M-630

Rev. 4, January 2004

Material data sheets for piping

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Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are as far as possible intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published supported by The Norwegian Oil Industry Association (OLF) and Federation of Norwegian Manufacturing Industries (TBL).

NORSOK standards are administered and published by Standards Norway.

Introduction

The provision of the NORSOK standards are intended to comply with the requirements of the EC "Pressure Equipment Directive" and the Norwegian implementation regulation "Forskrift for trykkpåkjent utstyr" issued 9 June 1999. When this NORSOK standard refers to PED only, it is implicit that it also refers to the Norwegian implementation regulation. In those applications where PED is governing, it is therefore necessary to apply the PED and to involve a notified body to obtain the required approvals dependent of the selected conformity assessment module applicable to each specific project.

An objective has been to facilitate and standardise the implementation of PED requirement for the Norwegian petroleum industry. The correct implementation of these requirements or any other requirement is left with the user of the MDSes.

This revision replace NORSOK standard M-630 rev 3. Revision 4 of this NORSOK standard is an update to include changes deemed necessary due to:

- Introduction of PED
- Changes made in the reference standards
- Experiences gained with the previous revision of the standard
- Deletion of the MDS P01, this due to the issue of ISO 14692

The MDSes under material type K (Cu/Ni 90/10) and type X (high strength low-alloyed steel) are not revised in this issue of this NORSOK standard.

The basis for the requirements included in the MDSes are fulfilment of the requirements deemed necessary for piping systems classified to PED category III. The PED specific requirements for materials to be used for pressure equipment are related to the following:

- No less than 14% elongation and no less than 27 J absorbed energy measured on Charpy V-notch at the lowest scheduled operating temperature
- Approval of welders and welding procedures by a 3rd party organization recognized an EC member state for Category II-IV.
- Approval of NDT operators for Category III-IV by a 3rd party organization recognized an EC member state
- Certification of specific product control.

The minimum elongation requirement is included unless covered by the reference standard. The minimum Charpy V-notch absorbed energy for carbon steel type 235 is implemented by limiting the carbon content to ≤ 0.20 % and $CE_{(IIW)} = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15 \leq 0.43$, with reference to Guideline 7/17. The

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use of this material type is in the NORSOK L-001 Pipe and Valve specification, limited to piping systems with minimum design temperature of -15°C (due to ambient conditions) and to a maximum wall thickness of < 16 mm.

The other requirements are included as deemed relevant on MDSes in the material Type C-, D-, N-, R- and S-serie except for MDSes for tubes to A 269/A 789. Tubes to A 269/A 789 are within the NORSOK standards not specified used in pressure equipment in Category II-IV.

The MDSes for Titanium Grade 2 are not prepared to comply with PED category II-IV requirements. The Titanium grade 2 (MDS T-01/-02) are only intended used for piping systems classified to SEP or Category I. The MDS for Cu/Ni material K-01/-02 are not specified used within the NORSOK standards, but are established as an optional material for seawater systems.

Polymer products specified by the MDSes in the P-serie are not classified as pressure bearing parts.

When any MDS is used for applications not covered by PED or to SEP and category I, those specific PED requirements listed above need not be applied as mandatory.

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1 Scope

This NORSOK standard includes material requirement in a collection of Material Data Sheets (MDS) for use in piping systems, selected according to NORSOK L-001, Piping and Valves.

2 Terms, definitions and abbreviations

2.1 Terms and definitions

For the purposes of this NORSOK standard, the following terms and definitions apply.

2.1.1

shall

verbal form used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted, unless accepted by all involved parties

2.1.2

should

verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required

2.1.3

mav

verbal form used to indicate a course of action permissible within the limits of the standard

2.1.4

can

verbal form used for statements of possibility and capability, whether material, physical or casual.

2.1.5

carbon steel type 235

carbon steel with SMYS ≥ 220MPa and not impact tested

2.1.6

carbon steel type 235LT

carbon steel with SMYS ≥ 220 MPa and impact tested at - 46 °C

2.1.7

carbon steel type 360LT

carbon steel with SMYS ≥ 350 MPa and impact tested at - 46 °C

2.1.8

stainless steel type 316

austenitic stainless steel alloys with approx. 2.5 % Mo of type AISI 316

2.1.9

stainless steel type 6Mo

austenitic stainless steel alloys with 6 % Mo and PRE ≥ 40

2.1.10

stainless steel type 22Cr duplex

ferritic/austenitic stainless steel alloys with 22 % Cr e.g. UNS S31803

2.1.11

stainless steel type 25Cr duplex

ferritic/austenitic stainless steel alloys with 25 % Cr and PRE ≥ 40, often also referred to as "super duplex".

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2.2 Abbreviations

API The American Petroleum Institute

ASTM The American Society of Testing and Materials
ASME The American Society of Mechanical Engineers

CE Carbon Equivalent
EN European Standard
MDS Material Data Sheet
NDT Non Destructive Testing
NPS Nominal Pipe Size

SMYS Specified Minimum Yield Strength
PED Pressure Equipment Directive
PRE Pitting Resistance Equivalent
UNS Unified Numbering System

WPAR Welding Procedure Approval Record

3 Collection of material data sheets

3.1 General

Materials/components manufactured in accordance with M- 630 rev. 2 and 3 may be accepted. This shall be agreed with the actual project/company.

The material selection menu for material standards and grades relevant for the piping systems is shown in Table 1. The actual grades to be used with respect to piping design shall be stated on the piping class sheet in the respective project Piping & Valve specification.

The materials shall be delivered in accordance with the standard referred to. In addition the MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.

The actual types of materials covered are as follow:

C - Carbon steels; Type 235, Type 235LT, Type 360LT

D - Ferritic/Austenitic Stainless Steels; Type 22Cr, Type 25Cr

K - Copper/Nickel 90/10 and other copper alloys

N - Nickel base alloys; Type 625

P - Polymers including fibre reinforced

R - Austenitic Stainless Steels; Type 6Mo

S - Austenitic Stainless Steels; Type 316

T - Titanium

X - High strength low alloyed steels.

Note: Welded products according to MDS D42, D43, D52, D53, R12, R13, S01 and T01 have acceptance classes, which give welding factors 0.8 and 1.0. The correct class is specified on the piping class sheet. The order shall include acceptable classes.

3.2 Deviations from ASME B31.3 code requirements

The use of the piping materials according to NORSOK Standards (L- 001, M-630 and M-601) will result in some minor deviations from the ASME B31.3 code. All deviations have been carefully considered, and they are in line with Norwegian and European practice. The deviations are:

- NORSOK have of practical reasons limited the thickness for requiring impact testing to 6 mm
- If sub-size Charpy V-notch impact test specimens are used, the energy requirement is increased instead of lowering the test temperature.
- Eddy current examination is accepted as replacement for spot radiography of stainless steel welds for wall thickness less than 4.0 mm.
- Thin walled (thickness up to 7 mm) longitudinal welded pipes in 6 Mo austenitic stainless is accepted in as welded condition provided the plate material used is solution annealed.

In general, the MDS have supplementary requirement beyond the ASTM standard to ensure a safe use of the material grades.

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Table 1 – Material selection menu for piping systems

Product	Carbon steel Type 235 ¹⁾	Carbon steel Type 235LT impact tested	Carbon steel Type 360LT impact tested	Stainless steel Type 316	Stainless steel Type 22Cr Duplex	Stainless steel Type 25Cr Duplex	Stainless steel Type 6Mo ²⁾	Cu/Ni 90/10 and other copper alloys	Nickel alloy	Titanium Grade 2 3)	High strength low alloyed steel
Pipes Seamless	A106 Grade B	A333 Grade 6	API 5L Grade X52	A312 Grade TP 316	A790 UNS S31803 UNS S32205	A790 UNS S32550, UNS S32750, UNS S32760	A312 UNS S31354, UNS N08367, UNS N08926	B466 UNS C70600	B705 UNS N06625	B861 Grade 2	A519 AISI 4130
Pipes Welded	API 5L Grade B ASTM A672 CC60, CC70 Class 12, 22	A671 Grade CC60, CC70 Class 12/22	A671 Grade CC70 Class 12/22	A312 Grade TP316 A358 Grade 316 Class 1/3/4	A928 UNS S31803 UNS S32205 Class 1/3/5	A928 UNS S32550, UNS S32750, UNS S32760, Class 1/3/5	A358 UNS S31254, UNS N08367, UNS N08926 Class 1/3/5	B467 UNS C70600	B705 UNS N06625	B862 Grade 2	
Fittings	A234 Grade WPB	A420 Grade WPL 6	A860 Grade WPHY 52	A403 Grade WP 316 Class S/W/WX	A815 UNS S31803 UNS S32205 Class S/W/WX	A815 UNS S32550, UNS S32750, UNS S32760, Class S/W/WX	A403 WP S31254, UNS N08367, UNS N08926 Class S/W/WX	- UNS C70600	B366 UNS N06625	B363 Grade WPT2 / WPT2W	A234 AISI 4130
Forgings	A105	A350 Grade LF2	A694 Grade F52	A182 Grade F316	A182 Grade F51 Grade F60	A182 F53/F55/F61	A182 Grade F44, UNS N08367, UNS N08926	- UNS C70600	B564 UNS N06625	B381 Grade F2	ASTM A 788 AISI 4140 API 6A 60K (AISI 4130) A182 F22
Plate	A516 Grade 60/70	A516 Grade 60/70	A516 Grade 70	A240 Grade 316	A240 UNS S31803 UNS S32205	A240 UNS S32550, UNS S32750, UNS S32760	A 240 UNS S31254, UNS N08367, UNS N08926	B171 UNS C70600	B443 UNS N06625	B265 Grade 2	
Castings	A216 Grade WCB	A352 Grade LCC	A352 Grade LCC	A351 Grade CF8M or CF3M	A995 UNS Grade 4 (J92205)	A995 A5 (UNS J93404), A6 (UNS J93380)	A 351 CK-3MCuN, CN-3MN	B148 UNS C95800	A494 Grade CW-6MC and CX2MW	B367 Grade C2	ASTM A 487 Gr 2B/2C
Bars				A276 UNS S31600	A276 UNS S31803 UNS S32205	A276 UNS S32550 UNS S32750 UNS S32760	A276 UNS S31254 UNS N08367 UNS N08926		B446 UNS N06625	B348 Grade 2	

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Product	Carbon steel Type 235 ¹⁾	Type 235LT	Carbon steel Type 360LT impact tested	Stainless steel Type 316		Stainless steel Type 25Cr Duplex	Stainless steel Type 6Mo ²⁾	Cu/Ni 90/10 and other copper alloys		Grade 2 3)	High strength low alloyed steel
Tubes				A269 Grade 316	A789	A789	A269		B444	B338	
					UNS S31803	UNS S32550	UNS S31254		UNS N06625	Grade 2	
					UNS S32205	UNS S32750	UNS N08367				
						UNS S32760	UNS N08926				

Note 1) Type 235 should be used in piping systems with minimum design temperature above or equal to -15 °C and thickness less than 16 mm. Note 2) The grades UNS N08367 and N08926 are considered equivalent to UNS S31254. The grade CN-3 MN is considered equivalent to CK-3MCuN. Note 3) GOST VT-1-0 is considered equivalent to Grade 2.

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3.3 Referenced standards and corresponding MDS

MDS No.	Rev. No.	Standard and Grade ¹⁾ (Products
		Carbon Steel Type 235	
C01	3	A 106-02Grade B API 5L-00 Grade B A 672-01 Grade CC60, CC70 A 234-02 Grade WPB A 105-02 A 516-01Grade 60, 70	Seamless pipes Welded pipes Welded pipes Wrought fittings Forgings Plates
C02	3	A 216-03Grade WCB Carbon Steel Type 235LT	Castings
C11	3	A 333-99 Grade 6 A 671-01 Grade CC60, CC70 A 420-02 Grade WPL 6 A 350-02 Grade LF 2 A 516-01 Grade 60, 70	Seamless pipes Welded pipes Wrought fittings Forgings Plates
C12	3	A 352-03 Grade LCC Carbon Steel Type 360LT	Castings
C21 C22	3 3 3	A 694-00 Grade F52 A 860-00 WPHY 52 API 5L-00 Grade X52	Forgings Wrought fittings Seamless pipes
		Ferritic/Austenitic Stainless Steel Type 22Cr D	uplex
D41 D42 D43 D44 D45 D46 D47 D48	3 3 3 3 3 3 3 3	A 790-03 UNS S31803, UNS S32205 A 928-00 UNS S31803, UNS S32205 A 815-01 UNS S31803, UNS S32205 A 182-02 Grade F51, F61 A 240-03 UNS S31803, UNS S32205 A 995-03 Grade 4A (UNS J92205) A 276-03 UNS S31803, UNS S32205 A 789-02 UNS S31803, UNS S32205	Seamless pipes Welded pipes Wrought fittings Forgings Plates Castings Bars Tubes
		Ferritic/Austenitic Stainless Steel Type 25Cr D	uplex
D51	3	A 790-03 UNS S32550 UNS S32750 UNS S32760	Seamless pipes
D52	3	A 928-00 UNS S32550 UNS S32750	Welded pipes
D53	3	UNS S32760 A 815-01 UNS S32550 UNS S32750	Wrought fittings
D54	3	UNS S32760 A 182-02 Grade F61UNS S32550 Grade F53 (UNS S32750)	Forgings
D55	3	Grade F55 (UNS S32760) A 240-03 UNS S32550 UNS S32750 UNS S32760	Plates
D56	3	A 995-03 Grade 6A (UNS J93380), Grade 5A (UNS J93404)	Castings

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MDS No.	Rev. No.	Standard and Grade ¹⁾	Products
D57	3	A 276-03 UNS S32550 UNS S32750 UNS S32760	Bars
D58	2	A 789-02 UNS S32550 UNS S32750 UNS S32760	Tubes
		Copper/Nickel 90/10	
K01	1	B 466-02 UNS C 70600 B 467-97 UNS C 70600 B 151-00 UNS C 70600 B 171-99 UNS C 70600 UNS C 70600 UNS C 70600	Seaml. pipes & tubes Welded pipes Rod & bar Plates & sheets Fittings Flanges
		Aluminium - Bronze Sand Castings	
K02	1	B 148-97 UNS C 9580	Castings
		Nickel Alloy Type 625	
N01	3	B 366-01 UNS N06625 B 705-00 UNS N06625 B 564-00 UNS N06625 B 443-00 UNS N06625 B 446-02 UNS N06625 B 444-00 UNS N06625	Wrought fittings Pipes Forgings Plates Bars Pipes and tubes
N02	3	A 494-03 Grade CW-6MC, CX 2MW	Castings
		Polymers	
P11 P12 P13 P14 P21	2 2 2 1 2	Hydrogenated Nitrile (HNBR) Fluorocarbon terpolymer (FKM) Fluorocarbon low T terpolymer (FKM GLT) Nitrile (NBR) PEEK (Poly-ether-ether-ketone)	O-ring O-ring O-ring O-ring Back-up rings and seal inserts
P22	2	PTFE (Poly-tetra-fluoro-ethylene)	Lipseals,back-up rings and seal inserts
P23	1	PEEK (Poly-ether-ether-ketone) with PTFE added	Seal inserts

