordance with ASME *BPVC* 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 shall require requalification.			
Heat treatment	The fittings shall be solution annealed followed by water/liquid quenching. 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 % HNO3 + 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 corrosion test shall be carried out for each lot as defined below. A test lot shall include all fittings from the same heat and heat treatment load, with a wall thickness range of ±5 mm (±0.2 in) and, where applicable, welded with the same WPS.			
Test sampling	Production 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.			

Material Data Sheet	**MDS No. IR113 / IR113S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Austenitic stainless steel type 6Mo*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***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

Non-destructive testing

Liquid penetrant testing

ASTM A960 supplementary requirement S52 shall apply as amended by this MDS.

NDE requirement	**Nominal thickness**	
	Seamless fittings	**Welded fittings** [a]
Frequency [b]	10 %	100 %
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 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 internal and external surfaces shall be examined. For welded fittings, the testing shall cover the weld only and the weld of each examined fitting shall be ground flush in a length of 100 mm (4 in) prior to penetrant 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 the original production 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 this MDS.

Hardness testing

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 35HRC 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 fittings shall be pickled. 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 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 temperature, holding time and 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.

Table A.65 — MDS IR114 / IR114S

Material Data Sheet	**MDS No. IR114 / IR114S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel 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 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.			
Metal making	The melt shall be refined by AOD or equivalent method.			
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	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 mid-thickness. For greater wall thickness the specimen shall expose a cross section from surface to a depth of 50 mm (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 % HNO3 + 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 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). – For forgings having maximum section thickness, T ≤ 50 mm (2 in), the test specimen shall be taken at mid thickness and its mid length shall be at least 50 mm (2 in) from any second surface or at equal distance from the second surfaces. – For forgings having maximum section thickness, T > 50 mm (2 in), the test specimens shall be taken at least ¼T from the nearest surface and mid-length of test specimens at least T or 100 mm (4 in), whichever is less, from any second surface. – Sketches shall be established showing type, and size of test samples and location for extraction of test specimens.			
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 pickled prior to the testing.			

Material Data Sheet	**MDS No. IR114 / IR114S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel 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

Non-destructive testing *(continued)*

Liquid penetrant 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

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.

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 (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 this MDS.

Hardness testing

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 be pickled. Machined surfaces do not require pickling.

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:

– MPS identification or MCPR/QTR number used.
– Steel manufacturer.
– Solution annealing temperature, holding time and 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.

Table A.66 — MDS IR115 / IR115S

Material Data Sheet	**MDS No. IR115 / IR115S** [a]			**Rev. 02**
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	-	-

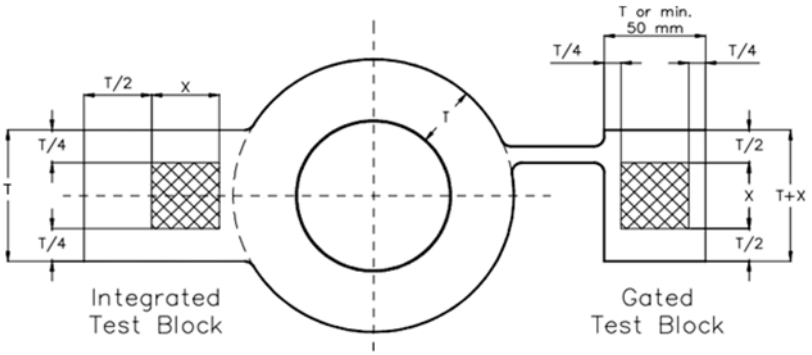
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.
Metal making	The melt shall be refined by AOD or equivalent method.
Chemical composition	PREN ≥ 40.0
Tensile testing	Tensile test specimens shall be sampled in the transverse orientation to the direction 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 % HNO3 + 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 each heat of steel and heat treatment 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 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, 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 this MDS. *Hardness testing* 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 traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished plates, sheets and strips shall be pickled.
Marking	The plates, sheets and strips shall be marked to ensure full traceability to heat and heat treatment lot.

Material Data Sheet	**MDS No. IR115 / IR115S** [a]			**Rev. 01**
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	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 temperature, holding time and 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.

Table A.67 — MDS IR116 / IR116S

Material Data Sheet	**MDS No. IR116 / 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 1 of 3				

Scope	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 A985 and this MDS shall apply.
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 or equally refined scrap as permitted by ISO 17782 is regarded to be equivalent to AOD refined materials.
Chemical composition	P ≤ 0.030 % PREN ≥ 40.0
Heat treatment	Material shall be solution annealed at temperature ≥ 1 225 °C (2 237 °F) followed by 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	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 % HNO3 + 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 corrosion test 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	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. 

Material Data Sheet	**MDS No. IR116 / 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

Non-destructive testing

Radiographic testing

ASTM A351 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IR116 / 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

Repair of defects	Repairs as described in ASTM A351, section 10.2 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2 or A985 S20, as applicable. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and the following requirements. – Welding procedure shall be qualified on the same cast material grade (UNS number) as used in production. – Welding shall be carried out with Ni-based consumable with enhanced Mo or Cr content compared to the base material; the S content 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 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, 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]	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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter for CK3MCuN castings. The maximum hardness shall be 100HRB (22HRC) from three readings taken in close proximity. For other alloys the maximum hardness shall not exceed 35HRC. 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 load.
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 temperature, holding time and 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.

Table A.68 — MDS IR117 / IR117S

Material Data Sheet	**MDS No. IR117 / IR117S** [a]			**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 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 (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.			
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 hot or cold finished cylindrical shaped with maximum diameter of 200 mm (8 in). NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted.			
Chemical composition	PREN ≥ 40.0			
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 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 % HNO3 + 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 and corrosion tests shall be carried out for each lot as defined in ASTM A484.			
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 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.			
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.			

Material Data Sheet	**MDS No. IR117 / IR117S** [a]	**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)	-	-

Non-destructive testing *(continued)*

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	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 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 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 this MDS.

Hardness testing

Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 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 product shall be white pickled.

Marking

The bars shall be marked to ensure full traceability to heat and heat treatment lot.

Certification

The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser.

The inspection documents shall be 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 temperature, holding time and 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.

Table A.69 — MDS IR118 / IR118S

Material Data Sheet	**MDS No. IR118 / IR118S** [a]			**Rev. 01**
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 1 of 1				

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.
Metal making	The melt shall be refined by 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: Rp0.2 ≥ 310 MPa (45 ksi); Rm ≥ 675 MPa (98 ksi); A ≥ 35 % − UNS N08367 Rp0.2 ≥ 310 MPa (45 ksi); Rm ≥ 690 MPa (100 ksi); A ≥ 35 % − UNS N08926 Rp0.2 ≥ 300 MPa (44 ksi); Rm ≥ 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 % HNO3 + 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 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 permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and this MDS. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A269. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished product shall be white pickled or bright annealed.
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: – MPS identification or MCPR/QTR number used. – Steel manufacturer. – Solution annealing temperature, holding time and 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.

Table A.70 — MDS IR119 / IR119S

Material Data Sheet	**MDS No. IR119 / IR119S** [a]			**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

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.
Manufacturing	Gas atomized powder made from AOD-refined metal. Powder blends shall be a homogenous mixture of powder heats in terms of composition, particle size and other properties.
Chemical composition	PREN ≥ 40.0
Heat treatment	HIP product shall be solution annealed followed by 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.
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 % HNO3 + 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 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 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	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 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 permitted.

Material Data Sheet	**MDS No. IR119 / IR119S** [a]			**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 2 of 2				
Sour service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 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 temperature, holding time and 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.

Table A.71 — MDS IS101 / IS101S

Material Data Sheet	**MDS No. IS101 / IS101S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A312	TP316	-	-
Page 1 of 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 is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156 /NACE MR0175 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 on 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 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 conditions. – The inspection documents shall confirm compliance to both UNS S31603 and UNS S31600.			

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

Table A.72 — MDS IS102 / IS102S

Material Data Sheet	**MDS No. IS102 / IS102S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A312	TP316	-	-
	ASTM A358	316	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 composition	The chemical composition shall comply with UNS S31603 (dual certified 316/316L).			
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 (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. *Hardness testing* – 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 conditions; – The inspection documents shall confirm compliance to both UNS S31603 and UNS S31600.			

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

Table A.73 — MDS IS103 / IS103S

Material Data Sheet	**MDS No. IS103 / IS103S** [a]			**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				

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).
Heat treatment	During heat treatment fittings shall be placed in such a way as to ensure free circulation around each fittings during the heat treatment process including possible quenching operation.
Non-destructive testing	Ultrasonic testing is not acceptable as replacement for radiography.
Repair of defects	Weld repair of base material is not acceptable. 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 (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. *Hardness testing* – Seamless fittings: • 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 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 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 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 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 UNS S31600.

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

Table A.74 — MDS IS104 / IS104S

Material Data Sheet	**MDS No. IS104 / IS104S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F316	-	-
Page 1 of 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 F316L (dual certified F316/F316L).			
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 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 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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on 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 and finish	Finished forgings shall be pickled or bright annealed. Machined surfaces do not require pickling.			
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.			

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

Table A.75 — MDS IS105 / IS105S

Material Data Sheet	**MDS No. IS105 / IS105S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates, sheets, strips	ASTM A240	316	-	-
Page 1 of 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).			
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 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]	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. *Hardness testing* 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 traceable in accordance with ISO 15156-3/NACE MR0175-3 section 7.2 and this MDS.			
Surface treatment and finish	According to the requirements in ASTM A480.			
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. The inspection documents shall confirm compliance with this specification and shall include the following information: – Heat treatment conditions. – The inspection documents shall confirm compliance to both UNS S31603 and UNS S31600.			

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

Table A.76 — MDS IS106 / IS106S

Material Data Sheet	**MDS No. IS106 / IS106S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Austenitic stainless steel type 316*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A351	CF8M	-	ASTM A351 S5, S6, ASTM A703 S20
	ASTM A351	CF3M	-	ASTM A351 S5, S6, ASTM A703 S20

Scope

This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.

Extent of testing

Tensile testing is required for each heat and heat treatment lot including any PWHT.

Test sampling

For castings with a weight of 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.

During any PWHT the test block shall be tack welded onto the casting.

Non-destructive testing

Visual inspection

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 testing

ASTM A351 supplementary requirement S6 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. 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 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 No. IS106 / IS106S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Austenitic stainless steel type 316*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A351	CF8M	-	ASTM A351 S5, S6, ASTM A703 S20
	ASTM A351	CF3M	-	ASTM A351 S5, S6, ASTM A703 S20

Non-destructive testing *(continued)*

Radiographic testing

ASTM A351 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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

Repairs as described in ASTM A351, section 10.2 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2.

The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS:

– Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production.

– Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material.

Weld repairs are not acceptable for castings that leak during pressure testing.

Solution annealing heat treatment is required after all major weld repairs.

If a minor cosmetic repair is required to a semi-finished or finished cast component, heat treatment may be omitted provided the welding procedure meets all the test requirements of this data sheet in the as-welded condition.