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MDS No.	Rev. No.	Standard and Grade ¹⁾	Products
		Austenitic Stainless Steel Type 6Mo	
R11	3	A 312-02 UNS S31254, UNS N08367, UNS N08926	Seamless pipes
R12	3	A 358-01 UNS S31254, UNS N08367, UNS N08926	Welded pipes
R13	3	A 403-03 UNS S31254, UNS N08367, UNS N08926	Wrought fittings
R14	3	A 182-02 Grade F44, UNS N08367, UNS N08926	Forgings
R15	3	A 240-03 UNS S31254, UNS N08367, UNS N08926	Plates
R16	3	A 351-03 Grade CK-3MCuN, CN-3MN	Castings
R17	3	A 276-03 UNS S31254, UNS N08367, UNS	Bars
R18	3	N08926 A 269-02 UNS S 31254, UNS N08367, UNS N08926	Tubes
		Austenitic Stainless Steel Type 316	
S01	3	A 312-02 Grade TP 316	Seamless & welded pipes
		A 358-01 Grade 316	Welded pipes
		A 403-03 Grade WP 316	Wrought fittings
		A 182-02 Grade F 316	Forgings
		A 240-03 Grade 316	Plates
		A 276-03 Grade 316	Bars
S02	3	A 269-02 Grade 316 A 351-03 Grade CF3M, CF8M	Tubes Castings
302	3	A 331-03 Grade of Sivi, of Givi	Castings
		Titanium Grade 2	
T01	3	B 861-02 Grade 2	Seamless pipes
		B 862-02 Grade 2	Welded pipes
		B 363-03 Grade WPT2/WPT2W	Wrought fittings
		B 381 Grade F2	Forgings
		B 265-02 Grade 2	Plates
		B 348-02 Grade 2	Bars
TOO	3	B 338-02 Grade 2 B 367-93 Grade C2	Tubes
T02	3		Castings
		High Strength Low Alloy Steel	
X01	1	A 519-94 AISI 4130	Seamless pipes
		A 234-96 AISI 4130	Wrought fittings
			(seamless)
X02	2	A 788-94 AISI 4140 (1994)	Forgings
X03	2	A 487-93 Grade 2B	Castings
X04	1	API 6A-96 60K (AISI 4130)	Forgings
X05	1	A 182-96 F22	Forgings
X06	1	A 487-93 Grade 2B, 2C	Castings

Note 1: The current year of issue of standards referenced is shown for guidance only. The latest year of issue shall be used unless otherwise specifically agreed.

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MATERIA	L DATA SH	EET	MDS C01	Rev. 3	
TYPE OF MATERIA	MATERIAL: Carbon Steel Type 235				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings Welded pipes	ASTM A 234 API 5L ASTM A 672	WPB B CC60, CC70	- PSL 1 t ≤ 19 mm: Class 12 t > 19 mm: Class 22	S3 - A 20 S20 A 20 S20	
Seamless pipes Forgings Plates	ASTM A 106 ASTM A 105 ASTM A 516	B - 60, 70	- - -	S5 S4 A 20 S20	
1. SCOPE	_	_	the referred standard and a sede the corresponding req		
2. MANUFACTURING PROCESS	Welded pipes to API		e by the sub-merged arc wrial. Electric resistance wel		
	All welded products:		carried out by qualified we res approved by a 3 rd party EC member State.		
3. HEAT TREATMENT	Welded pipes to API	5L: Stress relieving w	hen the nominal thickness	t ≥ 19 mm.	
4. CHEMICAL COMPOSITION	-	0%; Mn = 0.50 - 1.35% (Cr+Mo+V)/5 + (Cu+	%; S ≤ 0.025 %; P ≤ 0.030 Ni)/15 ≤ 0.43.	%;	
5. MECHANICAL	Welded pipes to API	5L: A ₅ > 22% (long.),	16% (transv.)		
PROPERTIES	Seamless pipes to A I	106: A _{5(Transverse)} >14 %			
6. TEST SAMPLING	Samples for production component.	on testing shall realistic	cally reflect the properties	in the actual	
7. NON DESTRUCTIVE TESTING	*	Γ of weld seam or RT and Γ	at ends and US/Eddy Curre	ent of the remaining	
	Fittings to A 234: U	T is not acceptable as r	replacement of RT.		
	All products: NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.				
8. REPAIR OF DEFECTS	Weld repair of base material is not acceptable.				
9. CERTIFICATION	10204 Type 3.1B pro	vided the manufacture	he specification and shall be r has a quality assurance sy and having undergone a sp	ystem certified by a	

MATER	IAL DATA SH	EET	MDS C02	Rev. 3			
TYPE OF MATERIA	Page 1 of 1						
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.			
Castings	ASTM A 216	WCB	-	S4, S5			
1. SCOPE	This MDS specifies the s requirements which shall referred standard.	-					
2. CHEMICAL COMPOSITION	$C \le 0.20$ % and $CE_{(IIW)} =$ butt weld ends.	$C \le 0.20$ % and $CE_{(IIW)} = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15 \le 0.43$ for castings with butt weld ends.					
3. EXTENT OF TESTING	One set of tensile test is r	required for each melt	and heat treatment load	1.			
4. TEST SAMPLING	Samples for mechanical testing shall realistically reflect the properties in the actual components. For castings with weight 250 kg and above the test blocks shall be integrally cast with the casting. The test blocks shall be heat treated together with the castings they represents.						
5. NON DESTRUCTIVE TESTING	 Magnetic particle testing: Supplementary requirement S4 shall apply to all surfaces (including internal surfaces) of all castings. The examination shall be carried out after final machining. The acceptance criterias shall be ASME VIII, Div.1, Appendix 7. Radiographic testing: Supplementary requirement S5 shall apply to: Critical areas as per ANSI B16.34 of the pilot cast of each pattern All butt weld ends of each casting. Class 1500 psi and above; all critical areas according to ANSI B16.34 of each casting. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. NDT operator qualification shall be approved by a 3rd party organization recognized by an EC member state 						
6. REPAIR OF DEFECTS	Welding shall be carried out by qualified welders according to qualified procedures approved by a 3 rd party organization recognized by an EC member State.						
7. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.						

MATERIA	AL DATA S	НЕЕТ	MDS C11	Rev. 3		
TYPE OF MATERIA	Page 1 of 2					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings Welded pipes	ASTM A 420 ASTM A 671	WPL 6 CC60, CC70	- t ≤ 19 mm: Class 12 t > 19 mm: Class 22	S51, S53, S69 S2, S7 S2, S7		
Seamless pipes Forgings Plates	ASTM A 333 ASTM A 350 ASTM A 516	6 LF2 60, 70	Class 1	S6, S55 S5		
1. SCOPE			the referred standard and a esponding requirements in t			
2. MANUFACTURING PROCESS		: Welding shall be carr	ied out by qualified welders by a 3 rd party organization	s according to qualified		
3. CHEMICAL COMPOSITION	$CE_{(IIW long formula)} = C$		5 %; P ≤ 0.030 %; /5 + (Cu+Ni)/15 ≤ 0.43. 0.40, Mo ≤ 0.15, Cu ≤ 0.40,	$Nb \le 0.010 \text{ V} \le 0.08$		
4. IMPACT TESTING	Charpy V-notch test thickness at the wel	ting at - 46°C is required neck. The minimum a	ed for the thickness ≥ 6 mm. absorbed energy for full size s for sub-size specimens shape of the size specimens specimens shape of the size specimens specim	For flanges apply the e specimens shall be 27		
5. EXTENT OF TESTING	Fittings to A 420: Pipes to A 671: Forgings to A 350:	In Supplementary requirement ASTM A 960, S51 shall apply. Impact testing shall be carried out to the same extent as tensile testing.				
6. TEST SAMPLING	All products: Forgings to A350:	Samples for production the actual component.	n testing shall realistically rollished showing type, size a	reflect the properties in		

MATERI	AL DATA S	SHEET	MDS C11	Rev. 3		
TYPE OF MATERI	TYPE OF MATERIAL: Carbon Steel Type 235LT					
PRODUCT	STANDARD	GRADE	SUPPL. REQ.			
Wrought fittings Welded pipes	ASTM A 420 ASTM A 671	WPL 6 CC60, CC70	- t ≤ 19 mm: Class 12 t > 19 mm: Class 22	S51, S53, S69 S2, S7 S2, S7		
Seamless pipes Forgings Plates	ASTM A 333 ASTM A 350 ASTM A 516	6 LF2 70	- Class 1	S6, S55 S5,		
TESTING	Forgings to A 350 All products:	Supplementary requirement ASTM A 960, S53 and S69, magnetic particle testing, shall apply to 10 % of all fittings (same test lot as defined for mechanical testing) for nominal thickness < 12.7 mm and 100 % of all fittings for nominal thickness ≥ 12.7 mm. The testing shall be carried out after calibration. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 6. Sings to A 350: Supplementary Requirement ASTM A 961, S55, magnetic particle testing shall apply to 10 % of all forgings (same test lot as defined for mechanical testing) with NPS > 2. The testing shall be carried out after final machining. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 6. NDT operator qualification shall be approved by a 3 rd party organization				
8. REPAIR OF DEFECTS	Weld repair of bas	e material is not acceptab	ole.			
9. MARKING	Heat treatment loa required per heat t	-	nently marked on the compo	nent where testing is		
10. CERTIFICATION	10204 Type 3.1B competent body esmaterials.	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials. Heat treatment temperature, soaking time and cooling medium should be stated in the				

MATERI	AL DATA SH	IEET	MDS C12	Rev. 3			
TYPE OF MATERI	AL: Carbon Steel Type	pe 235LT		Page 1 of 1			
PRODUCT	STANDARD	GRADE	ACCEPT. CLAS	SS SUPPL. REQ.			
Castings	ASTM A 352	LCC	-	S4, S5			
1. SCOPE	•	*	the referred standard and esponding requirements in	•			
2. CHEMICAL COMPOSITION	$C \le 0.22 \%; S \le 0.025$ CE = C + Mn/6 + (Cr.)		$(1)/15 \le 0.43$				
3. IMPACT TESTING	The minimum absorbe	ed energy for full size	e specimens shall be 27 J a	verage and 20 J single.			
4. EXTENT OF TESTING	One set of tensile and A test lot shall not exc	•	ed for each melt and heat to	reatment load.			
5. TEST SAMPLING							
	Test specimens shall be cut from the 1/4 T location from the surface where T is the thickness of the test block.						
	Test block shall be integrally cast or gated onto the castings and shall not be removed from the castings until after the final quality heat treatment.						
6. NON DESTRUCTIVE TESTING	Magnetic Particle testing: Supplementary requirement S4 shall apply to all surfaces (including internal surfaces) of all castings. The testing shall be carried out after final machining. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.						
	 Radiographic testing: Supplementary requirement S5 shall apply to: Critical areas as per ANSI B16.34 of the pilot cast of each pattern. All butt weld ends of each casting. Class 1500 psi and above; all critical areas to ANSI B16.34 of each casting The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. 						
	NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.						
7. REPAIR OF DEFECTS	A cast plate shall be u	sed in the qualification	on of the repair welding pr	ocedure.			
	Welding shall be carriby a 3 rd party organiza		velders according to qualif in EC member State.	ied procedures approved			
8. MARKING	The component shall	be marked to ensure	full traceability to melt and	d heat treatment lot.			
9. CERTIFICATION Certification shall affirm compliance with the specification and shall be according to 10204 Type 3.1B provided the manufacturer has a quality assurance system certified competent body established within the EC, and having undergone a specific assessing materials.							
	Heat treatment temper certificate.	rature, soaking time a	and cooling medium shall l	be stated in the			

MATERI	AL DATA	SHEET	MDS C21	Rev. 3
TYPE OF MATERI	AL: Carbon Steel	Type 360LT		Page 1 of 2
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Wrought fittings Forgings	ASTM A 860 ASTM A 694	WPHY 52 F52	Seamless and welded	
1. SCOPE			n the referred standard and a responding requirements in t	
2. CHEMICAL COMPOSITION	Ti ≤0.05 %; Nb ≤	$\leq 0.04 \%$; Al $\leq 0.06 \%$; N	0-0.50 %; $S \le 0.025$ %; $P \le 0$ $S \le 0.015$ %; $S \le 0.025$ %; $S \le 0.015$ %; $S \le 0.015$ %; $S \le 0.015$ %; $S \le 0.015$ %; $S \le 0.025$ %;	•
3. IMPACT TESTING	mm. The minimu	m absorbed energy for for	MA 370 at - 46 °C is requirull size specimen shall be 40 cimens shall be: 7.5 mm - 5/6	J average and 30 J
4. EXTENT OF TESTING	Forgings: One set of tensile and impact testing shall be carried out for each heat and heat treatment load. The testing shall be carried out on the component with heaviest wall thickness within the load. A test lot shall not exceed 2000 kg for forgings with as forged weight ≤ 50 kg, and 5000 kg for forgings with as forged weight > 50 kg.			
5. TEST SAMPLING	Forgings: Test for ma kg.	ual component. st samples shall be from gings shall be used for die-forged st location and orientation	prolongations on actual compile-forged components. Howell components with as forged in shall be:	ponents. Sacrificial ever, special agreements weight exceeding 50
		specimens shall be take least 50 mm from any For forgings having ma specimen shall be take or 100 mm, whichever	en at mid thickness and its mesecond surface. aximum section thickness, Ton at least ¼ T from the neare is less, from any second surfaced showing type, size and loc	1 > 50 mm, the test2 > st surface and at least T face.
6. WELDING	Fittings to A 860: Welding shall be carried out by qualified welders according to qualified procedures approved by a 3 rd party organization recognized by an EC member State. The WPQ shall be qualified in accordance with ASME IX or EN 288-3.			
7. NON DESTRUCTIVE TESTING	All products: Fittings to A 860.	operator qualification recognized by an EC not supplementary require % of all fittings (same nominal thickness ≤ 12 thickness ≥ 12.7 mm.	ement S4, magnetic particle t test lot as defined for mecha 2.7 mm and 100 % of all fitti The testing shall be carried o	testing, shall apply to 10 anical testing) for ings for nominal out after calibration.
	Forgings to A 69	testing) shall be magne	with NPS > 2 (same test lot as etic particle testing according cried out after final machining	g to ASME V Article 7.

MATERIA	AL DATA S	HEET	MDS C21	Rev. 3	
TYPE OF MATERIA	TYPE OF MATERIAL: Carbon Steel Type 360LT				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings Forgings	ASTM A 860 ASTM A 694	WPHY 52 F52	Seamless and welded		
8. REPAIR OF DEFECTS	Weld repair of base	material is not accep	table.		
9. MARKING	The component sha	ll be marked to ensur	e full traceability to melt and he	eat treatment lot.	
10. CERTIFICATION	The component shall be marked to ensure full traceability to melt and heat treatment lot. Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.				

MATERIA	AL DATA S	HEET	MDS C22	Rev. 3		
TYPE OF MATERIA	AL: Carbon Steel T	ype 360LT		Page 1 of 1		
PRODUCT	STANDARD	SUPPL. REQ.				
Seamless pipes	API 5L	X52	PSL 2	SR4.3, SR18		
1. SCOPE			in the referred standard and orresponding requirements in	*		
2. STEEL MAKING	Fine grain treatment	shall be carried out				
3. HEAT TREATMENT	Normalised or Quer	ched and Tempered				
4. CHEMICAL COMPOSITION		C ≤ 0.16 %; Mn = 0.90 - 1.60 %; Si= 0.10-0.50 %; Ti ≤ 0.05 %; Nb ≤ 0.04 %; Al ≤ 0.06 %; N ≤ 0.015 %; V+Nb+Ti ≤ 0.10 %; V+Nb ≤ 0.07 %;				
	$CE_{(IIW)} = C + Mn/6$	+ (Cr + Mo + V)/5 + (Cr + Mo	$Cu+Ni)/15 \le 0.43.$			
5. TENSILE TESTING	$A_5 > 22\%$ (long.), 10	5% (transv.)				
6. IMPACT TESTING	mm. The minimum	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy for full size specimens shall be 40 J average and 30 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
7. TEST SAMPLING	Samples for product component.	Samples for production testing shall realistically reflect the properties in the actual component.				
8. NON DESTRUCTIVE TESTING	Supplementary requirement SR 4.3 with notch calibration of 5 % of the nominal wall thickness shall apply for all thickness.					
9. SURFACE FINISH	The surface finish shall comply with ASTM A 106 para. 18.3.2.					
10. REPAIR OF DEFECTS	Weld repair is not acceptable.					
11. CERTIFICATION	10204 Type 3.1B pr	ovided the manufac	th the specification and shall turer has a quality assurance EC, and having undergone a s	system certified by a		

MATERIA	AL DATA S	SHEET	MDS D41	Rev. 3	
TYPE OF MATERIA	AL: Ferritic/Auste	nitic Stainless Steel,	Type 22Cr duplex	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	ASTM A 790	UNS S 31803 UNS S 32205	-	-	
1. SCOPE			in the referred standard and a rresponding requirements in		
2. QUALIFICATION	Manufacturers of p Standard M-650.	product to this MDS sh	all comply with the requirem	nent of NORSOK	
3. STEEL MAKING	The steel melt shall	l be refined with AOD	or equivalent.		
4. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
5. HARDNESS	The hardness shall	be maximum 28 HRC	or alternatively 271 HB or 2	290 HV10.	
6. IMPACT TESTING	Charpy V-notch testing (3 specimens) according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
7. MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the near surfaces and mid-thickness region of the pipe. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35-55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
8. EXTENT OF TESTING	Charpy V-notch impact, microstructure, hardness and tensile testing shall be carried out for each lot as defined in the referred standard. For batch furnace charges the specified tests shall be carried out for each heat treatment charge.				
9. TEST SAMPLING	Samples for produ components.	ction testing shall reali	stically reflect the properties	in the actual	
10. SURFACE FINISH	White pickled.				
11. REPAIR OF DEFECTS	Weld repair is not	acceptable.			
12. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
13 CERTIFICATION	10204 Type 3.1B ₁	provided the manufact	h the specification and shall larer has a quality assurance s C, and having undergone a sp	ystem certified by a	
	Heat treatment ten certificate.	nperature, soaking time	e and cooling medium should	be stated in the	

MATERIA	AL DATA SH	EET	MDS D42	Rev. 3		
TYPE OF MATERIA	Page 1 of 2					
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS				
Welded pipes	ASTM A 928	UNS S31803 UNS S32205	Class 1, 3 and 5	S3		
1. SCOPE	_	-	e referred standard and a onding requirements in t	-		
2. QUALIFICATION	Manufacturers of produstandard M-650.	ct to this MDS shall co	omply with the requirem	ent of NORSOK		
3. STEEL MAKING	The steel melt shall be a	refined with AOD or e	quivalent.			
4. MANUFACTURING PROCESS	Welding shall be carried by a 3 rd party organization		lers according to qualified C member State.	ed procedures approved		
4. HEAT TREATMENT	The pipes shall be solut	ion annealed followed	by water quenching.			
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. TENSILE TESTING	Base material properties	s: $R_{p0.2} \ge 450 \text{ MPa}$; R_n	$_{1} \ge 620 \text{ MPa}; A_{5} \ge 25 \%$			
7. HARDNESS		The hardness shall be maximum 28 HRC or alternatively 271 HB or 290 HV10 for base material, HAZ and weld metal.				
8. IMPACT TESTING	mm. The minimum absorbecimen, shall be carri	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average and 35 J single. Two sets, each 3 specimen, shall be carried out with notch located in weld metal and fusion line, respectively. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
9. MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the near surfaces and mid-thickness region of the pipe including the weld zone. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35-55 % for base material and 35-65 % for weld metal. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.					
10. EXTENT OF TESTING	Tensile test, impact test, hardness test and microstructure examination shall be carried out for each lot. The lot is defined as follows: - For batch furnace a lot is defined as maximum 60 m of pipe of the same heat, size and heat treatment charge. - For continuous heat treatment furnace the lot definition in para 8.1 of the ASTM standard apply					
11. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.					
12. WELDING	include the same exami	nations as for the prod l grade (UNS number)	_			
13. TOLERANCES	The pipes shall have a r	max. undertolerance of	0.3 mm for pipe with no	ominal OD ≥ 8".		

MATERIA	AL DATA SI	HEET	MDS - D42	Rev. 3		
TYPE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 22Cr duplex			, Type 22Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Welded pipes	ASTM A 928	UNS S31803 UNS S 32205	Class 1, 3 and 5	S3		
14. NON DESTRUCTIVE TESTING	Eddy current testing radiography for wall	•	1 A 450 is acceptable as re 4.0 mm.	placement for spot		
	to the weld area of 1 delivered. The testing	Supplementary requirement S3, penetrant testing, according to ASME V Article 6 shall apply to the weld area of 10 % of the pipes (same test lot as defined for mechanical testing) delivered. The testing shall be carried out after calibration and pickling. Acceptance criteria shall be to ASME VIII, Div. 1 Appendix 8.				
	NDT operator qualif member state.	NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.				
15. SURFACE FINISH	White pickled.					
16. REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds the same requirements to PQR/WPAR shall apply as for production welding.					
17. MARKING	The componenet shall be marked to ensure full traceability to melt and heat treatment lot.					
18. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.					
	Heat treatment tempo certificate.	erature, soaking tim	e and cooling medium sho	uld be stated in the		

MATERI	AL DATA SH	EET	MDS D43	Rev. 3		
TYPE OF MATERI	AL: Ferritic / Austeni	tic Stainless Stee	l, Type 22Cr duplex	Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings	ASTM A 815	UNS S 31803 UNS S 32205	WP-W, WP-S or WP-WX	S7		
1. SCOPE			in the referred standard and adorresponding requirements in th			
2. QUALIFICATION	Manufacturers of prod Standard M-650.	uct to this MDS sl	nall comply with the requirement	nt of NORSOK		
3. STEEL MAKING	The steel melt shall be	refined with AOI	O or equivalent.			
4. HEAT TREATMENT	The fittings shall be so	olution annealed fo	ollowed by water quenching.			
5.CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. HARDNESS	The hardness shall be material, HAZ and we		C or alternatively 271 HB or 290	0 HV10 for base		
7. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average and 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3. The notch location and number of specimen shall be:					
	Seamless fittings: One					
	Welded fittings: Two	o sets, each 3 spec	imen, located in weld metal and	l fusion line.		
8. MICROGRAPHIC EXAMINATION	fittings including the v E 562 or equivalent ar metal. The microstruct	The micrographic examination shall cover the near surfaces and mid-thickness region of the fittings including the weld zone. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 % for base material and 35-65 % for weld metal. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
9. EXTENT OF TESTING	, 1		d microstructure examination sheal thickness range of 5 mm and			
10. TEST SAMPLING		Samples for production testing shall realistically reflect the properties in the actual components. Test sampling shall be made from an actual fitting or from a prolongation				
11. WELDING	The PQR/WPAR shall be qualified in accordance with ASME IX or EN 288-3 and shall include the same examinations as for the production testing. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make of welding consumables requires requalification.					
	Welding shall be carri by a 3 rd party organiza		welders according to qualified an EC member State	procedures approved		
12. NON DESTRUCTIVE TESTING	(from the test lot as de shall be carried out aft the weld only. The acc	fined above) and 1 er calibration and eeptance criteria sh	enetrant testing, shall apply to 1 100 % of welded fittings above pickling. For welded fittings the tall be ASME VIII, Div. 1, Approved by a 3 rd party organization	NPS 2. The testing e testing shall cover sendix 8.		

MATERIA	AL DATA SHE	ET	MDS D43	Rev. 3	
TYPE OF MATERIA	TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings	ASTM A 815	UNS S31803 UNS S 32205	WP-W, WP-S or WP-WX	S7	
13. SURFACE FINISH	White pickled. Machined	surfaces do not i	equire pickling.		
14. REPAIR OF DEFECTS	Weld repair of base mater PQR/WPAR shall apply a		able. For repair of welds the sat welding.	me requirements to	
15. MARKING	The component shall be r	The component shall be marked to ensure full traceability to melt and heat treatment lot.			
16. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.				
	Heat treatment temperatu certificate.	re, soaking time	and cooling medium should be	stated in the	

MATERIA	AL DATA SHE	ET	MDS D44	Rev. 3	
TYPE OF MATERIA	AL: Ferritic / Austenitic	Stainless Steel,	Type 22Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Forgings	ASTM A 182	F51, F60	-	S56	
1. SCOPE	•		the referred standard and addiesponding requirements in the	•	
	This MDS is intended for thickness special agreeme	~ ~	eximum section thickness of 30 in each case.	00 mm. For larger	
2. QUALIFICATION	Manufacturers of product Standard M-650.	to this MDS shal	ll comply with the requirement	of NORSOK	
3. STEEL MAKING	The steel melt shall be ref	ined with AOD o	or equivalent.		
4. MANUFACTURING PROCESS	The Hot Isostatic Pressed	The Hot Isostatic Pressed (HIP) process is an acceptable alternative to forging.			
5. HEAT TREATMENT	The forgings shall be solu	tion annealed fol	lowed by water quenching.		
6. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
7. HARDNESS	The hardness shall be max	ximum 28 HRC (or alternatively 271 HB or 290	HV10).	
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm (thickness at the weld neck). The minimum absorbed energy shall satisfy 45 J average and 35 J single. Reduction factors for subsize specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
9. MICROGRAPHIC EXAMINATION	The micrographic examination shall be carried out at the same area as location of specimens for mechanical. The area shall be minimum 10 x 10 mm. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
10. EXTENT OF TESTING	carried out for each heat a component with heaviest	nd heat treatmen wall thickness wi	s test and microstructure exam t load. The testing shall be carr thin the load. A test lot shall no , and 5000 kg for forgings with	ried out on the ot exceed 2000 kg	

MATER	IAL DATA SH	EET	MDS D44	Rev. 3		
TYPE OF MATERIA	1L: Ferritic / Austenitic S	Stainless Steel,	Type 22Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Forgings	ASTM A 182	F51, F60	-	S56		
11. TEST SAMPLING	Samples for production te components.	Samples for production testing shall realistically reflect the properties in the actual components.				
	used for die-forged compo	Test samples shall be from prolongations on actual component. Sacrificial forgings shall be used for die-forged components. However, special agreements may be made for die-forged components with as forged weight exceeding 50 kg. Integrated test blocks shall be used for HIP.				
	Test location and orientati	ion shall be:				
			tion thickness, $T \le 50$ mm, the id length shall be at least 50 m			
	• For forgings having maximum section thickness, T > 50 mm, the test specimen shall be taken at least \(^1/4\) T from the nearest surface and at least T or 100 mm, whichever is less, from any second surface.					
	Sketches shall be establish test specimens.	ned showing type	, size and location of test samp	les and extraction of		
12. NON DESTRUCTIVE TESTING	Supplementary requirement ASTM A 961 S56, penetrant testing, shall apply to 10 % of forgings (from the lot as defined for mechanical testing) above NPS 2. The testing shall be carried out after final machining. Non-machined surfaces shall be pickled prior to the testing. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.					
	member state.	n shall be approv	red by a 3 rd party organization	recognized by an EC		
13. SURFACE FINISH	Finished products shall be	white pickled. M	fachined surfaces do not requi	re pickling.		
14. REPAIR OF DEFECTS	Weld repair is not accepta	ble.				
15. MARKING	The component shall be m	narked to ensure f	full traceability to melt and hea	at treatment lot.		
16. CERTIFICATION	10204 Type 3.1B provide	The component shall be marked to ensure full traceability to melt and heat treatment lot. Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.				
	Heat treatment temperatur certificate.	e, soaking time a	nd cooling medium should be	stated in the		