Material Data Sheet	**MDS No. IS106 / IS106S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE 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 3 of 3				
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 this MDS. *Hardness testing* – Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 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 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.			

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

Table A.77 — MDS IS107 / IS107S

Material Data Sheet	**MDS No. IS107 / 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 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 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	The chemical composition shall comply with UNS S31603 (dual certified 316/316L).			
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.			
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 diameter ≥ 100 mm intended for machining of valve parts, tensile testing shall be taken in both the longitudinal and transverse direction.			
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	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements)	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 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 pickled or bright annealed. Machined 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. IS107 / 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	-	-

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 UNS S31600.

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

Table A.78 — MDS IS108 / IS108S

Material Data Sheet	**MDS No. IS108 / IS108S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***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.			
Chemical composition	The chemical composition shall comply with UNS S31603 (dual certified 316/316L).			
Tensile testing	The following acceptance criteria shall apply: Rp0.2 ≥ 207 MPa (30 ksi); Rm ≥ 517 MPa (75 ksi); A ≥ 35 %.			
Extent of testing	Tensile testing shall be carried out for each lot as defined in the standard for mechanical tests.			
Non-destructive testing	Welded tubes: non-destructive electric testing is required.			
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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A269. 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 tubes shall be pickled or bright annealed.			
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 UNS S31600.			

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

Table A.79 — MDS IS109 / IS109S

Material Data Sheet	**MDS No. IS109 / IS109S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 316*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bolting	ASTM A193	B8M (UNS S31600)	Class 1 - for size over M72 (3 in)	ASTM A193 S5
	ASTM A193	B8M (UNS S31600)	Class 2 - for size M36 (1.5 in) and smaller	ASTM A193 S5, ASTM A193 S10
	ASTM A193	B8M2 (UNS S31600)	Class 2B - for size over M36 (1.5 in) and up to size M72 (3 in)	ASTM A193 S5 ASTM A193 S10
	ASTM A193	B8MA (UNS S31600) [a]	Class 1A	ASTM A193 S5
	ASTM A320	B8M (UNS S31600)	Class 1 - for size over M72 (1.5 in)	ASTM A962 S50
	ASTM A320	B8M (UNS S31600)	Class 2 - for size M36 (1.5 in) and smaller	ASTM A962 S50, ASTM A320 S3
	ASTM A320	B8MA (UNS S31600) [a]	Class 1A	ASTM A962 S50
	ASTM A194	8M (UNS S31600)	-	ASTM A194 S4
	ASTM A194	8MA (UNS S31600) [a]	-	ASTM A194 S4
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Threading of studs, bolts and screws may be done by machining or rolling. Except for Class 1A bolting, thread rolling shall be done after heat treatment. Threads in nuts shall be machined.			
Hardness testing	Supplementary requirement ASTM A193 S10 or ASTM A320 S3 shall apply to Class 2 and Class 2B bolting.			
Proof load testing	Supplementary requirement ASTM A194 S4 shall apply for nut size M42 ($1^5/_8$ in) and larger.			
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 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. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Marking	Supplementary requirement ASTM A193 S5 or ASTM A962 S50 shall apply.			
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.			

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

Table A.80 — MDS IS221 / IS221S

Material Data Sheet	**MDS No. IS221 / IS221S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 304*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A312	TP304	-	-
Page 1 of 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 S30403 (dual certified 304/304L).			
Repair of defects	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on 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 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 conditions. – The inspection documents shall confirm compliance to both UNS S30403 and UNS S30400.			

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

Table A.81 — MDS IS222 / IS222S

Material Data Sheet	**MDS No. IS222 / IS222S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 304*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A312	TP304	-	-
	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 composition	The chemical composition shall comply with UNS S30403 (dual certified 304/304L).			
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 (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. *Hardness testing* – 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 conditions. – The inspection documents shall confirm compliance to both UNS S30403 and UNS S30400.			

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

Table A.82 — MDS IS223 / IS223S

Material Data Sheet	**MDS No. IS223 / IS223S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 304*				
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 applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	The chemical composition shall comply with UNS S30403 (dual certified 304/304L).
Heat treatment	During heat treatment fittings shall be placed in such a way as to ensure free circulation around each fitting during the heat treatment process including possible quenching operation.
Non-destructive testing	Ultrasonic testing is not acceptable as replacement for radiography.
Repair of defects	Weld repair of base material is not acceptable. 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 (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. *Hardness testing* – Seamless fittings: • 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 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 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 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 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 UNS S30400.

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

Table A.83 — MDS IS224 / IS224S

Material Data Sheet	**MDS No. IS224 / IS224S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 304*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F304	-	-
Page 1 of 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 F304L (dual certified F304/F304L).			
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 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 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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on 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 and finish	Finished forgings shall be pickled or bright annealed. Machined surfaces do not require pickling.			
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.			

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

Table A.84 — MDS IS225 / IS225S

Material Data Sheet	**MDS No. IS225 / IS225S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel type 304*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates, sheets, strips	ASTM A240	304	-	-
Page 1 of 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 S30403 (dual certified 304/304L).
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 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, 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. *Hardness testing* 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 traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	According to the requirements in ASTM A480.
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 UNS S30400.

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

Table A.85 — MDS IS226 / IS226S

Material Data Sheet	**MDS No. IS226 / IS226S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Austenitic stainless steel 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

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Extent of testing	Tensile testing is required for each heat and heat treatment lot including any PWHT.
Test sampling	For castings with a weight of 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. During any PWHT the test block shall be tack welded onto the casting.
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 testing

ASTM A351 supplementary requirement S6 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. 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 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 No. IS226 / IS226S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Austenitic stainless steel 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

Non-destructive testing *(continued)*

Radiographic testing

ASTM A351 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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

Repairs as described in ASTM A351, section 10.2 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2.

The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS.

– Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production.
– Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material.

Weld repairs are not acceptable for castings that leak during pressure testing.

Solution annealing heat treatment is required after all major weld repairs.

If a minor cosmetic repair is required to a semi-finished or finished cast component, heat treatment may be omitted provided the welding procedure meets all the test requirements of this data sheet in the as-welded condition.

Material Data Sheet	**MDS No. IS226 / IS226S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel 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

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. *Hardness testing* – Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 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 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.

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

Table A.86 — MDS IS227 / IS227S

Material Data Sheet	**MDS No. IS227 / 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 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 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	The chemical composition shall comply with UNS S30403 (dual certified 304/304L).			
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 bar 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.			
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 diameter ≥ 100 mm (4 in) intended for machining of valve parts, tensile testing shall be taken in both the longitudinal and transverse direction.			
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	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 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 pickled or bright annealed. Machined 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. IS227 / 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	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 UNS S30400.			

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

Table A.87 — MDS IS228 / IS228S

Material Data Sheet	**MDS No. IS228 / IS228S** [a]			**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.
Chemical composition	The chemical composition shall comply with UNS S30403 (dual certified 304/304L).
Tensile testing	The following acceptance criteria shall apply: Rp0.2 ≥ 207 MPa (30 ksi); Rm ≥ 517 MPa (75 ksi); A ≥ 35 %.
Extent of testing	Tensile testing shall be carried out for each lot as defined in the standard for mechanical tests.
Non-destructive testing	Welded tubes: non-destructive electric testing is required.
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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A269. 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 tubes shall be pickled or bright annealed. Machined surfaces do not require pickling.
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 UNS S30400.

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

Table A.88 — MDS IS301 / IS301S

Material Data Sheet	**MDS No. IS301 / IS301S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A312	TP321	-	S6
	ASTM A312	TP347	-	S6
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	Supplementary requirement S6 applies with the following requirement: Stabilization heat treatment temperature shall be in the range of 815 °C to 900 °C (1 500 °F to 1 650 °F).			
Repair of defects	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on 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 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 conditions.			

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

Table A.89 — MDS IS302 / IS302S

Material Data Sheet	**MDS No. IS302 / IS302S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A312	TP321	-	S6
	ASTM A312	TP347	-	S6
	ASTM A358	TP321	Class 1, 3, 4, 5	S5
	ASTM A358	TP347	Class 1, 3, 4, 5	S5
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	Supplementary requirement ASTM A312 S6 or ASTM A358 S5 apply with the following requirement: Stabilization heat treatment temperature shall be in the range of 815 °C to 900 °C (1 500 °F to 1 650 °F).			
Repair of defects	ASTM A312: weld repair is not permitted. ASTM A358: weld repair of base material is not permitted. Repair welds shall be heat treated as per original production 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. *Hardness testing* 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 conditions.			

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

Table A.90 — MDS IS303 / IS303S

Material Data Sheet	**MDS No. IS303 / IS303S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A403	WP321	W or S or WX	ASTM A403 S2
	ASTM A403	WP347	W or S or WX	ASTM A403 S2
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	Supplementary requirement ASTM A403 S2 shall apply. During heat treatment fittings shall be placed in such a way as to ensure free circulation around each fitting during the heat treatment process including quenching operation.			
Non-destructive testing	Ultrasonic testing is not acceptable as replacement for radiography.			
Repair of defects	Weld repair of base material is not acceptable. 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 (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 on one fitting per lot. The maximum hardness shall be 22HRC from three readings taken in close proximity. – Welded fittings: 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 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 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.			
[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.				

Table A.91 — MDS IS304 / IS304S

Material Data Sheet	**MDS No. IS304 / IS304S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F321	-	S10
	ASTM A182	F347	-	S10
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	Supplementary requirement S10 shall apply. Forgings shall be placed in such a way as to ensure free circulation around each component during the heat treatment process including quenching operation.
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 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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on 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 and finish	Finished forgings shall be pickled or bright annealed. Machined surfaces do not require pickling.
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.

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

Table A.92 — MDS IS305 / IS305S

Material Data Sheet	**MDS No. IS305 / IS305S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates, sheets, strips	ASTM A240	321	-	-
	ASTM A240	347	-	-
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	Following annealing, a stabilization heat treatment shall be carried out in the temperature range of 815 °C to 900 °C (1 500 °F to 1 650 °F)
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 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, 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. *Hardness testing* 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 traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Pickled, descaled or bright annealed according to the requirements in ASTM A480.
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.

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

Table A.93 — MDS IS306 / IS306S

Material Data Sheet	**MDS No. IS306 / IS306S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A351	CF8C	-	ASTM A351 S5, S6, S33 ASTM A703 S20
Page 1 of 3				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	ASTM A351 supplementary requirement S33 shall apply.
Extent of testing	Tensile testing is required for each heat and heat treatment lot including any PWHT.
Test sampling	For castings with a weight of 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. During any PWHT the test block shall be tack welded onto the casting.
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 testing

ASTM A351 supplementary requirement S6 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC,* Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC,* Sec. 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 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 No. IS306 / IS306S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A351	CF8C	-	ASTM A351 S5, S6, S33 ASTM A703 S20

Non-destructive testing *(continued)*

Radiographic testing

ASTM A351 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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

Repairs as described in ASTM A351 section 10.2 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2.

The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS.

– Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production.
– Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material.

Weld repairs are not acceptable for castings that leak during pressure testing. Solution annealing heat treatment is required after all major weld repairs.

If a minor cosmetic repair is required to a semi-finished or finished cast component, heat treatment may be omitted provided the welding procedure meets all the test requirements of this data sheet in the as-welded condition.

Material Data Sheet	**MDS No. IS306 / IS306S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A351	CF8C	-	ASTM A351 S5, S6, S33 ASTM A703 S20

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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 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 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 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.

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

Table A.94 — MDS IS307 / IS307S

Material Data Sheet	**MDS No. IS307 / IS307S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A276	321	-	-
	ASTM A276	347	-	-
	ASTM A479	321	-	-
	ASTM A479	347	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 in). NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted.			
Heat treatment	Bars shall be supplied in the stabilized annealed conditions. Stabilization heat treatment temperature shall be in the range of 815 °C to 900 °C (1 500 °F to 1 650 °F). Bars shall be placed in such a way as to ensure free circulation around each bar during the heat treatment process including 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.			
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 100 mm (4 in), whichever is the lesser, 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. <u>*Valve parts manufactured from bar*</u> 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.			
Non-destructive testing	<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.			
Repair of defects	Weld repair is not permitted.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. <u>*Hardness testing*</u> Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 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 pickled or bright annealed. Machined or peeled surfaces do not require pickling.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be 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.			

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

Table A.95 — MDS IS308 / IS308S

Material Data Sheet	**MDS No. IS308 / IS308S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Tubes	ASTM A269	TP321	-	S3
	ASTM A269	TP347	-	S3
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	Supplementary requirement S3 shall apply with stabilization heat treatment carried out in the temperature range of 815 °C to 900 °C (1 500 °F to 1 650 °F).			
Tensile testing	The following acceptance criteria shall apply: Rp0.2 ≥ 207 MPa (30 ksi); Rm ≥ 517 MPa (75 ksi); A ≥ 35 %.			
Extent of testing	Tensile testing shall be carried out for each lot as defined in the standard for mechanical tests.			
Non-destructive testing	Welded tubes: non-destructive electric testing is required.			
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 (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> Production hardness testing shall be performed in accordance with the requirements in ASTM A269. 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 tubes shall be pickled or bright annealed. Machined surfaces do not require pickling.			
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.			

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

Table A.96 — MDS IS321 / IS321S

Material Data Sheet	**MDS No. IS321 / IS321S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A312	TP321H	-	S6
	ASTM A312	TP347H	-	S6
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	C ≤ 0.08 %
Heat treatment	Supplementary requirement S6 applies with the following requirement: Stabilization heat treatment temperature shall be in the range of 815 °C to 900 °C (1 500 °F to 1 650 °F).
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on 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 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 conditions.

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

Table A.97 — MDS IS322 / IS322S

Material Data Sheet	**MDS No. IS322 / IS322S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A312	TP321H	-	S6
	ASTM A312	TP347H	-	S6
	ASTM A358	TP321H	Class 1, 3, 4, 5	S5
	ASTM A358	TP347H	Class 1, 3, 4, 5	S5
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Chemical composition	C ≤ 0.08 %			
Heat treatment	Supplementary requirement ASTM A312 S6 or ASTM A358 S5 apply with the following requirement: Stabilization heat treatment temperature shall be in the range of 815 °C to 900 °C (1 500 °F to 1 650 °F).			
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 (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. *Hardness testing* 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 conditions.			

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

Table A.98 — MDS IS323 / IS323S

Material Data Sheet	**MDS No. IS323 / IS323S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A403	WP321H	W or S or WX	ASTM A403 S2
	ASTM A403	WP347H	W or S or WX	ASTM A403 S2
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	C ≤ 0.08 %
Heat treatment	Supplementary requirement ASTM A403 S2 shall apply. During heat treatment fittings shall be placed in such a way as to ensure free circulation around each fitting during the heat treatment process including quenching operation.
Non-destructive testing	Ultrasonic testing is not acceptable as replacement for radiography.
Repair of defects	Weld repair of base material is not acceptable. 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 (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. *Hardness testing* – Seamless fittings: 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: 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 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 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.

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

Table A.99 — MDS IS324 / IS324S

Material Data Sheet	**MDS No. IS324 / IS324S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F321H	-	S10
	ASTM A182	F347H	-	S10
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Chemical composition	C ≤ 0.08 %			
Heat treatment	Supplementary requirement S10 shall apply. Forgings shall be placed in such a way as to ensure free circulation around each component during the heat treatment process including quenching operation.			
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 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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on 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 and finish	Finished forgings shall be pickled or bright annealed. Machined surfaces do not require pickling.			
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.			

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

Table A.100 — MDS IS325 / IS325S

Material Data Sheet	**MDS No. IS325 / IS325S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates, sheets, strips	ASTM A240	321H	-	-
	ASTM A240	347H	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Chemical composition	C ≤ 0.08 %			
Heat treatment	Stabilization heat treatment shall be carried out in the temperature range of 815 °C to 900 °C (1 500 °F to 1 650 °F)			
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 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, 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. *Hardness testing* 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 traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Pickled, descaled or bright annealed according to the requirements in ASTM A480.			
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.			

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

Table A.101 — MDS IS327 / IS327S

Material Data Sheet	**MDS No. IS327 / IS327S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A479	321H	-	-
	ASTM A479	347H	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 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 ≤ 0.08 %			
Heat treatment	Bars shall be supplied in the stabilised annealing conditions. Stabilization heat treatment temperature shall be in the range of 815 °C to 900 °C (1 500 °F to 1 650 °F). Bars shall be placed in such a way as to ensure free circulation around each bar during the heat treatment process including 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.			
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 100 mm (4 in), whichever is the lesser, 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 (4 in) intended for machining of valve parts, tensile testing shall be taken in both the longitudinal and transverse direction.			
Non-destructive 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.			
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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 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 pickled or bright annealed. Machined or peeled surfaces do not require pickling.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be 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.			
[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.				

Table A.102 — MDS IS404 / IS404S

Material Data Sheet	**MDS No. IS404 / IS404S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, 200-series*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F XM-19 (UNS S20910)	-	-
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	Forgings shall be supplied solution annealed or hot rolled or solution annealed and cold worked. 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 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 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 (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. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one forging per lot. 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 be pickled or bright annealed. Machined surfaces do not require pickling.
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.

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

Table A.103 — MDS IS407 / IS407S

Material Data Sheet	**MDS No. IS407 / IS407S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Austenitic stainless steel, stabilized*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A276	XM-19 (UNS S20910)	-	-
	ASTM A479	XM-19 (UNS S20910)	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 in).			
Heat treatment	Bars shall be supplied solution annealed or hot rolled or solution annealed and cold worked. Bars shall be placed in such a way as to ensure free circulation around each bar 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.			
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 100 mm (4 in), whichever is the lesser, 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 (4 in) intended for machining of valve parts, tensile testing shall be taken in both the longitudinal and transverse direction.			
Non-destructive 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.			
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.			
	Hardness testing Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 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 bars shall be pickled or bright annealed. Machined or peeled surfaces do not require pickling.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be 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.			

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

Table A.104— MDS IM104 / IM104S

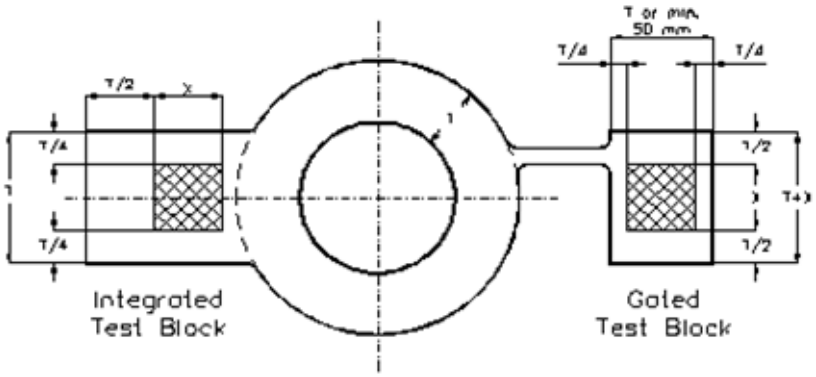
Material Data Sheet	**MDS No. IM104 / IM104S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F6A (UNS S41000)	Class 1, Class 2	-
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	Forgings shall be supplied in the normalized and double-temper condition with the final temper at a lower temperature than the intermediate temper, but not lower than the minimum tempering temperature stated in the standard. Forgings shall be placed in such a way as to ensure free circulation around each forging during the heat treatment process.
Non-destructive 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 (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 this MDS. *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on 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.
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 including tempering temperature.

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

Table A.105 — MDS IM106 / IM106S

Material Data Sheet	**MDS No. IM106 / IM106S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	CA15 (UNS J91150)	-	ASTM A217 S4, S5, S21, S52.6 ASTM A703 S14, S20
Page 1 of 3				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	Supplementary requirement ASTM A217 S52.6 shall apply.
Heat treatment	Supplementary requirement ASTM A217 S21 shall apply. Castings shall be supplied in the normalized and double-temper condition with the final temper at a lower temperature than the intermediate temper. The minimum tempering temperature shall be 621 °C (1 150 °F). During the heat treatment process, castings shall be placed in such a way as to ensure free circulation around each casting.
Test sampling	For castings with a weight of 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 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.  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.
Extent of testing	ASTM A703 supplementary requirement S14 shall apply for each heat and heat treatment charge including any PWHT.
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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.		

Material Data Sheet	**MDS No. IM106 / IM106S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Martensitic stainless steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	CA15 (UNS J91150)	-	ASTM A217 S4, S5, S21, S52.6 ASTM A703 S14, S20

Non-destructive testing *(continued)*

Magnetic particle testing

ASTM A217 supplementary requirement S4 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC,* Sec. V, Article 7	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC,* Sec. 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 castings, MT 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.

Radiographic testing

ASTM A217 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See nested table	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		100 % [d]
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IM106 / IM106S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	CA15 (UNS J91150)	-	ASTM A217 S4, S5, S21, S52.6 ASTM A703 S14, S20
Page 3 of 3				

Repair of defects	Repairs as described in ASTM A217, section 9.4 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS. − Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production. − Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material. Weld repairs are not acceptable for castings that leak during pressure testing. Stress relieving PWHT shall be required after all major weld repairs at a minimum temperature of 621 °C (1 150 °F). If a minor cosmetic repair is required to a semi-finished or finished cast component, PWHT may be omitted provided the welding procedure meets all the test requirements of this data sheet in the as-welded condition.
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 this MDS. *Hardness testing* Supplementary requirement ASTM A217 S13 shall apply with the following additions: Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per heat and heat treatment charge thereafter. 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.
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 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 including final tempering temperature.