MATERIA	AL DATA S	SHEET	MDS D45	Rev. 3	
TYPE OF MATERIA	4L: Ferritic / Aust	enitic Stainless Stee	l, Type 22Cr duplex	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Plates	ASTM A 240	UNS S 31803 UNS S 32205	-	-	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.				
2. QUALIFICATION	Manufacturers of p Standard M-650.	product to this MDS sh	nall comply with the requirement	ent of NORSOK	
3. STEEL MAKING	The steel melt shal	l be refined with AOI	or equivalent.		
4. HEAT TREATMENT	The plates shall be	solution annealed fol	lowed by water quenching.		
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
6. HARDNESS	The hardness shall	be maximum 28 HRC	C or alternatively 271 HB or 29	90 HV10.	
7. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness \geq 6 mm. The minimum absorbed energy shall satisfy 45 J average and 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
8. MICROGRAPHIC EXAMINATION	ferrite content shall within 35 -55 %. T	The micrographic examination shall cover the near surface and mid-thickness region. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 -55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.			
9. EXTENT OF TESTING		Impact test, tensile test, hardness test and micrographic examination shall be carried out for each heat, size and heat treatment load.			
10. TEST SAMPLING	Samples for production components.	ction testing shall real	istically reflect the properties i	n the actual	
11. SURFACE FINISH	White pickled.				
12. REPAIR OF DEFECTS	Weld repair is not	acceptable.			
13. MARKING	The component sha	all be marked to ensur	e full traceability to melt and h	neat treatment lot.	
14. CERTIFICATION	10204 Type 3.1B p	The component shall be marked to ensure full traceability to melt and heat treatment lot. Certification shall affirm compliance with the specification and shall be according to EN 0204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for naterials.			
	Heat treatment tem certificate.	perature, soaking time	e and cooling medium should l	be stated in the	

MATERI	AL DATA S	HEET	MDS D46	Rev. 3	
TYPE OF MATERI	AL: Ferritic / Auste	nitic Stainless Steel	l, Type 22Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 995	4A (UNS J92205	5) -	S5, S6, S20	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.				
2. QUALIFICATION	Manufacturers of pr standard M-650.	roduct to this MDS sh	all comply with the requirem	ent of NORSOK	
3. STEEL MAKING	The steel melt shall	be with AOD or equi	valent refining.		
4. HEAT TREATMENT	The castings shall b	e solution annealed for	ollowed by water quenching.		
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
6. HARDNESS	The hardness shall b	oe maximum 28 HRC	or alternatively 271 HB or 2	90 HV10.	
7. IMPACT TESTING	1.7	ting is required accorall satisfy 45 J averag	ding to ASTM A 370 at - 46 e and 35 J single.	°C. The minimum	
8. MICROGRAPHIC EXAMINATION	The micrographic examination shall be carried out at the same area as location of specimens for mechanical testing. The area shall be minimum 10 x 10 mm. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 %. The microstructure, as examined at 200 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
9. EXTENT OF TESTING			ts and microstructure examinates to the shall not exceed 5 000 kg		
10. TEST SAMPLING	components. Thickr	ness of the test block maximum thickness	istically reflect the properties shall be equal to the thickness of 100 mm. For flanged comp	s of the actual	
	Test specimens shal of the test block.	l be cut from the 1/4	Γ location from the surface w	here T is the thickness	
		integrally cast or gate ter the final quality he	d onto the castings and shall eat treatment.	not be removed from	
11. NON DESTRUCTIVE TESTING	internal surfaces) of	all castings. The exances shall be pickled	requirement S6 shall apply to mination shall be carried out prior to the testing. The accep	after final machining.	
	Radiographic testin	g: Supplementary rec	quirement S5 shall apply to:		
	- Critical area	as as per ANSI B16.3	4 of the pilot cast of each pat	tern.	
	- All butt wel	d ends of each castin	g		
	- Class 1500	psi and above; all cri	tical areas to ANSI B16.34 of	f each casting.	
	The acceptance crite	eria shall be to ASMI	E VIII, Div. 1 Appendix 7.		
	-		oved by a 3 rd organization rec	cognized by an EC	

MATERIA	AL DATA SHI	EET N	MDS D46	Rev. 3	
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 995	4A (UNS J92205)	-	S5, S6, S8, S20	
12. SURFACE FINISH	White pickled. Machine	ed surfaces do not requir	e pickling.		
13. REPAIR OF DEFECTS	Supplementary requirement ASTM A 703 S20 shall apply. The repair welding procedure qualification shall include the following: - Qualified on a cast plate of the same grade (UNS-number) which shall be welded - Change of specific make of filler metal (brand name) requires re-qualification - Examination of microstructure of base material and weld zone. The ferrite content shall be 35-55 % for the base material and 35-65 % for the weld metal. - Charpy V-notch testing as specified above, with two sets each 3 specimens, with - notch located in weld metal and fusion line, respectively. Welding shall be carried out by qualified welders according to qualified procedures approved				
14. MARKING	by a 3 rd party organization recognized by an EC member State. The component shall be marked to ensure full traceability to melt and heat treatment lot.				
15. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.				

MATER	RIAL DATA	SHEET	MDS D47	Rev. 3		
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex Page 1 of						
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Bars	ASTM A 276	UNS S 31803 UNS S 32205	-	-		
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirement which shall be added or supersede the corresponding requirements in the referred standard					
		ed for bars with maximu greements shall be made i	m section thickness of 300 in each case.	mm. For larger		
2. QUALIFICATION	Manufacturers of prostandard M-650.	roduct to this MDS shall	comply with the requirement	ent of NORSOK		
3. STEEL MAKING	The steel melt shall	be refined with AOD or	equivalent.			
4. HEAT TREATMENT			d by water quenching. The 182 for the actual grade/U			
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. HARDNESS	The hardness shall l	be maximum 28 HRC or	alternatively 271 HB or 29	90 HV10.		
7. IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at - 46 °C. The minimum absorbed energy shall satisfy 45 J average and 35 J single.					
8. MICROGRAPHIC EXAMINATION	The micrographic examination shall be carried out at the same area as location of specimens for mechanical testing. The area shall be minimum 10 x 10 mm. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.					
9. EXTENT OF TESTING	One set of impact test, tensile test, hardness test and microstructure examination shall be carried out for each heat and heat treatment load.					
10. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.					
	Test location and orientation shall be:					
	For bars having maximum section thickness, T ≤ 50 mm, the test specimens shall be taken at mid thickness and its mid length shall be at least 50 mm from any second surface.					
	■ For bars having maximum section thickness, T > 50 mm, the test specimen shall be taken at least ¼ T from the nearest surface and at least T or 100 mm, whichever is less, from any second surface.					
	■ The testing shall be carried out in longitudinal direction. For thickness exceeding 160 mm, the testing shall be carried out both in longitudinal and transverse (tangential) direction. All testing in longitudinal direction shall meet specified requirements (ASTM A 276 and this MDS). For testing in transverse (tangential) direction elongation shall be minimum 20 % and the minimum Charpy V-notch absorbed energy shall satisfy 27 J average and 20 J single.					

MATERIAL DATA SHEET			MDS D47	Rev. 3		
TYPE OF MATERIA	AL: Ferritic / Auster	nitic Stainless Steel,	Type 22Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Bars	ASTM A 276	UNS S 31803 UNS S 32205	-	-		
11. SURFACE FINISH	Finished products shall be white pickled. Machined surfaces do not require pickling.					
12. REPAIR OF DEFECTS	Weld repair is not acceptable.					
13. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
14. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.					
	Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.					

MATERIA	L DATA SH	IEET	MDS	D48	Rev. 3	
TYPE OF MATERI	AL: Ferritic / Auste	nitic Stainless Stee	l, Type 220	Cr duplex	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACC	CEPT. CLASS	SUPPL. REQ.	
Tubes	ASTM A 789	UNS S 31803 UNS S 32205	-		-	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.					
2. QUALIFICATION	Manufacturers of pr Standard M-650.	roduct to this MDS sh	nall comply	with the requiren	nent of NORSOK	
3. STEEL MAKING	The steel melt shall	be refined with AOD	or equivale	nt.		
4. HEAT TREATMENT	The tubes shall be se	The tubes shall be solution annealed followed by water quenching.				
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. HARDNESS	The hardness shall be maximum 28 HRC or alternatively 271 HB or 290 HV10.					
7. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.					
8. MICROGRAPHIC EXAMINATION	The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35-55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.					
9. EXTENT OF TESTING	Microstructure, hardness and tensile testing shall be carried out for each lot as defined in the referred standard.					
10. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.					
11. SURFACE FINISH	White pickled or bright annealed.					
12. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
13. CERTIFICATION	EN 10 204 Type 3.1B. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.					

MATERIA	L DATA SH	IEET	MDS	S D51	Rev. 3
TYPE OF MATERIA	AL: Ferritic / Auster	nitic Stainless Steel,	Гуре 250	Cr duplex	Page 1 of 2
PRODUCT	STANDARD	GRADE	AC	CEPT. CLASS	SUPPL. REQ.
Seamless pipes	ASTM A 790	UNS S 32550 UNS S 32750 UNS S 32760	-		-
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. This MDS is based on the mechanical properties of UNS S 32750.				
2. QUALIFICATION	Manufacturers of pro	oduct to this MDS shal	l comply	with the requirem	ent of NORSOK
3. STEEL MAKING	The steel melt shall l	pe refined with AOD o	r equivale	ent.	
4. HEAT TREATMENT	The pipes shall be so	olution annealed follow	ed by wa	ter quenching.	
5. CHEMICAL COMPOSITION	$PRE = \% Cr + 3.3 \% Mo + 16 \% N \ge 40.0$				
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa; } R_n$	$_{1} \ge 800 \text{ MPa}; A_{5} \ge 25\%$, 0		
7. HARDNESS	The harness shall be max. 32 HRC (or alternatively 301 HB or 330 HV 10).				
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
9. CORROSION TEST	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. The specimen shall have the internal and external surfaces in the as-delivered condition (including pickling). Cut edges shall be prepared according to ASTM G 48, and the whole specimen shall be pickled (20 % HNO ₃ + 5 % HF, 60 °C, 5 minute). The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. The acceptance criteria are: - No pitting 20 X magnification.				
	- The weight loss shall be less than 4.0 g/m^2 .				
10. MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the near surfaces and mid-thickness region of the pipe. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35-55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
11. EXTENT OF TESTING	Charpy V-notch impact, microstructure, hardness, corrosion and tensile testing shall be carried out for each lot as defined in the referred standard. For batch furnace charges the specified tests shall be carried out for each heat treatment charge.				
12. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.				
13. SURFACE FINISH	White pickled.				
14. REPAIR OF DEFECTS	Weld repair is not acceptable.				

MATERIAL DATA SHEET MDS D51				Rev. 3		
TYPE OF MATER	RIAL: Ferritic / Austo	enitic Stainless Steel,	Гуре 25Cr duplex	Page 2 of 2		
PRODUCT	STANDARD GRADE ACCEPT. CLASS		SUPPL. REQ.			
Seamless pipes	ASTM A 790	UNS S 32550 UNS S 32750 UNS S 32760	-	-		
15. MARKING	The component sha	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
16. CERTIFICATION	10204 Type 3.1B p competent body est for materials.					
	Heat treatment tem certificate.	Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.				

MATERIA	L DATA SHE	CET M	DS D52	Rev. 3		
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 25Cr duplex Page 1 of 2						
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Welded pipes	ASTM A 928	UNS S 32550 UNS S 32750 UNS S 32760	Class 1, 3 and 5	-		
1. SCOPE	requirements which sha	e selected options in the rall be added or supersede MDS is based on the me	the corresponding req	uirements in the		
2. QUALIFICATION	Manufacturers of produ Standard M-650.	uct to this MDS shall con	nply with the requirem	ent of NORSOK		
3. STEEL MAKING	The steel melt shall be	refined with AOD or equ	iivalent.			
4. HEAT TREATMENT	The pipes shall be solut	tion annealed followed b	y water quenching.			
5. CHEMICAL COMPOSITION	PRE = % Cr + 3.3 % M	$16 + 16 \% N \ge 40.0$				
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa}; R_m \ge$	795 MPa; A ≥ 25 %				
7. HARDNESS	The hardness shall be maximum 32 HRC (or alternatively 301 HB or 330 HV10) for base material, HAZ and weld metal.					
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Two sets, each 3 specimens, shall be carried out with notch located in weld meal and fusion line, respectively. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.					
9. CORROSION TEST	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. The specimen shall have the internal and external surfaces in the as-delivered condition (including pickling). Cut edges shall be prepared according to ASTM G48, and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose the external and internal surfaces and a cross section surface including weld zone in full wall thickness. The acceptance criteria are: No pitting at 20 X magnification					
	- The weight loss shall be less than 4.0 g/m ²					
10. MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the near surfaces and mid-thickness region of the pipe including the weld and heat affected zone. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35-55 % for base material and 35-65% for weld metal. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.					
11. EXTENT OF TESTING	for each lot. The lot is of a for batch furnace a linear treatment charge	lot is defined as maximum	m 60 m of pipe of the s	same heat, size and		

MATERI	AL DATA SHE	ET I	MDS D52	Rev. 3
TYPE OF MATERIA	AL: Ferritic/Austenitic Sta	ninless Steel, Type 2	25Cr duplex	Page 2 of 2
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Welded pipes	ASTM A 928	UNS S 32550 UNS S 32750 UNS S 32760	Class 1, 3 and 5	
12. TEST SAMPLING	Samples for production test components.	ting shall realistically	reflect the properties in	the actual
13. WELDING	The PQR/WPAR shall be qualified in accordance with ASME IX or EN 288-3 and shall include the same examinations as for the production testing. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make (brand name) of welding consumables requires requalification. Welding shall be carried out by qualified welders according to qualified procedures approved by a 3 rd party organization recognized by an EC member State.			
14. TOLERANCES	The pipes shall have a max	undertolerance of 0	.3 mm for nominal OD	≥ 8".
15. NON DESTRUCTIVE TESTING	Eddy current testing according to ASTM A 450 is acceptable as replacement for spot radiography for wall thickness less than 4.0 mm. Supplementary requirement S3, penetrant testing, according to ASME V Article 6 shall			
	apply to the weld of 10 % of the pipes (same test lot as defined for mechanical testing) delivered. The weld of each examined pipe shall be ground flush in a length of 100 mm prior to penetrant testing. The testing shall be carried out after calibration and pickling. Acceptance criteria shall be to ASME VIII, Div 1, Appendix 8.			
	NDT operator qualification EC member state.	shall be approved by	y a 3 rd party organization	n recognized by an
16. SURFACE FINISH	White pickled.			
17. REPAIR OF DEFECTS	Weld repair of base materia to PQR/WPAR shall apply			ame requirements
18. MARKING	The component shall be ma	arked to ensure full tr	aceability to melt and he	eat treatment lot.
Certification shall affirm compliance with the specification and shall be according 10204 Type 3.1B provided the manufacturer has a quality assurance system certific competent body established within the EC, and having undergone a specific assest for materials.			stem certified by a	
	Heat treatment temperature certificate.	, soaking time and co	ooling medium should b	e stated in the

MATERIA	L DATA SHE	EET	MDS D53	Rev. 3	
TYPE OF MATERI	AL: Ferritic/Austenitic	Stainless Steel, T	Type 25Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings	ASTM A 815	UNS S 32550 UNS S 32750 UNS S 32760	WP-S, WP-WX and WP-W	S7	
1. SCOPE	_	-	the referred standard and addressed the corresponding requi		
2. QUALIFICATION	Manufacturers of produ Standard M-650.	uct to this MDS shall	ll comply with the requirement	nt of NORSOK	
3. STEEL MAKING	The steel melt shall be	refined with AOD o	or equivalent.		
4. HEAT TREATMENT	Solution annealing follo	owed by water quer	nching.		
5. CHEMICAL COMPOSITION	PRE = % Cr + 3.3 % M	$I_0 + 16 \% N \ge 40.0$			
6. TENSILE TESTING	Base material propertie	s: $R_{p0.2} \ge 550 \text{ MPa}$;	$R_m \ge 800 \text{ MPa}; A_5 \ge 25 \%$		
7. HARDNESS	The hardness shall be maximum 32 HRC (or alternatively 301 HB or 330 HV10) for base material, HAZ and weld metal.				
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm -5/6 and 5 mm -2/3. The notch location and number of specimen shall be:				
	Seamless fittings: One Welded fittings: Two			nd fusion line.	
9. CORROSION TEST	Welded fittings: Two sets, (each 3 specimen) located in weld metal and fusion line. Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. The specimen shall have the internal and external surfaces in the as-delivered condition (including pickling). Cut edges shall be prepared according to ASTM G 48, and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose the external and internal surfaces and a cross section including weld zone (if relevant) in full wall thickness. The acceptance criteria are:				
	- No pitting at 20 X m	nagnification.			
	- The weight loss shall	ll be less than 4.0 g/	m^2 .		
10. MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the near surfaces and mid-thickness region. For welded fittings both the weld and the base material is required examined. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35-55 % for base material and 35-65 % for weld metal. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
11. EXTENT OF TESTING		rried out for each h	sting, corrosion testing and meat and heat treatment load whe same WPS.		