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

Table A.106 — MDS IM107

Material Data Sheet	**MDS No. IM107** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A276	410 (UNS S41000)	-	-
	ASTM A479	410 (UNS S41000)	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot finished cylindrical shaped with maximum diameter of 300 mm (12 in). NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination).			
Heat treatment	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.			
Hardness testing	Hardness of the finished bar shall be in the range 200HBW-275HBW. Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot.			
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.			
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 100 mm (4 in), whichever is the lesser, 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 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.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be 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 including tempering temperature.			
[a] Material shall not be used in sour service.				

Table A.107 — MDS IM127

Material Data Sheet	**MDS No. IM127** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A276	420 (UNS S42000)	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Bars shall be hot or cold finished cylindrical shaped with maximum diameter of 300 mm (12 in).			
Heat treatment	Bars shall be placed in such a way as to ensure free circulation around each component during the heat treatment process.			
Hardness testing	Hardness of the finished bar shall be in the range 200HBW-275HBW.Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot.			
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.			
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 diameter ≥ 100 mm intended for machining of valve parts, tensile testing shall be taken in both the longitudinal and transverse direction.			
Non-destructive 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.			
Marking	The bars shall be marked to ensure full traceability to heat and heat treatment lot.			
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be 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 including tempering temperature.			

[a] Material shall not be used in sour service.

Table A.108 — MDS IU604 / IU604S

Material Data Sheet	**MDS No. IU604 / IU604S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel, precipitation-hardened*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A705	630 (UNS S17400)	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	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.			
Heat treatment	Forgings shall be supplied in condition H1150D or H1150M. 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.			
Hardness testing	The maximum hardness shall be 33HRC from three readings taken in close proximity. Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on one forging per lot.			
Impact testing / toughness testing	Impact testing is required for thickness ≥ 6 mm (0.236 in). The test temperature shall be minus 29 °C (-20 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average, 20 J (15 ft lbf) single.			
Non-destructive 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 (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 requirement to the MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.			
Surface treatment and finish	Finished forgings shall be pickled. Machined surfaces do not require pickling.			
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.			

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

Table A.109 — MDS IU607 / IU607S

Material Data Sheet	**MDS No. IU607 / IU607S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel, precipitation-hardened*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A564	630 (UNS S17400)	-	-
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	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.
Manufacturing	Bars shall be manufactured to the following requirements: − Bar forgings as defined in ASTM A788 and certified to ASTM A705; or − Hot or cold finished cylindrical shaped bar manufactured to ASTM A564 with maximum diameter of 125 mm (5 in). NOTE Cold finishing shall be restricted to turning, grinding or polishing (singly or in combination); cold drawing or cold forming is not permitted.
Heat treatment	Bars shall be supplied in condition H1150D or H1150M. Bars shall be placed in such a way as to ensure free circulation around each bar 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.
Hardness testing	The maximum hardness shall be 33HRC from three readings taken in close proximity. Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot.
Impact testing / toughness testing	The test temperature shall be minus 29 °C (-20 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average, 20 J (15 ft lbf) single.
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.
Non-destructive 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.
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 requirement to the MDS. The material shall be traceable in accordance with ISO 15156-3/NACE MR0175-3, section 7.2 and this MDS.
Surface treatment and finish	Finished bars shall be pickled. Machined or peeled 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. IU607 / IU607S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Martensitic stainless steel, precipitation-hardened*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A564	630 (UNS S17400)	-	-
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: – Heat treatment conditions.			

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

Table A.110 — MDS IL101

Material Data Sheet	**MDS No. IL101** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A333	3	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	Products shall be delivered in the normalized or normalized and tempered condition. 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 615 °C (1 139 °F).			
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 101 °C (-150 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single.			
Test sampling	Test specimens shall be prepared and tested after simulated PWHT in accordance with the product standard.			
Repair of defects	Weld repair is not permitted.			
Marking	The pipes shall be marked to ensure full traceability to heat and heat treatment load.			
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.			
[a] Material shall not be used in sour service.				

Table A.111 — MDS IL102

Material Data Sheet	**MDS No. IL102 [a]**			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A671	CFE 70	Cl. 22, Cl. 32, Cl. 42	ASTM A671 S2, S7, S14
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	The longitudinal weld shall be straight. Welds shall be made using the SAW process.			
Heat treatment	For products delivered in the tempered condition, the minimum tempering temperature shall be 615 °C (1 139 °F).			
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 101 °C (-150 °F). 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	Impact testing per ASTM A671 supplementary requirement S2, as modified by this MDS, shall be carried out per lot. ASTM A671 supplementary requirement S14 shall apply for lot definition. Impact test samples for base metal shall be taken from mid-thickness.			
Test sampling	Test specimens shall be prepared and tested after simulated PWHT at 600 °C with minimum holding time of 2.5 min/mm, and then furnace cooled to a temperature not exceeding 315 °C (600 °F).			
Non-destructive testing	ASTM A671 supplementary requirement S7 shall apply.			
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 meet the requirements of the original manufacturing weld.			
Marking	The pipes shall be marked to ensure full traceability to heat and heat treatment load.			
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 stress relieved condition or tempered conditions, the stress relieving temperature or tempering temperature shall be stated.			
[a] Material shall not be used in sour service.				

Table A.112 — MDS IL103

Material Data Sheet	**MDS No. IL103** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A420	WPL3	-	ASTM A960 S51, S53, S59, S69
	ASTM A420	WPL3W	-	ASTM A960 S51, S53, S59, S69

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Manufacturing	Fittings shall be made from seamless pipe, welded pipe, forging or plate (for caps only) compliant with the MDSs of this specification. Caps shall be seamless.
Welding	An electric fusion welding process shall be used with the addition of filler metal. Autogenous welding is not permitted.
Heat treatment	Fittings shall be delivered in the normalized or normalized and tempered condition. During the heat treatment process, fittings shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation. All hot formed or forged fittings, including those manufactured by locally heating a portion of the fitting stock, shall be heat treated after manufacture. ASTM A960 supplementary requirement S59 shall apply.
Tensile testing	ASTM A960 supplementary requirement S51 shall apply as amended by this MDS. Test sampling shall be made from an actual fitting, from a prolongation thereof, or if not possible, a length of starting material that has been heat treated in the same heat treatment load as the fittings it represents.
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 101 °C (-150 °F). 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	Impact testing and tensile testing shall be carried out for each heat and heat treatment load.
Non-destructive testing	UT is not acceptable in-lieu of RT. <u>*Magnetic particle testing*</u> ASTM A960 supplementary requirement S53 and S69 shall apply as amended by this MDS.

NDE requirement	**Wrought fittings**
Frequency [a]	10 %
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] 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.

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 meet the chemistry requirements of the original manufacturing weld.

Material Data Sheet	**MDS No. IL103** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A420	WPL3	-	ASTM A960 S51, S53, S59, S69
	ASTM A420	WPL3W	-	ASTM A960 S51, S53, S59, S69
Page 2 of 2				
Marking	The fittings shall be marked to ensure full traceability to heat and heat treatment load.			
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 including tempering temperature.			

[a] Material shall not be used in sour service.

Table A.113 — MDS IL104

Material Data Sheet	**MDS No. IL104** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A350	LF3	Class 2	ASTM A961 S55
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	Forgings shall be delivered in the normalized or normalized and tempered condition. During the heat treatment process, forgings shall be placed in such a way as to ensure free circulation around each forging including any quenching operation.
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.
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	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] 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.

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.
Marking	The forgings shall be marked to ensure full traceability to heat and heat treatment load.
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 including tempering temperature.

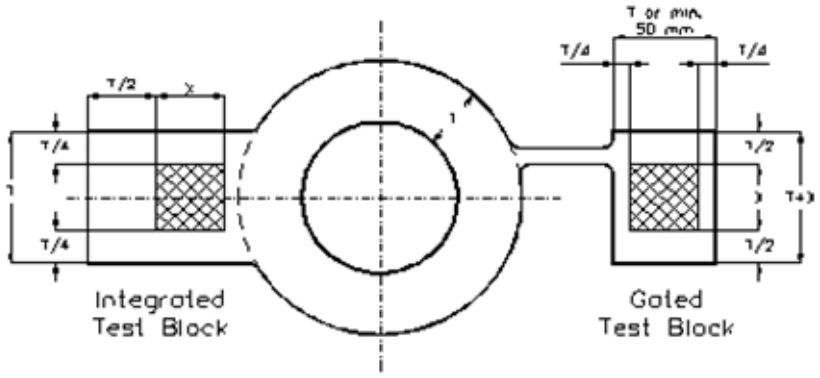
[a] Material shall not be used in sour service.

Table A.114 — MDS IL105

Material Data Sheet	**MDS No. IL105** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A203	D, E	-	ASTM A20 S5
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Impact testing / toughness testing	ASTM A20 supplementary requirement S5 shall apply as amended by this MDS. Impact testing is required for thickness ≥ 6 mm (0.236 in) after final heat treatment. The test temperature shall be minus 101 °C (-150 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single. The test specimen shall be taken at mid-thickness in the longitudinal orientation to the final direction of rolling final heat treatment.			
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 by the purchaser, the requirements in this MDS shall apply.			
Repair of defects	Weld repair is not permitted.			
Marking	The plates shall be marked to ensure full traceability to heat and heat treatment load.			
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.			
[a] Material shall not be used in sour service.				

Table A.115 — MDS IL106

Material Data Sheet	**MDS No. IL106** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A352	LC3 (UNS J31550)	-	ASTM A352 S4, S5 ASTM A703 S8, S14, S20
Page 1 of 3				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Heat treatment	During the heat treatment process, castings shall be placed in such a way as to ensure free circulation around each casting including possible quenching operation. The minimum tempering temperature shall be 615 °C (1 139 °F).
Impact testing / toughness testing	ASTM A703 supplementary requirement S8 shall apply. The test temperature shall be minus 101 °C (-150 °F). The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single. Specimens shall be removed from mid-thickness.
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 heat treatment operations including any post weld stress relieving. Thickness of the test block shall be equal to the thickest part of the casting represented up to a maximum thickness of 100 mm (4 in). For flanged components, the largest flange thickness is the ruling section. Dimensions of test blocks and location of test specimens within the test blocks are shown in the figure below for integral and gated test block. The test specimens shall be taken within the cross hatched area. Distance from end of test specimen to end of test block shall minimum be T/4. 
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each production casting
Method	ANSI/MSS SP-55	
Extent	100 % of all accessible surfaces including welding 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.		

Material Data Sheet	MDS No. IL106 [a]	Rev. 01

TYPE OF MATERIAL: *3.5 % Nickel alloy steel*

PRODUCT FORM	*STANDARD*	*GRADE*	*ACCEPTANCE CLASS*	*SUPPLEMENTARY REQUIREMENT*
Castings	ASTM A352	LC3 (UNS J31550)	-	ASTM A352 S4, S5 ASTM A703 S8, S14, S20

Non-destructive testing
(continued)

Magnetic particle testing

ASTM A352 supplementary requirement S4 shall apply as amended by this MDS.

NDE requirement	Pilot casting (section 4.8)	Production casting [a]
Frequency [b]	100 %	
Method	ASME *BPVC,* Sec. V, Article 7	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC,* Sec. 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 castings, MT 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.

Radiographic testing

ASTM A352 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	Pilot casting (section 4.8)	Production casting	
		Valve castings [a]	Other pressure containing castings [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC,* Sec. VIII, Div. 1, Appendix 7		

NPS	DN	Pressure class			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IL106** [a]	**Rev. 01**

TYPE OF MATERIAL: *3.5 % Nickel alloy steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A352	LC3 (UNS J31550)	-	ASTM A352 S4, S5 ASTM A703 S8, S14, S20

Repair of defects	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.
Marking	The castings shall be marked to ensure full traceability to heat and heat treatment load.
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 including tempering temperature shall be stated.

[a] Material shall not be used in sour service.

Table A.116 — MDS IL108

Material Data Sheet	**MDS No. IL108** [a]			**Rev. 01**
TYPE OF MATERIAL: *3.5 % Nickel alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Tubes	ASTM A334	3	-	-
Page 1 of 1				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Heat treatment	Products shall be delivered in the normalized or normalized and tempered condition. For products delivered in the tempered condition, the minimum tempering temperature shall be 615 °C (1 139 °F). During the heat treatment process, tubes shall be placed in such a way as to ensure free circulation around each tube including any tempering operation.			
Impact testing / toughness testing	The minimum absorbed energy for full size specimens shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single. The test temperature shall be minus 101 °C (-150 °F).			
Repair of defects	Weld repair is not permitted.			
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 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 including tempering temperature shall be stated.			
[a] Material shall not be used in sour service.				

Table A.117 — MDS IT101 / IT101S

Material Data Sheet	**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				

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.
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 of 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 on 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.

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

Table A.118 — MDS IT102 / IT102S

Material Data Sheet	**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 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.
Welding	Welding procedures shall be qualified in accordance with ASME *BPVC*, Sec. IX or ISO 15614-5.
Non-destructive testing	Method and acceptance criteria for penetrant testing shall be to ASME *BPVC*, Sec. VIII, Div. 1, Appendix 8. B862 supplementary requirement S1.1 shall apply.
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, 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> − 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 or 250HV. 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.

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

Table A.119 — MDS IT103 / IT103S

Material Data Sheet	**MDS No. IT103 / IT103S** [a]	**Rev. 01**

TYPE OF MATERIAL: *Titanium grade 2*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM B363	WPT2 / WPT2W (UNS R50400)	-	ASTM B363 S1

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 testing	*Liquid penetrant testing* ASTM B363 supplementary requirement S1 shall apply as amended by this MDS.

NDE requirement	**Nominal Thickness**	
	Seamless fittings	**Welded fittings** [a]
Frequency [b]	10 %	100 %
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] 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.

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, 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. *Hardness testing* − Seamless fittings: • 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.

Material Data Sheet	**MDS No. IT103 / IT103S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Titanium grade 2*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM B363	WPT2 / WPT2W (UNS R50400)	-	ASTM B363 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 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.			

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

Table A.120 — MDS IT104 / IT104S

Material Data Sheet	**MDS No. IT104 / IT104S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Titanium grade 2*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM B381	F2 (UNS R50400)	-	-
Page 1 of 1				

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.
Extent of testing	Tensile test specimens shall be taken from each heat and heat treatment lot, with a maximum deviation from the test block thickness of ±10 mm (±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 as defined for mechanical testing.
[c] All accessible internal and external surfaces shall be examined.

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 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 of 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 on one forging 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.

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

Table A.121 — MDS IT105 / IT105S

Material Data Sheet	**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 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.			
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 of 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 on one plate 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.			

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

Table A.122 — MDS IT106 / IT106S

Material Data Sheet	**MDS No. IT106 / IT106S** [a]			**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

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Qualification	Manufacturers and the manufacturing process shall be qualified in accordance with ISO 17782 or NORSOK M-650. The qualification testing shall meet the requirements of this MDS.
Manufacturing	All castings shall be subject to hot isostatic pressing (HIP).
Heat treatment	All castings, which due to size limitations cannot be HIP, shall be heat treated and radiographed. When the HIP operation is applied, this shall be in accordance with ASTM A1080.
Test sampling	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 ruling thickness. Test samples shall accompany the castings through HIP and any heat treatment, chemical cleaning process or any other operation that may alter metallurgical or mechanical properties.
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each 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 testing

NDE requirement	**Pilot casting (section 4.8)**	**Production casting** [a]
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 6	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7	
NOTE The testing shall be carried out after machining, if applicable. Non-machined surfaces shall be 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.
[c] All accessible internal and external surfaces shall be examined.

Material Data Sheet	**MDS No. IT106 / IT106S** [a]	**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

Non-destructive testing *(continued)*

Radiographic testing

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings** [b]
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**	
		≤ 150	**300**
< 10	< 250	N/R	N/R
≥ 10	≥ 250	5 %	5 %

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

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 *BPVC* IX or ISO 15614-5 and this MDS.

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]

Material covered by this MDS is not referenced in ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103.

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.

Surface treatment and finish

For castings manufactured to this MDS alfa-case in the casting surface shall be completely removed at the 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.

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.

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

Table A.123 — MDS IT107 / IT107S

Material Data Sheet	**MDS No. IT107 / IT107S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Titanium grade 2*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM B348	2 (UNS R50400)	-	-
Page 1 of 1				

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.
Extent of testing	Tensile test specimens shall 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 permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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 on the end surface of one bar per lot. The maximum hardness shall be 100HRB 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.
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.

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

Table A.124 — MDS IT108 / IT108S

Material Data Sheet	**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 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.
Non-destructive testing	Method and acceptance criteria for penetrant testing shall be to ASME *BPVC* 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, 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> 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 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.

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

Table A.125 — MDS IU100 / IU100S

Material Data Sheet	**MDS No. IU100 / IU100S** [a]			**Rev. 01**
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				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Manufacturing	Threading of studs, bolts and screws may be done by machining or rolling. Thread rolling shall be done after heat treatment. Threads in nuts shall be machined.
Heat treatment	Heat treatment shall be carried out after the final hot forming operation.
Impact testing / toughness testing	Impact testing shall be carried out at minus 101 °C (-150 °F). The minimum absorbed energy shall be 27 J (20 ft lbf) average and 20 J (15 ft lbf) single, the lateral expansion shall be 0.38 mm (0.015 in).
Proof load testing	Proof load testing shall be according to ASTM A962 and the load shall comply with ASTM A194 Grade 7.
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 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. *Hardness testing* 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 ensure full traceability to heat and heat treatment lot.
Certification	The material manufacturer shall have a quality system certified in accordance with ISO 9001 or another quality requirements standard accepted by the purchaser. The inspection documents shall be issued in accordance with ISO 10474 /EN 10204 Type 3.1 and shall confirm compliance with this specification. The inspection documents shall include the following information: − Heat treatment condition (solution annealing and annealing temperature) shall be stated.

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

Table A.126 — MDS IX100 / IX100S

Material Data Sheet	**MDS No. IX100 / IX100S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Low alloyed steel fasteners (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 applicable options and/or requirements that supplement or amend the referenced standard specification.
Manufacturing	Threading of studs and bolts may be done by machining or rolling. Thread rolling shall be done after heat treatment. Threads in nuts shall be machined.
Impact testing / toughness testing	Nuts to ASTM A194: S3 shall apply.
Proof load testing	Nuts to ASTM A194: S4 shall apply.
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	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 1⅛ 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.

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

Table A.127 — MDS IX109 / IX109S

Material Data Sheet	**MDS No. IX109 / IX109S** [a]			**Rev. 01**
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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Threading of studs and bolts may be done by machining or rolling. Thread rolling shall be done after heat treatment. Threads in nuts shall be machined.			
Impact testing / toughness testing	Nuts to ASTM A194: S3 shall apply.			
Proof load testing	Nuts to ASTM A194: S4 shall apply.			
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 ⅛ 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.			

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

Table A.128 — MDS IX110 / IX110S

Material Data Sheet	**MDS No. IX110 / IX110S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Low alloyed steel fasteners (black/uncoated)*				
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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Threading of studs and bolts may be done by machining or rolling. Thread rolling shall be done after heat treatment. 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 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 ⅛ in and larger. – Nuts: • Nuts shall be ASME heavy HEX-series, double chamfered.			
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 2.2 as minimum.			

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

Table A.129 — MDS IX120 / IX120S

Material Data Sheet	**MDS No. IX120 / IX120S** [a]			**Rev. 01**
TYPE OF MATERIAL: *Low alloyed steel fasteners (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 applicable options and/or requirements that supplement or amend the referenced standard specification.			
Manufacturing	Threading of studs and bolts may be done by machining or rolling. Thread rolling shall be done after heat treatment. 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.			
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 ⅛ 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 2.2 as minimum.			

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

Table A.130 — MDS IX124 / IX124S

Material Data Sheet	**MDS No. IX124 / IX124S** [a]			**Rev. 01**
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 1 of 2

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS applies to pressure controlling parts of valves only.
Chemical composition	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	For products delivered in the quenched and tempered condition the minimum tempering temperature shall be 620 °C (1 148 °F). 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	Impact testing shall be carried out at -46 °C (-50 °F). One set of three samples shall be tested. Test samples shall be taken from the same location and have the same orientation as tensile test specimens. Mid-length of the test piece shall be a distance T or minimum 100 mm (4 in) from any second surface, whichever is greatest where T is the ruling thickness. 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	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 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. 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 permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103 and the following additional requirements to the MDS. *Chemical composition* Ni < 1.0 % *Hardness testing* 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 22HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Marking	The forgings shall be marked to ensure full traceability to melt and heat treatment lot.

Material Data Sheet	**MDS No. IX124 / IX124S** [a]			**Rev. 01**
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	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 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 condition. For tempered condition, tempering temperature and holding time shall be stated.			

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

Table A.131 — MDS IX127 / IX127S

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	-	-

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced ASTM standard specification. Valve parts machined from bar covered by this MDS are restricted to pressure controlling parts only.
Manufacturing	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 ≤ 50 kg (110 lb), and 5 000 kg (11 000 lb) for forgings with weight > 50 kg (110 lb).
Test sampling	*Valve parts manufactured from bar* Sampling of test specimens for bars intended for machining pressure controlling parts of valve DN 100 (NPS 4) and under shall comply with the following 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 and the mid-point of the specimens at a minimum of 100 mm (4 in) from the end of the bar. − The notch of the impact test specimen shall be located perpendicular to the bar surface.

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	-	-

Test sampling *(continued)*	For bar with outside diameter < 100 mm (4 in): one tensile and one set impact test specimens shall be taken. For bar with outside diameter ≥ 100 mm (4 in): one tensile and one set impact test specimens shall be taken in axial direction of the bar. In addition, one tensile test specimen and one set impact test specimens shall be taken in tangential direction of the bar; the centreline of the tensile test specimen shall be located a minimum of 100 mm (4 in) from the end of the bar. The specified minimum tensile strength of the referenced standard specification and impact energies specified in this data sheet 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 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.
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 % *Hardness testing* Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the end surface of one bar per lot. The maximum hardness shall be 22HRC from three readings taken in close 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 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 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 condition. For tempered condition, tempering temperature and holding time shall be stated.