MATERI	AL DATA SH	IEET	MDS D53	Rev. 3	
TYPE OF MATERIA	AL: Ferritic / Austeniti	ic Stainless Steel,	Type 25Cr duplex	Page 2 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings	ASTM A 815	UNS S 32550 UNS S 32750 UNS S 32760	WP-S, WP-WX and WP-W	S7	
12. TEST SAMPLING			ically reflect the properties in from an actual fitting or from		
13. WELDING	The PQR/WPAR shall be qualified in accordance with ASME IX or EN 288-3 and shall include the same examinations as for the production testing. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make (brand name) of welding consumables requires requalification. Welding shall be carried out by qualified welders according to qualified procedures				
14. NON DESTRUCTIVE TESTING	approved by a 3 rd party organization recognized by an EC member State. Supplementary requirements S7, Penetrant Testing, shall apply to 10 % of seamless (from the test lot as defined above) and 100 % of welded fittings above NPS 2. The examination shall be carried out after calibration and pickling. For welded fittings the examination shall cover the weld only. The weld of each examined fitting shall be ground flush in a length of 100 mm prior to penetrant testing. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8. NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.				
15. SURFACE FINISH	White pickled.				
16. REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds the same requirements to PQR/WPAR shall apply as for production welding.				
17. MARKING	The component shall be	e marked to ensure f	full traceability to melt and he	eat treatment lot.	
18. CERTIFICATION	10204 Type 3.1B provi	The component shall be marked to ensure full traceability to melt and heat treatment lot. Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.			
	Heat treatment tempera certificate.	ture, soaking time a	and cooling medium should b	e stated in the	

MATERIA	AL DATA SI	HEET M	IDS D54	Rev. 3	
TYPE OF MATER	IAL: Ferritic/Auster	nitic Stainless Steel, Type	25Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Forgings	ASTM A 182	F61 - UNS S 32550 F53 - UNS S 32750 F55 - UNS S 32760	-	S56	
1. SCOPE		s the selected options in the n shall be added or supersed			
		led for forgings with maxim greements shall be made in e		200 mm. For larger	
2. QUALIFICATION	Manufacturers of p Standard M-650.	roduct to this MDS shall con	mply with the requirement	ent of NORSOK	
3. STEEL MAKING	The steel melt shall	be refined with AOD or eq	uivalent.		
4. MANUFACTURING	The component sha	all be quenched in water afte	er forging.		
PROCESS	The Hot Isostatic P	ressed (HIP) process is an a	cceptable alternative to	forging.	
5. HEAT TREATMENT	Solution annealing	followed by water quenching	ıg.		
6. CHEMICAL COMPOSITION	PRE = % Cr + 3.3	$PRE = \% Cr + 3.3 \% Mo + 16 \% N \ge 40.0.$			
7. TENSILE TESTING	1	$R_{m} \ge 800 \text{ MPa}; A \ge 25 \%. \text{ Fo}$ $R_{m} \ge 730 \text{ MPa}; A \ge 25 \%. \text{ Fo}$			
8. HARDNESS	The hardness shall	be maximum 32 HRC (or al	ternatively 301 HB or 3	330 HV10).	
9. IMPACT TESTING	6 mm (thickness at	Charpy V-notch testing according to ASTM A 370 at -46 °C is required for the thickness ≥ 6 mm (thickness at the weld neck). The minimum absorbed energy shall satisfy 45 J average / 35 J single. Reduction factors for subsize specimens shall be: 7.5 mm - 5/6 and 5			
10. MICROGRAPHIC EXAMINATION	The micrographic examination shall be carried out at the same area as location of specimens for mechanical testing. The area shall be minimum 10 x 10 mm. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 -55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
11. CORROSION TEST	50 °C and the expolocation as those fo	ording to ASTM G 48, Methorsure time 24 hours. The corner mechanical testing. Cut ed 20 % HNO3 + 5 % HF, 60 °	rosion test specimen sha lges shall be prepared ac	all be at the same ecording to ASTM	
	- No pitting at 20	X magnification.			
	- The weight loss	shall be less than 4.0 g/m^2 .			

MATERIA	L DATA SH	EET M	IDS D54	Rev. 3
TYPE OF MATERIA	AL: Ferritic/Austenit	ic Stainless Steel, Type	25Cr duplex	Page 2 of 2
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Forgings	ASTM A 182	F61 - UNS S 32550 F53 - UNS S 32750 F55 - UNS S 32760	-	S56
12. EXTENT OF TESTING	shall be carried out for on the component with	nsile, hardness, corrosion to each heat and heat treats the heaviest wall thickness with as forged weight ≤ 50 g.	ment load. The testing s within the load. A test l	hall be carried out ot shall not exceed
13. TEST SAMPLING	components.	on testing shall realistically		
	be used for die-forged	from prolongations on ac d components. However, s ith as forged weight exceed	special agreements may	be made for die-
	Test location and orie	entation shall be:		
	 For forgings having maximum section thickness, T ≤ 50 mm, the test specimens shall be taken at mid thickness and its mid length shall be at least 50 mm from a second surface. For forgings having maximum section thickness, T > 50 mm, the test specimen shall be taken at least ½ T from the nearest surface and at least T or 100 mm, whichever is less, from any second surface. 			
	Sketches shall be esta extraction of test spec	blished showing type, size	e and location of test sa	mples and
14. NON DESTRUCTIVE TESTING	Supplementary requirement of ASTM A 961 S56, liquid penetrant testing, shall apply to 10 % of forgings (from the lot as defined for mechanical testing) above NPS 2. The testing shall be carried out after final machining and pickling. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.			
	NDT operator qualific EC member state.	cation shall be approved b	y a 3 rd party organization	on recognized by an
15. SURFACE FINISH	Finished products sha	all be white pickled, include	ding machined surfaces.	
16. REPAIR OF DEFECTS	Weld repair is not acc	ceptable.		
17. MARKING	The component shall	be marked to ensure full t	raceability to melt and l	heat treatment lot.
18. CERTIFICATION	10204 Type 3.1B pro	irm compliance with the s vided the manufacturer ha dished within the EC, and	s a quality assurance sy	stem certified by a
	Heat treatment tempe certificate.	rature, soaking time and c	ooling medium should	be stated in the

MATERIA	AL DATA SI	HEET	MDS D55	Rev. 3		
TYPE OF MATERIA	AL: Ferritic/Austen	itic Stainless Steel,	Type 25Cr duplex	Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Plates	ASTM A 240	UNS S 32550 UNS S 32750 UNS S 32760	-	-		
1. SCOPE	which shall be added	_	the referred standard and additional sponding requirements in the of UNS S 32750.	_		
2. QUALIFICATION	Manufacturers of pro M-650.	Manufacturers of product to this MDS shall comply with the requirement of NORSOK Standard M-650.				
3. STEEL MAKING	The steel melt shall b	oe refined with AOD o	r equivalent.			
4. HEAT TREATMENT	Solution annealing for	ollowed by water quen	ching.			
5. CHEMICAL COMPOSITION	PRE = %Cr + 3.3 %	$Mo + 16 \% N \ge 40.0.$				
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa; } R_m$	≥ 750 MPa; A ≥ 25%.				
7. HARDNESS	The hardness shall be	e maximum 32 HRC o	r alternatively 301 HB or 330	HV10.		
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for thickness ≥ 6mm. - The minimum absorbed energy shall satisfy 45 J average / 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.					
9. MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the near surface and mid-thickness region. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 -55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.					
10. CORROSION TEST	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. The specimen shall have surfaces in the as-delivered condition (including pickling). Cut edges shall be prepared according to ASTM G 48, and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose both surfaces and a cross section in full wall thickness. The acceptance criteria are: No pitting at 20 X magnification. The weight loss shall be less than 4.0 g/m².					
11.EXTENT OF TESTING		pact testing, microstruc	ture, hardness, corrosion and to lot.	ensile testing shall be		
12. TEST SAMPLING	Samples for producti	on testing shall realist	cally reflect the properties in t	he actual components.		
13. SURFACE FINISH	White pickled.					
14.REPAIR OF DEFECTS	Repair welding is not acceptable.					
15. MARKING	The component shall	be marked to ensure f	full traceability to melt and hea	t treatment lot.		
16. CERTIFICATION	Type 3.1B provided	the manufacturer has a	he specification and shall be a quality assurance system cert undergone a specific assessm	fied by a competent		
	Heat treatment temper	erature, soaking time a	nd cooling medium should be	stated in the certificate.		

MATERIA	L DATA SHE	ET M	DS D56	Rev. 3
TYPE OF MATERIA	AL: Ferritic/Austenitic	Stainless Steel, Type	25Cr duplex	Page 1 of 2
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Castings	ASTM A 995	5A (UNS J93404) 6A (UNS J93380)	-	S5, S6, S20
I. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.			
2. QUALIFICATION	Manufacturers of produ Standard M-650.	ect to this MDS shall be	qualified in accordan	ce with NORSOK
3. STEEL MAKING	The steel melt shall be a	refined with AOD or equ	uivalent process.	
4. HEAT TREATMENT	According to Grade 5A	(UNS J93404) or 6A (U	UNS J93380).	
5. CHEMICAL COMPOSITION	PRE = % Cr + 3.3 % M S \leq 0.025 and P \leq 0.030			
6. TENSILE TESTING	$R_{p0.2} \ge 450 \text{ MPa}; R_m \ge$	700 MPa; $A \ge 18 \%$.		
7. HARDNESS	The hardness shall be le	ess than 32 HRC (or alte	ernatively 301 HB or 3	330 HV10).
8. IMPACT TESTING	15	is required according to atisfy 45 J average / 35		5 °C. The minimum
9. MICROGRAPHIC EXAMINATION	The micrographic examination shall be carried out at the same area as location of specimens for mechanical tests. The area shall be minimum 10 x 10 mm. On WPQ's both the weld, HAZ and base material shall be examined. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 %. The microstructure, as examined at 200 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.			mm. On WPQ's both ent shall be hin 35 - 55 %. The
10. CORROSION TEST	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 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 G 48 and pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are:			
	- No pitting at 20X mag	_		
	- The weight loss shall	be less than 4.0 g/m ² .		
11. EXTENT OF TESTING		l and corrosion tests and heat treatment charge. A		
12. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components. Thickness of the test block shall be equal to the thickness of the actual components up to a maximum thickness of 100 mm. For flanged components the largest flange thickness shall apply			
	Test specimens shall be thickness of the test blo	e cut from the 1/4 T loca eck.	tion from the surface	where T is the
	Test block shall be integrited from the castings until a	grally cast or gated onto after the final quality he	-	l not be removed

MATERI	AL DATA SHE	ET	MDS D56	Rev. 3	
TYPE OF MATERIA	AL: Ferritic/Austenitic Sta	ainless Steel, Type	25Cr duplex	Page 2 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 890	UNS J93404 UNS J93380	-	S5, S6, S8, S20	
13. NON DESTRUCTIVE TESTING	Liquid penetrant testing: S (including internal surfaces machining and pickling. Th 7.	s) of all castings. The	e testing shall be carrie	d out after final	
	Radiographic testing: Supp	plementary requirem	ent S5 shall apply to:		
	- Critical areas as per ANS	I B16.34 of the pilot	cast of each pattern		
	- All butt weld ends of each	h casting			
	- Class 1500 psi and above	; all critical areas to	ANSI B16.34 of each	casting.	
	The acceptance criteria sha	ll be to ASME VIII,	Div. 1 Appendix 7.		
	NDT operator qualification shall be approved by a 3 rd party organization recognized an EC member state.				
14. SURFACE FINISH	White pickled shall be carried out after any blasting and shall include finished machined surfaces.				
15. REPAIR OF DEFECTS	Supplementary requirement of ASTM A 703 S20 shall apply. The repair welding procedure shall be qualified in accordance with ASME IX or EN 288-3 and this MDS. The repair welding procedure qualification shall include the following:				
	- Qualified on a cast plate of	of the same grade (U	NS number), which sh	all be welded.	
	- Change of specific make	of filler metal (branc	and names) requires requalification.		
	- Examination of microstructure of base material and weld zone. The ferrite content shall be 35 - 55 % for the base material and 35-65 % for the weld metal.				
	- Charpy V-notch testing as specified above, with two sets (each 3 specimens), with notch located in weld metal and fusion line, respectively.				
	- Corrosion test as specified above. The specimen shall include weld zone.				
	Welding shall be carried or approved by a 3 rd party org				
16. MARKING	The component shall be ma	arked to ensure full t	raceability to melt and	heat treatment lot.	
17. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.				
	Heat treatment temperature certificate.	e, soaking time and c	cooling medium should	be stated in the	