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

Table A.132 — MDS IV101 / IV101S / IV101K

Material Data Sheet	**MDS No. IV101 / IV101S [a] / IV101K [b]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A335	P11 (UNS K11597)	-	S2
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	For pipes with governing thickness 50 mm (2 in) and greater, the steel shall be vacuum degassed and made to fine grain practice.
Chemical composition	For pipes with governing thickness 50 mm (2 in) and greater, the requirements of API 934-C shall apply.
Heat treatment	Minimum tempering temperature shall be 725 °C (1 337 °F).
Tensile testing	Supplementary requirement S2 shall apply on one specimen per finished pipe per lot. Specimen shall be removed from mid-thickness location.
Hardness testing	Hardness testing shall be made on one finished pipe per lot and shall not exceed 225 HBW.
Extent of testing	Product analysis shall be carried out in accordance with the standard.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. *Chemical composition* 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 material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-C.
Marking	The pipes 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 including tempering temperature and holding time 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.

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

Table A.133 — MDS IV102 / IV102S / IV102SH / IV102K

Material Data Sheet	**MDS No. IV102 / IV102S [a] / IV102SH [b] / IV102K [c]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A691	1 ¼ CR (UNS K11789)	Class 22 or Class 42	S3, S7, S12
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Starting plate material shall comply with ASTM A387 Grade 11 Class 1. For pipes with governing thickness 50 mm (2 in) and greater, the steel shall be vacuum degassed and made to fine grain practice.
Manufacturing	The longitudinal weld shall be straight. Welds shall be made using the SAW process.
Chemical composition	For pipes with governing thickness 50 mm (2 in) and greater, the requirements of API 934-C shall apply.
Heat treatment	For Class 22 pipes, the starting plate shall be in the normalized and tempered or quenched and tempered conditions. Tempering temperature shall be minimum 725 °C (1 337 °F).
Hardness testing	Supplementary requirement S3 shall apply on one finished pipe per lot .
Extent of testing	Mechanical testing shall be carried out on one finished pipe per lot. Supplementary requirement S12 shall apply for lot definition.
Non-destructive testing	Radiographic examination shall be performed after heat treatment. Supplementary requirement S7 shall apply. Acceptance criteria shall be according to ASME *BPVC,* Sec. VIII, Div. 1, Appendix 6. Examination shall be performed after calibration.
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 meet the chemistry requirements of the original manufacturing weld.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	Class 42 pipes shall be used in 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 MDS. *Chemical composition* S ≤ 0.003 % *Hardness testing* In addition to the production hardness 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 235HV. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS. 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. • 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 A691, S10 shall apply.

Material Data Sheet	**MDS No. IV102 / IV102S [a] / IV102SH [b]/ IV102K [c]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A691	1 ¼ CR (UNS K11789)	Class 22 or Class 42	S3, S7, S12
Page 2 of 2				
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [c]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and Impact testing shall be carried out in accordance with API 934-C.			
Marking	The pipes 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 including stress relieving PWHT temperature or tempering temperature and holding time 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.

[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.

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

Table A.134 — MDS IV103 / IV103S / IV103SH / IV103K

Material Data Sheet	**MDS No. IV103 / IV103S [a] / IV103SH [b] / IV103K [c]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A234	WP11	Class 1 or Class 2	ASTM A960 S51, S53, S69
	ASTM A234	WP11W	Class 1 or Class 2	ASTM A960 S51, S53, S69

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	For fittings with governing thickness 50 mm (2 in) and greater, the steel shall be vacuum degassed and made to fine grain practice.
Chemical composition	For fittings with governing thickness 50 mm (2 in) and greater, the requirements of API 934-C shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). All hot formed or forged fittings, including those manufactured by locally heating a portion of the fitting stock, shall be heat treated after manufacture. During the heat treatment process, fittings shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation.
Hardness testing	Hardness testing shall be carried out on two fittings for each test lot, including parent material, weld and HAZ.
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.
Non-destructive testing	ASTM A960 supplementary requirement S53 and S69 shall apply as amended by this MDS. Acceptance criteria shall be according to ASME *BPVC,* Sec. VIII, Div. 1, Appendix 6. Examination shall be performed after final heat treatment and after final machining or calibration. NDT shall be carried out after final heat treatment.
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 meet the chemistry requirements of the original manufacturing weld.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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. *Chemical composition* − S ≤ 0.003 % for WP11W fitting made from flat-rolled products − S ≤ 0.007 % for WP11 fitting made from forging *Hardness testing* For WP11W fittings, in addition to the production hardness 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 235HV. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.

Material Data Sheet	**MDS No. IV103 / IV103S [a] / IV103SH [b] / IV103K [c]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A234	WP11	Class 1 or Class 2	ASTM A960 S51, S53, S69
	ASTM A234	WP11W	Class 1 or Class 2	ASTM A960 S51, S53, S69

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b] *(continued)*	*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: • 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 testing of flat-rolled product before manufacture: • ASTM A578, S1, S2.1 shall apply.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [c]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. *Impact testing* Impact testing shall be carried out in accordance with API 934-C.
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 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 including tempering temperature and holding time.

[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.

[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.

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

Table A.135 — MDS IV104 / IV104S / IV104K

Material Data Sheet	**MDS No. IV104 / IV104S [a] / IV104K [b]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F11	Class 2	ASTM A961 S55
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Forgings with governing thickness 50 mm (2 in) and greater shall be manufactured from steel vacuum degassed and made to fine grain practice.
Chemical composition	For forgings with governing thickness 50 mm (2 in) and greater, the requirements of API 934-C shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, forgings shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation.
Non-destructive testing	ASTM A961 supplementary requirement S55 shall apply. Acceptance criteria shall be according to ASME *BPVC,* Sec. VIII, Div. 1, Appendix 6. Examination shall be performed after final heat treatment and final machining. *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 (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 additional requirements of this MDS. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-C. Sketches shall be established showing type, and size of test samples and location for extraction of test specimens.
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 including tempering temperature and holding time; − Sketches for test sampling.

[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.

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

Table A.136 — MDS IV105 / IV105S / IV105SH / IV105K

Material Data Sheet	**MDS No. IV105 / IV105S [a] / IV105SH [b] / IV105K [c]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A387	Grade 11 (UNS K11789)	Class 1 or Class 2	ASTM A387 S53
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Steel plate with thickness 50 mm (2 in) and greater shall be vacuum degassed and made to fine grain practice.
Chemical composition	For plate with thickness 50 mm (2 in) and greater, the requirements of API 934-C shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, plates shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation.
Hardness testing	Hardness testing shall be carried out on in accordance with ASTM A370 on one plate per lot. Hardness shall not exceed 197HBW.
Test sampling	Supplementary requirement S53 shall apply. Specimens shall be oriented transverse to the final rolling direction.
Non-destructive 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, manufacturing, testing and certification requirements) [a, b]	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. *Chemical composition* − S ≤ 0.003 % The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS. *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. • 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 A387 supplementary requirement S8 shall apply.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [c]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-C.
Marking	The plates shall be marked to ensure full traceability to melt and heat treatment lot.

Material Data Sheet	**MDS No. IV105 / IV105S [a] / IV105SH [b] / IV105K [c]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A387	Grade 11 (UNS K11789)	Class 1 or Class 2	ASTM A387 S53
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: − Heat treatment condition. Tempering temperature shall be stated.			

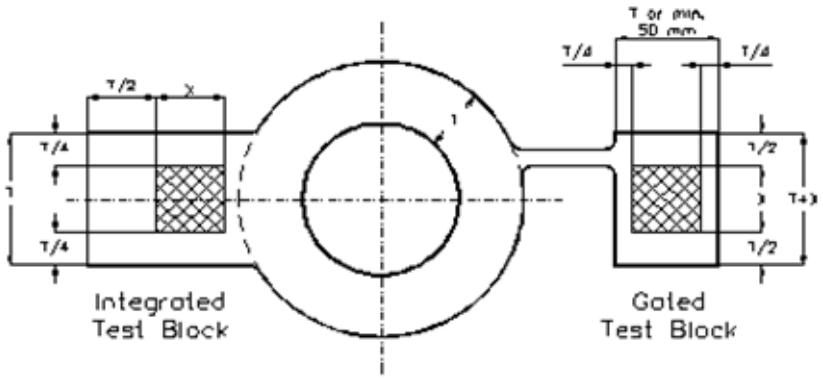
[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

[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.

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

Table A.137 — MDS IV106 / IV106S / IV106K

Material Data Sheet	**MDS No. IV106 / IV106S [a] / IV106K [b]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	WC6 (UNS J12072)	-	ASTM A217 S4, S5, S21, S52.2 ASTM A703 S14, S20
Page 1 of 3				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	Supplementary requirement ASTM A217 S52.2 shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, castings shall be placed in such a way as to ensure free circulation around each item.
Extent of testing	ASTM A703 supplementary requirement S14 shall apply.
Test sampling	For castings with a weight of 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 the figure below for integral and gated test block. The test specimens shall be taken within the cross hatched area. Distance from end of test specimen to end of test block shall minimum be T/4. 
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each production casting
Method	ANSI/MSS SP-55	
Extent	100 % of all accessible surfaces including welding 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.		

Material Data Sheet	**MDS No. IV106 / IV106S [a] / IV106K [b]**	**Rev. 01**

TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*

PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	WC6 (UNS J12072)	-	ASTM A217 S4, S5, S21, S52.2 ASTM A703 S14, S20

Non-destructive testing *(continued)*

Magnetic particle testing

ASTM A217 supplementary requirement S4 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting [a]**
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 7	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. 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 castings, MT 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.

Radiographic testing

ASTM A217 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings [b]**
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IV106 / IV106S [a] / IV106K [b]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	WC6 (UNS J12072)	-	ASTM A217 S4, S5, S21, S52.2 ASTM A703 S14, S20

Repair of defects	Repairs as described in ASTM A217, section 9.4 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS: − Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production; − Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material. Weld repairs are not acceptable for castings that leak during pressure testing. Stress relieving PWHT shall be required after all major weld. If a minor cosmetic repair is required to a semi-finished or finished cast component, PWHT may be omitted provided the welding procedure meets all the test requirements of this data sheet in the as-welded condition and preheat is applied according to the standard. The weld metal composition shall comply with the following requirement: – 10P + 5Sb + 4Sn + As ≤ 1500 (values in mg/Kg) – C ≤ 0.15%, Cu ≤ 0.20%, Ni ≤ 0.30%
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. *Hardness testing* − Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 22HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Tensile testing and impact testing shall be carried out in accordance with API 934-C.
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 including 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.