MATERI	AL DATA SH	EET	MDS D57	Rev. 3	
TYPE OF MATERIA	AL: Ferritic/Austenitic	Stainless Steel, Type	25Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Bars	ASTM A 276	UNS S 32550 UNS S 32750 UNS S 32760	-	-	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. This MDS is intended for bars with maximum thickness of 200 mm. For larger thickness special agreements shall be made in each case.				
2. QUALIFICATION	Manufacturers of produ Standard M-650.	ect to this MDS shall co	mply with the require	ment in NORSOK	
3. STEEL MAKING	The steel melt shall be a	refined with AOD or eq	uivalent.		
4. HEAT TREATMENT	Solution annealing followed by water quenching. The solution annealing temperature shall be as defined in ASTM A 182 for the actual grades/UNS number.				
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3 % Mo	$0 + 16 \% N) \ge 40.0.$			
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa}; R_m \ge 10^{-1}$	750 MPa; $A \ge 25 \%$.			
7. HARDNESS	The hardness shall be m	naximum 32 HRC (or al	ternatively 301 HB or	330 HV10).	
8. IMPACT TESTING	Charpy V-notch testing absorbed energy shall sa			5 °C. The minimum	
9. MICROGRAPHIC EXAMINATION	The micrographic examination shall be carried out at the same area as location of specimens for mechanical testing. The area shall be minimum 10 x 10 mm. The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.				
10. CORROSION TEST	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 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 G 48 and pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are:				
	- No pitting at 20 X magnification.				
	- The weight loss shall	be less than 4.0 g/m ² .			
11. EXTENT OF TESTING	One set of impact test, t corrosion test shall be c	•	·		

MATERI	AL DATA SH	EET	MDS D57	Rev. 3	
TYPE OF MATERIA	PE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 25Cr duplex			Page 2 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Bars	ASTM A 276	UNS S 32550 UNS S 32750 UNS S 32760	-	-	
12. TEST SAMPLING	Samples for production components.	testing shall realistica	ally reflect the propert	ies in the actual	
	Test location and orien	tation shall be:			
	For bars having maximum section thickness, T ≤ 50 mm, the test specimens shall be taken at mid thickness and its mid length shall be at least 50 mm from any second surface.				
	For bars having maximum section thickness, T > 50 mm, the test specimen shall be taken at least ½ T from the nearest surface and at least T or 100 mm, whichever is less, from any second surface.				
	160 mm, the te (tangential) dir requirements (direction elong	he testing shall be carried out in longitudinal direction. For thickness exceed to mm, the testing shall be carried out both in longitudinal and transverse angential) direction. All testing in longitudinal direction shall meet specific quirements (ASTM A 276 and this MDS). For testing in transverse (tangent rection elongation shall be minimum 20 % and the minimum Charpy V-not psorbed energy shall satisfy 27 J average and 20 J single.			
15. SURFACE FINISH	White pickled.				
16. REPAIR OF DEFECTS	Weld repair is not acce	ptable.			
17. MARKING	The component shall be	e marked to ensure ful	l traceability to melt a	and heat treatment lot.	
18. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according 10204 Type 3.1B provided the manufacturer has a quality assurance system certifical a competent body established within the EC, and having undergone a specific assess for materials.				
	Heat treatment tempera certificate.	ture, soaking time and	d cooling medium sho	uld be stated in the	

MATERIA	L DATA SHE	EET N	1DS D58	Rev. 2
TYPE OF MATERIA	AL: Ferritic/Austenitic	Stainless Steel, Type	e 25Cr duplex	Page 1 of 1
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Tubes	ASTM A 789	UNS S 32550 UNS S 32750 UNS S 32760	-	
1. SCOPE	requirements which sha	all be added or supersed	referred standard and ad le the corresponding requechanical properties of	uirements in the
2. QUALIFICATION	Manufacturers of produ Standard M-650.	uct to this MDS shall co	omply with the requirement	ent of NORSOK
3. STEEL MAKING	The steel melt shall be	refined with AOD or ed	quivalent.	
4. HEAT TREATMENT	The tubes shall be solut	tion annealed followed	by water quenching.	
5. CHEMICAL COMPOSITION	PRE = % Cr + 3.3 % M	$10 + 16 \% N \ge 40.0.$		
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa}; R_m \ge$	750 MPa; A ≥ 25 %.		
7. HARDNESS	The hardness shall be max. 32 HRC (or alternatively 301 HB or 330 HV10).			
8. IMPACT TESTING	Charpy V-notch testing (3 specimens) according to ASTM A 370 at - 46 °C is required for the thickness ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for sub-size specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.			
9.CORROSION TEST	50 °C and the exposure surfaces in the as-delive prepared according to A + 5 % HF, 60 °C, 5 min cross section surface in - No pitting at 20	e time 24 hours. The speered condition (pickling ASTM G 48, and the wlaute). The test shall exp	od A is required. Test te ecimen shall have the integ or bright annealed). Cunole specimen shall be pose the external and integ acceptance criteria are g/m ² .	ernal and external at edges shall be ickled (20 % HNO3 ernal surfaces and a
10. MICROGRAPHIC EXAMINATION	The ferrite content shall be determined according to ASTM E 562 or equivalent and shall be within 35 - 55 %. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.			
11. EXTENT OF TESTING	Microstructure, hardness, tensile testing, impact testing and corrosion testing shall be carried out for each lot as defined in the referred standard.			
12. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.			
13. SURFACE FINISH	White pickled or bright annealed.			
14. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.			
15. CERTIFICATION	EN 10 204 Type 3.1B. should be stated in the	-	ture, soaking time and c	cooling medium

MATERI	AL DATA S	HEET MI	DS - K01	Rev. 1	
TYPE OF MATERIA	IL: Copper/Nickel	90/10		Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Sml pipes & tubes Welded pipes Rod & bar Plates & sheets Fittings Flanges	ASTM B 466 ASTM B 467 ASTM B 151 ASTM B 171	UNS C 70600 UNS C 70600 UNS C 70600 UNS C 70600 UNS C 70600 UNS C 76000	- - - - -	- - - - -	
1.SCOPE			e referred standard and a conding requirements in t		
2.DESIGN AND DIMENSIONAL STANDARDS	The following EEMUA standards for: "90/10 Copper/Nickel Piping for Offshore Applications "shall be used: - EEMUA Publication No. 144: "Tubes, Seamless and Welded" EEMUA Publication No. 145: "Flanges, Composite and Solid" EEMUA Publication No. 146: "Fittings".				
3. MATERIALS			y with the above listed st	andards and this MDS.	
4. MANUFACTURING PROCESS	Materials for fittings and flanges shall comply with the above listed standards and this MDS. Forming: Cold forming or hot forming may be used according to written procedures established in cooperation with the material manufacturers. Welding:				
5. HEAT TREATMENT/ DELIVERY CONDITION	An electric fusion welding process shall be used. Hot formed components: Parts hot formed in the temperature range of 760 - 800 °C do not need annealing after forming. Cold formed components: Annealed. Welded components: Annealed, but acceptable as welded from annealed materials.				
6.CHEMICAL COMPOSITION	*	ing the chemical compose 02% and $C \le 0.05 \%$.	sition shall be modified as	s stated:	
7.EXTENT OF TESTING	Tensile test specimens shall be taken from each lot. 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.				
8.TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components. Test samples shall be cut from the products themselves. Sacrificial components or overlength on the components may be used. Sketches shall be established showing type, size and location of test samples and extraction of test specimens.				
9.WELDING		_	qualified in accordance v	vith ASME IX.	

MATERI	AL DATA SI	HEET MI	DS - K01	Rev. 1	
TYPE OF MATERI	TYPE OF MATERIAL: Copper/Nickel 90/10				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Sml pipes & tubes	ASTM B 466	UNS C 70600	-	-	
Welded pipes	ASTM B 467	UNS C 70600	-	-	
Rod & bar	ASTM B 151	UNS C 70600	-	-	
Plates & sheets	ASTM B 171	UNS C 70600	-	-	
Fittings	-	UNS C 70600	-	-	
Flanges	-	UNS C 76000	-	-	
10. NON DESTRUCTIVE TESTING	Welded Pipes to B 467: Sch. 10S: Welded pipes shall be spot radiographed to the extent of not less than 12 in. (300 mm) of radiograph per 50 ft (15 m) of weld. Otherwise: All welds shall be completely radiographed. The radiographic testing shall be in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, Paragraph UW-51 and UW-52 for 100 % and spot check tested respectively.				
11. HYDROSTATIC TESTS	Sml. pipes & tubes to B 466 and Welded pipes to B 467: Each length of finished pipe shall be subjected to the hydrostatic test in accordance with ASTM A 530.				
12. CERTIFICATION	EN 10 204 Type 3.1F	3.			

MATERI	IAL DATA SHEI	ET M	IDS - K02	Rev. 1		
TYPE OF MATERI	AL: Aluminium - Bronze S	Sand Castings		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Castings	ASTM B 148	UNS C95800	-	-		
1.SCOPE		This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.				
2.CHEMICAL COMPOSITION	$Pb \le 0.02 \%$.					
3.HEAT TREATMENT	Heat treatment shall be carrefor 6 hours.	ried out at the dis	cretion of the manufactu	rer, e.g. approx. 700 °C		
4.EXTENT OF TESTING	One tensile test shall be car load.	ried out for each	lot, as defined by the in	B148, and heat treatment		
5.TEST SAMPLING	Samples for mechanical testing shall realistically reflect the properties in the actual components. Thickness of the test block shall be equal to the thickness of the actual components up to a maximum thickness of 100 mm. For flanged components the largest flange thickness shall apply.					
	Test specimens shall be cut of the test block.	from the 1/4 T le	ocation from the surface	where T is the thickness		
	Test block shall be integral the castings until after the f			l not be removed from		
6.WELDING	Welding procedures shall be for all repair welding.	e established and	qualified in accordance	with ASME IX		
7.NON DESTRUCTIVE TESTING	Liquid penetration testing: 100 % on all accessible surfaces of all castings. The testing shall be carried out after final machining. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.					
	 Radiographic testing: Critical areas as per ANSI B 16.34 of the pilot cast of each pattern. All butt weld ends of each casting. Class 1500 psi and above, all critical areas to ANSI B16.34 of each casting. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. 					
8.WELD REPAIR	The repair welding procedu	ıre shall be qualit	ried in accordance with A	ASME IX and this MDS.		
	 A cast plate of the same material grade shall be used. A macro test shall be carried out. Repairs by peening and impregnation are prohibited. Change of filler metal brand names requires requalification. 					
9.CERTIFICATION	EN 10 204 Type 3.1B.					

MATERIA	L DATA SI	HEET	MDS N01	Rev. 3
TYPE OF MATERIA	AL: Nickel alloy	Гуре 625		Page 1 of 1
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Wrought fittings Pipes Forgings Plates Bars Pipes and tubes	ASTM B 366 ASTM B 705 ASTM B 564 ASTM B 443 ASTM B 446 ASTM B 444	UNS N06625 UNS N06625 UNS N06625 UNS N06625 UNS N06625 UNS N06625	- Class 1 - - -	S3 - S5.3 - -
1. SCOPE	_	_	n the referred standard and ersede the corresponding r	
3. HEAT TREATMENT	Annealed.			
4. TEST SAMPLING	Samples for producomponent.	ction testing shall realis	stically reflect the propertion	es in the actual
5. NON DESTRUCTIVE TESTING		the weld area at 10 % mechanical testing) an welded fittings the test	ment S3, liquid penetrant to of seamless (from the same ad 100 % of welded fittings ting shall cover the weld or	e lot as defined for above NPS2. For ally.
	Forgings to B 364		ement S5.3, liquid penetral forgings above NPS 2 (of s	-
	NDT operator qua EC member state.	lification shall be appro	oved by a 3 rd party organiza	ntion recognized by an
6. SURFACE FINISH	White pickled. She surfaces.	all be carried out after a	iny blasting and shall inclu	de finished machined
7. REPAIR OF DEFECTS	Weld repair of bas	se material is not accept	able.	
8. MARKING	The component sh	all be marked to ensure	full traceability to melt an	d heat treatment lot.
9. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.			
	Heat treatment ten certificate.	nperature, soaking time	and cooling medium shou	ld be stated in the

MATERI	AL DATA SE	HEET	MDS N02	Rev. 3	
TYPE OF MATERIA	AL: Cast Nickel alloy	I		Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 494	Grade CW-6MC (UNS N06625) Grade CX2MW (UNS N26022)	Class 1 Class 1	S2, S3 S2, S3	
1. SCOPE		ne selected options in	the referred standard and		
2. QUALIFICATION	Manufacturers of prod Standard M-650.	duct to this MDS shal	comply with the require	ement of NORSOK	
3. STEEL MAKING			r equivalent process. Rer eptable. Use of internal s		
4. HARDNESS	The hardness shall be	maximum 35 HRC (d	or alternatively 301HB or	330HV).	
5. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 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 G 48 and pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are: - No pitting at 20 X magnification. - The weight loss shall be less than 4.0 g/m².				
6. EXTENT OF TESTING		sion test shall be mad	e for each melt and heat	treatment load. A test lo	
7. TEST SAMPLING	components. Thickness	ss of the test block shaximum thickness of	ically reflect the propertial be equal to the thickness 100 mm. For flanged con	ess of the actual	
	Test specimens shall thickness of the test b		location from the surface	where T is the	
	Test block shall be int the castings until after		onto the castings and sha treatment.	ll not be removed from	
8. NON DESTRUCTIVE TESTING	surfaces of all casting The acceptance criteri	s. The testing shall be ia shall be ASME VII		achining and pickling.	
	 Radiographic testing: Supplementary requirement S2 shall apply to: - Critical areas as per ANSI B 16.34 of the pilot cast of each pattern. - All butt weld ends of each casting. - Class 1500 psi and above; all critical areas to ANSI B 16.34 of each casting. 				
	-			cacii castilig.	
	The acceptance criteria shall be ASME VIII, Div. 1, Appendix 7. NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.				
9. SURFACE FINISH	White pickled. Shall burfaces.	pe carried out after an	y blasting and shall inclu	de finished machined	

MATERIA	L DATA SHI	EET	MDS N02	Rev. 3	
TYPE OF MATERIA	TYPE OF MATERIAL: Cast Nickel alloy				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 494	Grade CW-6MC (UNS N06625) Grade CX2MW (UNS N26022)	Class 1 Class 1	S2, S3 S2, S3	
10. REPAIR OF DEFECTS	Repair welding shall be carried out in accordance with ASTM A 488. Welding shall be carried out by qualified welders according to qualified procedures approved by a 3 rd party organization recognized by an EC member State. The repair welding procedure shall be qualified in accordance with ASME IX or EN 288-3 and this MDS. - A cast plate of the same material grade (UNS number), which shall be used. - A macro and corrosion test as specified above shall be carried out. - Change of specific make of filler metal (brand name) requires requalification. All casting with major repairs shall be given a solution heat treatment after welding.				
11. MARKING	The component shall b	e marked to ensure f	ull traceability to melt an	d heat treatment lot.	
12. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials. Heat treatment temperature, soaking time and cooling medium should be stated in the				