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

Table A.138 — MDS IV107 / IV107S / IV107K

Material Data Sheet	**MDS No. IV107 / IV107S [a] / IV107K [b]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A739	B11	-	-
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 (NPS 4) and under manufactured from bars, when permitted by the valve specification.
Metal making	For bar thickness 50 mm (2 in) and greater the steel shall be vacuum degassed and made to fine grain practice.
Chemical composition	For bar thickness 50 mm (2 in) and greater, the following requirements shall apply: – 10P + 5Sb + 4Sn + As ≤ 1500 (values in mg/kg) – C ≤ 0.15%, P ≤ 0.010 %, S ≤ 0.007 %, Cu ≤ 0.20 %, Ni ≤ 0.30 %
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, bars shall be placed in such a way as to ensure free circulation around each bar including any quenching operation.
Hardness testing	Hardness testing shall be carried out on in accordance with ASTM A370 on the end surface of one bar per lot. The maximum hardness shall not exceed 207HBW.
Test sampling	*Valve parts manufactured from bar* Sampling of test specimens for bars intended for machining of valve parts shall comply with the following requirements: − The mid-length of the axial 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, and the centreline of the specimen shall be located at mid thickness (1/2 OD). − The centreline of the tangential tensile specimens shall be located at mid thickness (1/2 OD) 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): one tensile specimen and one set of impact test specimens shall be taken. − For bar with outside diameter ≥ 100 mm (4 in): one tensile specimen and one set of impact test specimens shall be taken in axial direction of the bar. In addition, one tensile test specimen and one set of impact test specimens shall be taken in tangential direction of the bar − The specified minimum tensile strength 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 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	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 surfaces shall be examined.

Material Data Sheet	**MDS No. IV107 / IV107S [a] / IV107K [b]**			**Rev. 01**
TYPE OF MATERIAL: *1¼ Cr ½ Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A739	B11	-	-
Page 2 of 2				

Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 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.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-C.
Marking	The bars 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 including 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.

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

Table A.139 — MDS IV201 / IV201S / IV201K

Material Data Sheet	**MDS No. IV201 / IV201S [a] / IV201K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Seamless pipes	ASTM A335	P22 (UNS K21590)	-	-
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	For pipes with governing thickness 50 mm (2 in) and greater, Steel shall be vacuum degassed and made to fine grain practice.
Chemical composition	For pipes with governing thickness 50 mm (2 in) and greater, the requirements of API 934-A shall apply.
Heat treatment	Minimum tempering temperature shall be 725 °C (1 337 °F).
Hardness testing	Hardness testing shall be made on one finished pipe per lot and shall not exceed 235 HBW.
Extent of testing	Product analysis shall be carried out in accordance with the standard.
Repair of defects	Weld repair is not permitted.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a]	When sour service requirements are specified by the purchaser, the material shall conform to the requirements of ISO 15156/NACE MR0175 or ISO 17945/NACE MR0103, and the following additional requirements to the MDS. *Chemical composition* S ≤ 0.010 % The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-A.
Marking	The pipes 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 including tempering temperature and holding time 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.

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

Table A.140 — MDS IV202 / IV202S / IV202SH / IV202K

Material Data Sheet	**MDS No. IV202 / IV202S [a] / IV202SH [b] / IV202K [c]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A691	2 ¼ CR (UNS K21590)	Class 22 or 42	S3, S7, S12
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	For pipes with thickness 50 mm (2 in) and greater, the steel shall be vacuum degassed and made to fine grain practice.
Manufacturing	The longitudinal weld shall be straight. Welds shall be made using the SAW process.
Chemical composition	For pipes with governing thickness 50 mm (2 in) and greater, the requirements of API 934-A shall apply.
Heat treatment	For Class 22 pipes, the starting plate shall be in the normalized and tempered or quenched and tempered conditions. Stress relieving PWHT temperature and tempering temperature shall be minimum 725 °C (1 337 °F).
Hardness testing	Supplementary requirement S3 shall apply on one finished pipe per lot.
Extent of testing	Mechanical testing shall be carried out on one finished pipe per lot. Supplementary requirement S12 shall apply for lot definition.
Non-destructive testing	Radiographic examination shall be performed after heat treatment. Supplementary requirement S7 shall apply. Acceptance criteria shall be according to ASME *BPVC*, Sec. VIII, Div. 1, Appendix 6. Examination shall be performed after calibration.
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 meet the chemistry requirements of the original manufacturing weld.
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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. *Chemical composition* S ≤ 0.003 % *Hardness testing* − In addition to the production hardness 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 225HV. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS. 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. • 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 A691, S10 shall apply.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [c]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-A.

Material Data Sheet	**MDS No. IV202 / IV202S [a] / IV202SH [b] / IV202K [c]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Welded pipes	ASTM A691	2 ¼ CR (UNS K21590)	Class 22 or 42	S3, S7, S12
Page 2 of 2				
Marking	The pipes 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 including stress relieving PWHT temperature or tempering temperature and holding times 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.

[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.

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

Table A.141 — MDS IV203 / IV203S / IV203SH / IV203K

Material Data Sheet	**MDS No. IV203 / IV203S [a] / IV203SH [b] / IV203K [c]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A234	WP22 Class 1 or Class 3		ASTM A960 S51, S53, S69
	ASTM A234	WP22W Class 1 or Class 3		ASTM A960 S51, S53, S69
Page 1 of 2				
Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.			
Metal making	For fitting thickness 50 mm (2 in) and greater, the steel shall be vacuum degassed and made to fine grain practice.			
Chemical composition	For fittings with governing thickness 50 mm (2 in) and greater, the requirements of API 934-A shall apply.			
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). All hot formed or forged fittings, including those manufactured by locally heating a portion of the fitting stock, shall be heat treated after manufacture. During the heat treatment process, fittings shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation.			
Hardness testing	Hardness testing shall be carried out on two fittings for each test lot, including parent material, weld and HAZ.			
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.			
Non-destructive testing	ASTM A960 supplementary requirement S53 and S69 shall apply as amended by this MDS. Acceptance criteria shall be according to ASME *BPVC*, Sec. VIII, Div. 1, Appendix 6. Examination shall be performed after final heat treatment and after final machining or calibration. NDT shall be carried out after final heat treatment.			
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 meet the chemistry requirements of the original manufacturing weld.			
Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b]	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>*Chemical composition*</u> − S ≤ 0.003 % for WP22W fitting made from flat-rolled products − S ≤ 0.007 % for WP22 fitting made from forging <u>*Hardness testing*</u> For WP22W fittings, in addition to the production hardness 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 225HV. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.			

Material Data Sheet	**MDS No. IV203 / IV203S [a] / IV203SH [b] / IV203K [c]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Wrought fittings	ASTM A234	WP22 Class 1 or Class 3		ASTM A960 S51, S53, S69
	ASTM A234	WP22W Class 1 or Class 3		ASTM A960 S51, S53, S69

Sour service (additional metallurgical, manufacturing, testing and certification requirements) [a, b] *(continued)*	*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: • 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 testing of flat-rolled product before manufacture: • ASTM A578, S1, S2.1 shall apply.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [c]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-A.
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 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 including tempering temperature and holding time.

[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.

[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.

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

Table A.142 — MDS IV204 / IV204S / IV204K

Material Data Sheet	**MDS No. IV204 / IV204S [a] / IV204K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Forgings	ASTM A182	F22	Class 3	ASTM A961 S55
Page 1 of 1				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	For forgings with governing thickness 50 mm (2 in) and greater, steel shall be vacuum degassed and made to fine grain practice.
Chemical composition	For forgings with governing thickness 50 mm (2 in) and greater, the requirements of API 934-A shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, forgings shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation.
Non-destructive testing	ASTM A961 supplementary requirement S55 shall apply. Acceptance criteria shall be according to ASME *BPVC*, Sec. VIII, Div. 1, Appendix 6. Examination shall be performed after final heat treatment and final machining. *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 (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 additional requirements of this MDS. *Chemical composition* S ≤ 0.025 % The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-A. Sketches shall be established showing type, and size of test samples and location for extraction of test specimens.
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 including tempering temperature and holding time.

[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.

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

Table A.143 — MDS IV205 / IV205S / IV205SH / IV205K

Material Data Sheet	**MDS No. IV205 / IV205S [a] / IV205SH [b] / IV205K [c]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A387	Grade 22 (UNS K21590)	Class 2	ASTM A387 S53
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Metal making	Steel plate with thickness 50 mm (2 in) and greater shall be vacuum degassed and made to fine grain practice.
Chemical composition	For plate with thickness 50 mm (2 in) and greater, the requirements of API 934-A shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, plates shall be placed in such a way as to ensure free circulation around each fitting including any quenching operation.
Hardness testing	Hardness testing shall be carried out on in accordance with ASTM A370 on one plate per lot. Hardness shall not exceed 197HBW.
Test sampling	Supplementary requirement S53 shall apply. Specimens shall be oriented transverse to the final rolling direction.
Non-destructive 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, manufacturing, testing and certification requirements) [a, b]	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. *Chemical composition* S ≤ 0.003 % The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS. *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. • 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 A387 supplementary requirement S8 shall apply.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [c]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-A.
Marking	The plates shall be marked to ensure full traceability to melt and heat treatment lot.

Material Data Sheet	**MDS No. IV205 / IV205S [a] / IV205SH [b] / IV205K [c]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Plates	ASTM A387	Grade 22 (UNS K21590)	Class 2	ASTM A387 S53
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: − Heat treatment condition. Tempering temperature and holding time shall be stated.			

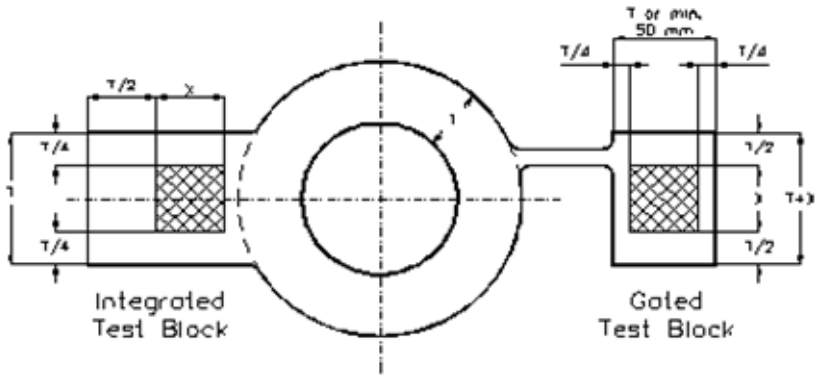
[a] The supplementary suffix “S” shall be used to designate a material delivered in accordance with the MDS plus the additional supplementary requirements for sour service.

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

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

Table A.144 — MDS IV206 / IV206S / IV206K

Material Data Sheet	**MDS No. IV206 / IV206S [a] / IV206K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	WC9 (UNS J21890)	-	ASTM A217 S4, S5, S21, S52.3, S53 ASTM A703 S14, S20
Page 1 of 3				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification.
Chemical composition	Supplementary requirement ASTM A217 S52.3 and S53 shall apply with a J-factor ≤ 100.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, castings shall be placed in such a way as to ensure free circulation around each item.
Extent of testing	ASTM A703 supplementary requirement S14 shall apply.
Test sampling	For castings with a weight of 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 the figure below for integral and gated test block. The test specimens shall be taken within the cross hatched area. Distance from end of test specimen to end of test block shall minimum be T/4. 
Non-destructive testing	*Visual inspection*

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**
Frequency	Each pilot casting	Each production casting
Method	ANSI/MSS SP-55	
Extent	100 % of all accessible surfaces including welding 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.		