MATERI	AL DATA SH	EET M	DS P11	Rev. 2		
TYPE OF MATERI	AL: Hydrogenated 1	Nitrile (HNBR)		Page 1 of 1		
PRODUCT	O-ring	TEMPERATURE RANGE	- 46°C to + 150°C exposure below - 2	Only short time 20°C is acceptable.		
1. SCOPE	This MDS specifies the	e technical requirements fo	or the HNBR O-ring	material.		
2. PURCHASE		The purchase order shall contain the following information: Product form, dimensions, tolerances and / or referenced drawing(s) and grade designation.				
INFORMATION			de designation.			
3. CHEMICAL COMPOSITION	36 – 40% acrylonitrile	content (ACN)				
4. QUALIFICATION TEST REQUIREMENTS	The material shall be rapid pressure reduction resistant (ED resistant) and satisfy the following minimum requirements. The qualification shall be repeated if there are change the production route, manufacturing procedures, specified composition or properties of product which exceeds the limits defined from qualification testing (each manufacturer seal type shall be qualified): ED-test Qualification test requirements: O-ring cross section diameter 5.33 mm, 20% compress text fixture, 70 – 85% groove fill, test medium 3% CO ₂ in Methane, test temperature 100 °C, 72 hours initial soak at full pressure, followed by 5 cycles of: • 200 bar (24h) • Depressurisation: 20-40 bar/min. • 1 hour rest time • Re-pressurisation • Leakage test No leakage shall occur in a leakage test at room temperature and service pressure follow the 5 decompression cycles. Further, no cracks shall be longer than 80 % of the sample					
	Mechanical propertie • Hardness	ASTM D 2240	$90 \pm 5 \text{ Sho}$	ma A		
	• Tensile strength		14 min. 20 MI min. 100%	ra		
	 Elongation at ofe Compression set 	eakASTM D 412/1414 ASTM D 395		(after 24 hours at 150°C)		
	Physical properties			(
	• Specific gravity	ASTM D 792	1.2 - 1.3 g/	/cm ³		
5. DIMENSIONS	According to BS 4518.					
6. PRODUCTION TEST REQUIREMENTS	The below properties si requirements listed abo	hall be documented by test	ting for each produc	tion batch and satisfy the		
	 Specific gravity 		(ASTM D 792)			
	• Hardness		(ASTM D 2240)			
			(ASTM D 412/14			
7. MARKING & PACKAGING	batch number, and such to raw materials, formu	Seals shall be supplied in sealed airtight bags. Markings on the bags shall clearly indicate batch number, and such markings shall ensure traceability through the producers QC system to raw materials, formulation and manufacturing details. In addition, the bags shall be marked with an expected shelf life assuming storage at room temperature and without direct exposure				
		EN 10204 Type 3.1B sha				

MATERI	AL DATA SH	IEET N	MDS P12	Rev. 2
TYPE OF MATERI	IAL: Fluorocarbon	terpolymer (FKM)		Page 1 of 1
PRODUCT	O-ring	TEMPERATURE RANGE	- 46°C to + 150°C. O exposure below - 10°	3
1. SCOPE	This MDS specifies th	he technical requirements	for the FKM O-ring mat	terial.
2. PURCHASE INFORMATION		hall contain the following Perenced drawing(s) and g		rm, dimensions,
3. CHEMICAL COMPOSITION	•	VF2), hexafluoropropylen ilisers, cross-link agents.	e (HFP), and tetrafluoro	ethylene (TFE) with
4. QUALIFICATION TEST REQUIREMENTS	necessary fillers, stabilisers, cross-link agents. The material shall be rapid pressure reduction resistant (ED resistant) and satisfy the following minimum requirements. The qualification shall be repeated if there are change the production route, manufacturing procedures, specified composition or properties of t product which exceeds the limits defined from qualification testing (each manufacturer a seal type shall be qualified): ED-test Qualification test requirements: O-ring cross section diameter 5.33 mm, 20% compression text fixture, 70 – 85% groove fill, test medium 3% CO ₂ in Methane, test temperature 100 72 hours initial soak at full pressure, followed by 5 cycles of: 200 bar (24h) Depressurisation: 20-40 bar/min. 1 hour rest time Re-pressurisation Leakage test No leakage shall occur in a leakage test at room temperature and service pressure follow the 5 decompression cycles. Further, no cracks shall be longer than 80 % of the sample			
	Mechanical properti	issection, after the leakage ies		
	Hardness Tangila strangeth	ASTM D 2240		A
	Tensile strength Elegation at by	n ASTM D 412/1 reakASTM D 412/1414	min. 90%	
	Compression se			fter 24 hours at 150°C)
	Physical propertiesSpecific gravity	ASTM D 792	1.6 - 1.9 g/cm	n^3
5. DIMENSIONS	According to BS 4518		1.0 – 1.9 g/cn	11
6. PRODUCTION TEST	•	shall be documented by to	esting for each production	on batch and satisfy the
REQUIREMENTS	requirements listed ab		coming for each production	in Saton and Satisfy the
TEG OTTEMENTS	Specific gravity		(ASTM D 792)	
	Hardness		(ASTM D 2240)	
		ngation properties	(ASTM D 412/1414	α
7. MARKING &		d in sealed airtight bags. N	,	,
PACKAGING		ch markings shall ensure t		
TACKTONYO	to raw materials, form with an expected shell	nulation and manufacturin f life assuming storage at	g details. In addition, the	e bags shall be marked
	to sunlight.			
8. CERTIFICATION	Inspection certificate	to EN 10204 Type 3.1B s	hall contain ID No. and	all test results.

MATERI	AL DATA SH	EET N	MDS P13	Rev. 2
TYPE OF MATERI	AL: Fluorocarbon le	ow T terpolymer (F	KM GLT)	Page 1 of 1
PRODUCT	O-ring	TEMPERATURE RANGE	- 46°C to + 150°C. O exposure below - 30°	2
1. SCOPE	This MDS specifies the	e technical requirements	for the FKM GLT O-rin	g material.
2. PURCHASE INFORMATION	*	all contain the following erenced drawing(s) and g		rm, dimensions,
3. CHEMICAL COMPOSITION	Vinylidenefluoride (V. cross-link agents.	F2) and tetrafluoroethyle	one (TFE) with necessary	fillers, stabilisers and
4. QUALIFICATION TEST REQUIREMENTS				
	Mechanical propertie	ssection, after the leakage es		
	 Hardness 	ASTM D 2240		A
	• Tensile strength			
	_	eakASTM D 412/1414	min. 90 %	
	Compression set	t ASTM D 395	max. 40 % (at	fter 24 hours at 150°C)
	Physical properties	A CTD 4 D 700	1.6.10./	3
	Specific gravity A secretic to DS 4518	ASTM D 792	1.6 - 1.9 g/cm	1
5. DIMENSIONS	According to BS 4518			
6. PRODUCTION TEST	requirements listed abo	shall be documented by to	esting for each production	on batch and satisfy the
REQUIREMENTS	*	ove.	(ASTM D 702)	
	Special Similar		(ASTM D 792)	
		antina amonantina	(ASTM D 2240)	1
Z 14 (PVP)C ^		gation properties	(ASTM D 412/1414	,
7. MARKING &		l in sealed airtight bags. N		
PACKAGING		h markings shall ensure tulation and manufacturin		
		Tife assuming storage at		
8. CERTIFICATION		o EN 10204 Type 3.1B s	hall contain ID No. and	all test results

MATERI	AL DATA SHE	CET M	IDS P14	Rev. 2		
TYPE OF MATERI	<i>IAL:</i> Nitrile (NBR)			Page 1 of 1		
PRODUCT	O-ring	TEMPERATURE RANGE	- 46°C to + 150°C. exposure below – acceptable.			
1. SCOPE	This MDS specifies the t	echnical requirements f	or the NBR O-ring m	naterial.		
2. PURCHASE	The purchase order shall	The purchase order shall contain the following information: Product form, dimensions,				
INFORMATION	tolerances and / or refere	enced drawing(s) and gra	ade designation.			
3. CHEMICAL COMPOSITION	36 – 40% acrylonitrile co	ontent (ACN)				
4. QUALIFICATION TEST REQUIREMENTS	The material shall be tested for oil resistance and satisfy the following minimum requirements. The qualification shall be repeated if there are changes in the production route, manufacturing procedures, specified composition or properties of the product which exceeds the limits defined from qualification testing (each manufacturer and seal type shall be qualified): Oil resistance test Qualification test requirements: O-ring cross section diameter 5.33 mm, 20% compression, text fixture, 70 – 85% groove fill, test medium 10% toluene/ 90% Iso-octane/ ASTM oil no. 3, test temperature 70°C, 72 hours soak time. The test vessel shall be pressurised with nitrogen to 50 bars. No leakage shall occur in a leakage test at room temperature and service pressure following the exposure time. Further, the volume change shall be within + 25%/ -5%. Mechanical properties • Hardness ASTM D 2240 70 ± 5 Shore A • Tensile strength ASTM D 412/1414 min. 15 MPa • Elongation at breakASTM D 412/1414 min. 350% • Compression set ASTM D 395 max. 25% (after 24 hours at 150°C) Physical properties					
5. DIMENSIONS	According to BS 4518.					
6. PRODUCTION TEST	* *	2	sting for each produc	tion batch and satisfy the		
REQUIREMENTS	requirements listed above	e.	/			
	 Specific gravity 		(ASTM D 792)			
	• Hardness		(ASTM D 2240)			
	Tensile and elonga		(ASTM D 412/14	/		
7. MARKING &	Seals shall be supplied in					
PACKAGING	batch number, and such i					
	to raw materials, formula	•	· · · · · · · · · · · · · · · · · · ·	•		
	to sunlight.	ie assuming storage at r	oom temperature and	without direct exposure		
	Inspection certificate to I					

MATERI	AL DATA SHEE	T MI	DS P21	Rev. 2	
TYPE OF MATER	IAL: PEEK (Poly-ether-e	ether-ketone)		Page 1 of 1	
PRODUCT	Back-up rings and seat inserts R				
1. SCOPE	This MDS specifies the tech	nical requirements for	the PEEK material.		
2. PURCHASE INFORMATION	The purchase order shall contolerances and / or reference	ntain the following info	ormation: Product for	n, dimensions,	
3. CHEMICAL COMPOSITION	Poly-ether-ether-ketone poly	<u> </u>		ng aids.	
4. QUALIFICATION TEST REQUIREMENTS	The material shall satisfy the repeated if there are changes composition or properties of testing:	s in the production rou	te, manufacturing prod	cedures, specified	
	Mechanical properties	Test standard	Virgin	Glass filled	
	 Tensile strength Tensile modulus Compressive strength HDT @ 1.81 MPa Impact strength (notche 	ASTM D 638 ASTM D 638 ASTM D 695 ASTM D 648 d) ASTM D 256	95 MPa > 3000MPa > 110 MPa 150 °C > 70 J/m	> 150 MPa > 3500MPa > 150 MPa 300 °C > 70 J/m	
	 Ultimate elongation Physical properties 	ASTM D 230 ASTM D 638	> 55 %	> 3 %	
	 Specific gravity Melting point Water absorption (24 hr 	ASTM D 792 ASTM D 3418 ASTM D 570	1.3 - 1.4 g/cm ³ 340 °C 0.15 %	1.4 - 1.6 g/cm ³ 340 °C 0.15 %	
5. DIMENSIONS	According to BS 4518.	/ [1	
6. PRODUCTION TEST REQUIREMENTS	The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. • Specific gravity ASTM D 792 • Tensile strength ASTM D 638				
	Ultimate elongation	ASTM D 638			
7. MARKING & PACKAGING	Components shall be supplied damage prior to installation. number, and such markings materials, formulation and n	ed in suitable packagin Markings on the pack shall ensure traceabilit	aging shall clearly inc	licate material batch	
8. CERTIFICATION	Inspection certificate to EN		l contain ID No. and a	ıll test results.	

MATERIA	AL DATA SHEE	T	MDS P22	,	Rev. 2
TYPE OF MATERIA	AL: PTFE (Poly-tetra-fl	uoro-ethylene)		Page 1 of 1
PRODUCT	Lip-seals, back-up rings and seat inserts R	EMPERATURE ANGE	-100°C to +	-250°C	
1. SCOPE	This MDS specifies the tech	nical requirements	s for the PTFE n	naterial.	
2. PURCHASE	The purchase order shall cor	ntain the following	g information: Pi	roduct form,	dimensions,
INFORMATION	tolerances and / or reference	d drawing(s) and	grade designatio	n.	
3. CHEMICAL COMPOSITION	Carbon and fluorine, polymerocess aids. Also with graphinternally by a metallic spring	hite, glass or carbo	on fibre fillers. T	•	
4. QUALIFICATION TEST REQUIREMENTS	The material shall satisfy the repeated if there are changes composition or properties of testing:	e following minim in the production	um requirement route, manufact	turing proced	lures, specified
	Mechanical properties	Test standard	Virgin	25%Glass	25%Graph
	Tensile strength	ASTM D 638	> 25 MPa	> 15 MPa	> 15 MPa
	• Hardness	ASTM D 785	50-60 Shore D		
	• Compressive strength, 1%	ASTM D 695	> 4 MPa	> 6 MPa	> 6 MPa
	• Compressive modulus	ASTM D 695	> 400 MPa	> 600 MPa	> 600 MPa
	• HDT @ 1.81 MPa	ASTM D 648	54°C	110°C	95°C
	• Impact strength (notched)	ASTM D 256	> 145 J/m	> 130 J/m	> 140 J/m
	Ultimate elongation	ASTM D 638	> 220 %	> 180 %	> 75 %
	Physical properties				
	 Specific gravity 	ASTM D 792	$2.0 - 2.2 \text{ g/cm}^3$	2.0-2.3 g/c	$m^3 \left[1.9 - 2.1 \text{ g/cm}^3 \right]$
	 Melting point 	ASTM D 3418	325 °C	325 °C	325 °C
	• Water absorption (24hrs)	ASTM D 570	0.01 %	0.02 %	0.01 %
5. DIMENSIONS	According to BS 4518.		•	•	
6. PRODUCTION TEST	The below properties shall b	e documented by	testing for each	production b	atch and satisfy the
REQUIREMENTS	requirements listed above.				
	• Hardness (Shore D)	ASTM D785			
	 Specific gravity 	ASTM D 792			
	Tensile strength	ASTM D 638			
	Ultimate elongation	ASTM D 638			
7. MARKING &	Components shall be supplied	ed in suitable pack	taging as to prote	ect the items	from physical
PACKAGING	damage prior to installation. number, and such markings	shall ensure tracea	ability through th	-	
	materials, formulation and m				
8. CERTIFICATION	Inspection certificate to EN	10204 Type 3.1B	shall contain ID	No. and all t	test results.