Material Data Sheet	**MDS No. IV206 / IV206S [a] / IV206K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	WC9 (UNS J21890)	-	ASTM A217 S4, S5, S21, S52.3, S53 ASTM A703 S14, S20

Non-destructive testing *(continued)*

Magnetic particle testing

ASTM A217 supplementary requirement S4 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting [a]**
Frequency [b]	100 %	
Method	ASME *BPVC*, Sec. V, Article 7	
Extent [c]	100 %	
Acceptance criteria	ASME *BPVC*, Sec. 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 castings, MT 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.

Radiographic testing

ASTM A217 supplementary requirement S5 shall apply as amended by this MDS.

NDE requirement	**Pilot casting (section 4.8)**	**Production casting**	
		Valve castings [a]	**Other pressure containing castings [b]**
Frequency [c]	100 %	See table below	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		100 % [d]
Acceptance criteria	ASME *BPVC*, Sec. VIII, Div. 1, Appendix 7		

NPS	**DN**	**Pressure class**			
		≤ 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 %

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.

Material Data Sheet	**MDS No. IV206 / IV206S [a] / IV206K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Castings	ASTM A217	WC9 (UNS J21890)	-	ASTM A217 S4, S5, S21, S52.3, S53 ASTM A703 S14, S20
Page 3 of 3				

Repair of defects	Repairs as described in ASTM A217, section 9.4 shall be considered major. All major repairs shall be documented in accordance with ASTM A703 S20.2. The repair welding procedure shall be qualified in accordance with ASTM A488 or ISO 11970 and this MDS: − Welding procedure shall be qualified on casting or plate of the same cast material grade as used in production. − Testing methodology and acceptance criteria shall be in accordance with the requirements of this MDS for the parent material. Weld repairs are not acceptable for castings that leak during pressure testing. Stress relieving PWHT shall be required after all major weld repairs. If a minor cosmetic repair is required to a semi-finished or finished cast component, PWHT may be omitted provided the welding procedure meets all the test requirements of this data sheet in the as-welded condition and preheat is applied according to the standard. The weld metal composition shall comply with supplementary requirement ASTM A217 S53.1.3.
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. *Hardness testing* − Production hardness testing shall be performed in accordance with the requirements in ASTM A370/A1058 on the pilot casting and one casting per lot thereafter. The maximum hardness shall be 22HRC from three readings taken in close proximity. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Tensile testing and impact testing shall be carried out in accordance with API 934-A.
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 including tempering temperature and holding time 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.

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

Table A.145 — MDS IV207 / IV207S / IV207K

Material Data Sheet	**MDS No. IV207 / IV207S [a] / IV207K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A739	B22	-	-
Page 1 of 2				

Scope	This MDS defines applicable options and/or requirements that supplement or amend the referenced standard specification. This MDS includes additional requirements for valve parts DN 100 (NPS 4) and under manufactured from bars, when permitted by the valve specification.
Metal making	For bar thickness 50 mm (2 in) and greater, steel shall be vacuum degassed and made to fine grain practice.
Chemical composition	For bar thickness 50 mm (2 in) and greater, the requirements of API 934-A shall apply.
Heat treatment	Tempering temperature shall be minimum 725 °C (1 337 °F). During the heat treatment process, bars shall be placed in such a way as to ensure free circulation around each bar including any quenching operation.
Hardness testing	Hardness testing shall be carried out on in accordance with ASTM A370 on the end surface of one bar per lot. The maximum hardness shall not exceed 207HBW.
Test sampling	*Valve parts manufactured from bar* Sampling of test specimens for bars intended for machining of valve parts shall comply with the following requirements: − The mid-length of the axial 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, and the centreline of the specimen shall be located at mid thickness (1/2 OD). − The centreline of the tangential tensile specimens shall be located at mid thickness (1/2 OD) 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), one tensile specimen and one set of impact test specimens shall be taken. − For bar with outside diameter ≥ 100 mm (4 in), one tensile specimen and one set of impact test specimens shall be taken in axial direction of the bar. In addition, one tensile test specimen and one set of impact test specimens shall be taken in tangential direction of the bar. − The specified minimum tensile strength 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 including magnetic particle testing according to the following table.
Repair of defects	Weld repair is not permitted.

NDE requirement	**Part manufactured from bar**
Frequency [a]	10 %
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] 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 surfaces shall be examined.

Material Data Sheet	**MDS No. IV207 / IV207S [a] / IV207K [b]**			**Rev. 01**
TYPE OF MATERIAL: *2¼ Cr 1 Mo alloy steel*				
PRODUCT FORM	***STANDARD***	***GRADE***	***ACCEPTANCE CLASS***	***SUPPLEMENTARY REQUIREMENT***
Bars	ASTM A739	B22	-	-
Page 2 of 2				

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. The material shall be traceable in accordance with ISO 15156-2/NACE MR0175-2, section 9 and this MDS.
Hydrogen service (additional metallurgical, manufacturing, testing and certification requirements) [b]	When hydrogen service requirements are specified by the purchaser, the material shall conform to the following additional requirements to the MDS. Products shall be delivered in the normalized and tempered or quenched and tempered condition. Tensile testing and impact testing shall be carried out in accordance with API 934-A.
Marking	The bars 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 including tempering temperature and holding time 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.

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

Annex B
(normative)
Element data sheets

The element data sheets listed in Table B.1 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 B.1 — 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	IH002	01
Electroless nickel coating	IH004	01
Solid tungsten carbide material	IH005	02
Alloy 625 corrosion resistant overlay welding	IO001	01

B.2 IOGP element data sheets

Table B.2 — EDS IH001

Element Data Sheet	**EDS No. IH001**	**Rev. 01**
Type of Special process: *Hard facing by overlay welding*		
Page 1 of 2		
Scope	This EDS specifies requirements for hard facing by overlay welding of piping and valve parts.	
Welding	*Welding 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 qualification testing	*General* The hard facing shall be carried out using welding procedures qualified in accordance with ASME *BPVC* 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 *BPVC* 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/m^2. 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 section* The macro section for the qualification shall show no cracking and complete fusion between base material and the hard facing layer.	
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.	

Element Data Sheet	**EDS No. IH001**	**Rev. 01**
Type of Special process: *Hard facing by overlay welding*		
Page 2 of 2		

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).
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, Sec. V, Article 6 with acceptance criteria according to ASME *BPVC* 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.

Table B.3 — EDS IH002

Element Data Sheet	**EDS No. IH002**	**Rev. 01**
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 µm to 8 µm (160 µin to 320 µin) Ra. All edges shall be chamfered or rounded. Balls shall be spherical within 0.05 mm (0.002 in). The components shall be at a temperature minimum 10 °C (50 °F) above dew point and be immediately grit blasted in warm condition. Any oil, dust or particles shall be removed by suitable means before spraying. *Thermal spraying* The component shall be coated immediately after grit blasting, while the component still is at a temperature above the dew point. All thermal spraying shall be carried out under optimal conditions and accordance with established and qualified procedures to ensure that the coating on all areas fulfil the specified requirements. For valves all seating area shall be coated. For ball valves the complete spherical part of the ball shall be coated. For gate valves all surfaces sliding against the seats during valve opening and closing shall be coated. *Sealing* All coated surfaces shall be sealed 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. *Finishing* All coated parts shall be ground and lapped to a mirror like finish and maximum roughness of Ra = 0.15 µm (6 µin).	
Procedure qualification testing	*General* The thermal spray procedure shall be supported by a qualification test and the following essential variables shall apply to each procedure: − the type of equipment used; − nozzle length; − fuel and gas flow rate, ±5 %; − spray distance, ±5 %; − spray rate, ±5 %; − grade of powder; − powder supplier; − sealer type (if used). The procedure shall be re-qualified if any of the above is changed outside given allowable range. The qualification test shall be made at test samples of sufficient size for extraction the required test specimens. Each procedure qualification shall be tested as specified in the following sections.	
Procedure qualification testing	*Bonding test* The bonding strength shall be tested in accordance with ASTM C633 or ISO 4624. Not less than 3 specimens of a type shall be tested. Acceptance criteria: minimum bond strength shall be 60 MPa (8.7 ksi).	

Element Data Sheet	**EDS No. IH002**	**Rev. 01**
Type of Special process: *Hard facing by thermal spraying of tungsten carbide*		
Page 2 of 2		

Procedure qualification testing *(continued)*	*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 ≤ 0.15 µm (6 µin).
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.

Table B.4 — EDS IH004

Element Data Sheet	**EDS No. IH004**	**Rev. 01**
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 ≤ 2 µm (79 min) and Ra ≤ 0.4 µm (16 min). – For other surfaces: Rt ≤ 60 µm (2360 min) and Ra ≤ 12.5 µm (490 min).	
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 to 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 only suitable for use with magnetic substrates).	

Table B.5 — EDS IH005

Element Data Sheet	**EDS No. IH005**	**Rev. 02**
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 6507-1. *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 (h-phase) shall be present, and porosity/uncombined carbon levels shall be ≤ A02/B00/C00 in accordance with ISO 4499-4.	
Extent of testing	Testing shall be performed on one sample per powder batch and HIP batch.	
Non-destructive testing	*Visual inspection* All components shall be examined and be free from visible porosity, cracks and other defects. *Liquid penetrant testing* 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 accessible internal and external surfaces shall be examined.	

Table B.6 — EDS IO001

Element Data Sheet	**EDS No. IO001**	**Rev. 01**
Type of Special process: *Alloy 625 corrosion resistant overlay welding*		
Page 1 of 1		
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 *BPVC* IX, ISO 9606 or ISO 14732.	
Procedure qualification testing	*General* The welding procedures shall be qualified in accordance with ASME *BPVC* 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 *BPVC* 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 the unaffected base material. Testing of HAZ shall be carried out with maximum 0.5 mm (0.02 in) distance between the indentations from fusion line, through HAZ into unaffected base material. The hardness for HAZ and unaffected base material shall not exceed 350 HV. When sour service is specified by the purchaser, the hardness of the weld overlay, HAZ and unaffected base material shall not exceed the maximum values specified in ISO 15156 /NACE MR0175 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 *BPVC* V, Article 6 with acceptance criteria according to ASME *BPVC* 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.	
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.	

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

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

Brussels Office
Avenue de Tervuren 188A
B-1150 Brussels
Belgium

T +32 (0)2 790 7762
reception-europe@iogp.org

Houston Office
15377 Memorial Drive
Suite 250
Houston, TX 77079
USA

T +1 (713) 261 0411
reception-americas@iogp.org

www.iogp.org