MATERI	AL DATA SHEET	M	DS P23	Rev. 2
TYPE OF MATERI	IAL: PEEK (Poly-ether-ether	er-ketone) with	n PTFE added	Page 1 of 1
PRODUCT	` • • • • • • • • • • • • • • • • • • •	PERATURE	-100°C to +250°C	
1. SCOPE	This MDS specifies the technical	l requirements for	the PEEK/ PTFE ma	terial.
2. PURCHASE INFORMATION	The purchase order shall contain tolerances and / or referenced dr	the following info	ormation: Product for	
3. CHEMICAL COMPOSITION	Poly-ether-ether-ketone polymer % PTFE (Poly-tetra-fluoro-ethy		abilisers and processi	ng aids and 10 to 20
4. QUALIFICATION TEST REQUIREMENTS	The material shall satisfy the fol repeated if there are changes in composition or properties of the testing:	lowing minimum the production rou	te, manufacturing pro	cedures, specified
	Mechanical properties	Test sta	ndard	Virgin
	 Tensile strength 	ASTM		> 80 MPa
	Hardness	ASTM		82 - 88 Shore D
	Tensile modulus	ASTM		> 3000MPa
	 Compressive strength 	ASTM		> 100 MPa
	• HDT @ 1.81 MPa	ASTM		150°C
	• Impact strength, (notched)	ASTM		> 50 J/m
	Ultimate elongation	ASTM	D 638	> 20 %
	Physical properties			
	Specific gravity	ASTM	D 792	$1.4 - 1.5 \text{ g/cm}^3$
	Melting point	ASTM		340 °C
	• Water absorption (24 hrs.)	ASTM		0.10 %
5. DIMENSIONS	According to BS 4518.		l l	
6. PRODUCTION TEST	The below properties shall be do	ocumented by testi	ng for each productio	n batch and satisfy the
REQUIREMENTS	requirements listed above.			
	Hardness	ASTM D 785		
	 Specific gravity 	ASTM D 792		
	Tensile strength	ASTM D 638		
	Ultimate elongation	ASTM D 638		
7. MARKING &	Components shall be supplied in	suitable packagin	ng as to protect the ite	ms from physical
PACKAGING	damage prior to installation. Ma	rkings on the pack	aging shall clearly inc	dicate material batch
	number, and such markings shall	l ensure traceabili	ty through the produce	ers QC system to raw
	materials, formulation and manu			
8. CERTIFICATION	Inspection certificate to EN 102	04 Type 3.1B shal	l contain ID No. and a	all test results.

MATERIA	L DATA SHE	ET M	DS R11	Rev. 3	
TYPE OF MATERIA	AL: Austenitic stainles	s steel, Type 6Mo		Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	ASTM A 312	UNS S31254 UNS N08367 UNS N08926	-	-	
1. SCOPE	This MDS specifies the requirements which sha referred standard.	*			
2. QUALIFICATION	Manufacturers of produ Standard M-650.	ect to this MDS shall co	mply with the require	ment of NORSOK	
3. STEEL MAKING	The steel melt shall be i	refined by AOD or equi	valent.		
4. HEAT TREATMENT	The pipes shall be solut	ion annealed followed	by water quenching.		
5. TENSILE TESTING	$R_{P0,2} \ge 310 \text{ MPa}, R_M \ge 675 \text{ MPa for } t \le 5.0 \text{ mm and } R_M \ge 655 \text{ MPa for } t > 5.0 \text{ mm}, A_5 \ge 35 \% \text{ (long.)}$				
6. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. Test specimens shall have the internal and external surfaces in the as-delivered condition (including pickling). Cut edges shall be prepared according to ASTM G48, and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. The acceptance criteria are: - No pitting at 20 X magnification.				
7. EXTENT OF TESTING	- The weight loss shall be less than 4.0 g/m. Corrosion test shall be carried out to the same extent as stated for mechanical tests in the referred standard.				
8. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.				
9. SURFACE FINISH	White pickled.				
10. REPAIR OF DEFECTS	Weld repair is not acceptable.				
11. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
12. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.				
	Heat treatment tempera certificate.	ture, soaking time and o	cooling medium shoul	d be stated in the	

MATERIA	L DATA SHE	EET M	DS R12	Rev. 3	
TYPE OF MATERIA	AL: Austenitic Stainle	ss Steel, Type 6Mo		Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Welded Pipes	ASTM A 358	UNS S31254 UNS N08367 UNS N08926	Class 1, 3 and 5.	S3	
1. SCOPE		e selected options in the re all be added or supersede t			
2. QUALIFICATION	Manufacturers of production Standard M-650.	uct to this MDS shall comp	oly with the requirement	nt of NORSOK	
3. STEEL MAKING	Steel melt shall be refin	ned with AOD or equivale	nt refining.		
4. HEAT TREATMENT	annealing is not require	tion annealed followed by ed of pipes with nominal w plution annealed plate mate	vall thickness up to 7.1	1 mm	
5. TENSILE TESTING	$R_{P0,2} \ge 310 \text{ MPa}, R_{M} \ge$	690 MPa, $A_5 \ge 35 \%$.			
	50 °C and the exposure time 24 hours. Test specimens shall have the internal and external surfaces in the as-delivered condition (including pickling). Cut edges shall be prepared according to ASTM G 48, and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose the external and internal surfaces and a cross section surface including weld zone in full wall thickness. The acceptance criteria are: - No pitting at 20 X magnification. - The weight loss shall be less than 4.0 g/m ² .				
7. EXTENT OF TESTING	Tensile and corrosion testing shall be carried out for each lot defined as follows: - For batch furnace a lot is defined as maximum 60 m pipe of the same heat, size and heat treatment charge. - For continuous heat treatment furnace a lot is defined as maximum 60 m of pipe of the same heat and size and which are heat treated the same day.				
8. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.				
9. WELDING	 The PQR/WPAR shall be qualified in accordance with ASME IX or EN 288-3 and this MDS: The weld consumable shall be Ni-base and the alloying content shall be: Mo ≥ 8.0 %; Cr ≥ 15.0 %; (Mo + Cr) ≥ 28 %; C ≤ 0.030 %; and S ≤ 0.015 % The PQR/WPAR shall be corrosion tested as specified above. The qualification shall be carried out on the same material grade (UNS number) as used in production. Change of specific make (brand name) of welding consumables requires requalification. Welding shall be carried out by qualified welders according to qualified procedures approved by a 3rd party organization recognized by an EC member State. 				

MATERIA	L DATA SH	HEET	MDS R12	Rev. 3		
TYPE OF MATERIA	L: Austenitic Stair	nless Steel, Type 6Mo)	Page 2 of 2		
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS				
Welded Pipes	ASTM A 358	UNS S31254 UNS N08367 UNS N08926	Class 1, 3 and 5.	S3		
10. NON DESTRUCTIVE TESTING		ng according to ASTM all thickness less than 4	A 450 is acceptable as repla,0 mm.	acement for		
	Supplementary requirement S3, penetrant testing, shall apply according to ASME V Article 6, to the weld area of 10 % of the pipes (same test lot as defined for mechanical testing) delivered. The weld of each examined pipe shall be ground flush in a length of 100 mm prior to penetrant testing. The testing shall be carried out after calibration and pickling. Acceptance criteria shall be to ASME VIII Div. 1 Appendix 8. NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.					
11. SURFACE FINISH	White pickled.	White pickled.				
12. REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds the same requirements to PQR/WPAR as for production welding shall apply.					
13. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
14. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.					
	Heat treatment ten certificate.	nperature, soaking time	and cooling medium should	d be stated in the		

MATERIA	AL DATA S	HEET	MDS R13	Rev. 3		
TYPE OF MATERIA	AL: Austenitic Sta	inless Steel, Type	6Мо	Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings	ASTM A 403	WP S31254 UNS N08367 UNS N08926	WP-S, WP-WX and WP-W			
1. SCOPE	_	_	is in the referred standard and ad- corresponding requirements in th	-		
2. QUALIFICATION	Manufacturers of p Standard M-650.	product to this MDS	shall comply with the requireme	nt of NORSOK		
3. STEEL MAKING	Steel melt shall be	refined with AOD o	r equivalent.			
4. HEAT TREATMENT	The fittings shall b	e solution annealed	followed by water quenching.			
5. TENSILE TESTING	$R_{P0,2} \ge 300 \text{ MPa, R}$	$L_{\rm M} \ge 650 - 820 \text{ MPa},$	$A_5 \ge 35 \%$.			
	surfaces in the as-daccording to ASTM 60 °C, 5 minute). To including weld zon. - No pitting at 2	lelivered condition (and G 48, and the who The test shall expose	e specimen shall have the internal including pickling). Cut edges shall be specimen shall be pickled (20 the external and internal surface I wall thickness. The acceptance 4.0 g/m ² .	hall be prepared % HNO3 + 5 % HF, s and a cross section		
7. EXTENT OF TESTING		Tensile and corrosion testing shall be performed for each heat, heat treatment load with a wall thickness range of 5 mm and welded with the same WPS.				
8. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components. Test sampling shall be made from an actual fitting or from a prolongation thereof.					
9. WELDING	this MDS: - The weld consu 28 %; C ≤ 0.030 - The PQR/WPA The qualification s production. Change requalification. Welding shall be c	mable alloying conton 0% ; $S \le 0.015\%$; R shall be corrosion hall be carried out one of specific make (but arried out by qualification).	ed in accordance with ASME IX ent shall be: Mo \geq 8.0 %; Cr \geq 1: tested as specified above. In the same material grade (UNS) brand name) of welding consumated welders according to qualified cognized by an EC member State	5.0 %;(Mo + Cr) ≥ number) as used in bles requires I procedures		

MATERIA	L DATA SH	EET	MDS R13	Rev. 3		
TYPE OF MATERIA	Page 2 of 2					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings	ASTM A 403	WP S31254 UNS N08367 UNS N08926	WP-S, WP-WX and WP-W			
10. NON DESTRUCTIVE TESTING	Penetrant testing, shall apply to 10 % of seamless fittings (from the test lot as defined above) and 100 % of welded fittings above NPS 2. For welded fittings the testing shall cover the weld only. The weld of each examined fitting shall be ground flush in a length of 100 mm prior to penetrant testing. The resting shall be carried out after calibration and pickling. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 8. NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.					
11. SURFACE FINISH	White pickled.	White pickled.				
12. REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds the same requirement to PQR/WPAR shall apply as for production testing.					
13. MARKING	The component shall	be marked to ensure fu	Ill traceability to melt and hea	at treatment lot.		
14. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials. Heat treatment temperature, soaking time and cooling medium should be stated in the					
	certificate.	tature, soaking time an	ia cooming meanum should be	stated III tile		

MATERIA	L DATA SH	EET	MDS R14	Rev.3
TYPE OF MATERIA	L: Austenitic Stainl	less Steel, Type 6Mo		Page 1 of 2
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Forgings	ASTM A 182	F44 UNS N08367 UNS N08926	-	S56
1. SCOPE	_	the selected options in the shall be added or supersed		
		ed for forgings with maxin reements shall be made in		nm. For larger
2. QUALIFICATION	Manufacturers of pr Standard M-650.	roduct to this MDS shall co	omply with the require	ment of NORSOK
3. STEEL MAKING	The steel melt shall	be refined with AOD or e	quivalent.	
4. MANUFACTURING PROCESS	The Hot Isostatic Pr	ressed (HIP) process is an	acceptable alternative	to forging.
5. HEAT TREATMENT	The forgings shall b	e solution annealed follow	wed by water quenching	g.
6. TENSILE TESTING	$R_{P0,2} \ge 300 \text{ MPa, } R_{M}$	$_{M} \ge 650 \text{ MPa}, A_{5} \ge 35 \%.$		
7. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. The corrosion test specimens shall be at the same location as those for mechanical testing. Cut edges shall be prepared according to ASTM G 48 and pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are: No pitting at 20 X magnification.			
	- The weight loss sl	hall be less than 4.0 g/m ² .		
8. EXTENT OF TESTING	One set of tensile test and corrosion test shall be carried out for each heat and heat treatment load. The testing shall be carried out on the component with heaviest wall thickness within the load. A test lot shall not exceed 2000 kg for forgings with as forged weight ≤ 50 kg, and 5000 kg for forgings with as forged weight > 50 kg.			
9. TEST SAMPLING	Samples for product components.	tion testing shall realistica	lly reflect the propertie	es in the actual
	Test samples shall be from prolongations on actual component. Sacrificial forgings shall be used for die-forged components. However, special agreements may be made for dieforged components with as forged weight exceeding 50 kg. Integrated blocks shall be used for HIP.			ay be made for die-
	Test location and or	rientation shall be:		
For forgings having maximum section thickness, $T \le 50$ mm, the test specin shall be taken at mid thickness and its mid length shall be at least 50 mm from second surface.				-
	shall be taken	naving maximum section t at least ¼ T from the near less, from any second surfa	rest surface and at least	_
	Sketches shall be es extraction of test sp	tablished showing type, si ecimens.	ze and location of test	samples and

MATERIA	L DATA SHE	EET	MDS R14	Rev. 3		
TYPE OF MATERIA	Page 2 of 2					
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS				
Forgings	ASTM A 182	F44 UNS N08367 UNS N08926	-	S56		
10. NON DESTRUCTIVE TESTING	Supplementary requirement ASTM A 961 S56, penetrant testing, shall apply to 10 % of all forgings (from the lot as defined for mechanical testing) above NPS 2. The testing shall be carried out after final machining and pickling. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 8.					
	NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.					
11. SURFACE FINISH	White pickled including	White pickled including machined surfaces.				
12. REPAIR OF DEFECTS	Weld repair is not accep	ptable.				
13. MARKING	The component shall be	e marked to ensure full t	raceability to melt and h	neat treatment lot.		
14. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.					
	Heat treatment tempera certificate.	ture, soaking time and c	cooling medium should b	pe stated in the		

MATERIA	L DATA SHE	ET	MDS R15	Rev. 3	
TYPE OF MATERIA	AL: Austenitic Stainle	ss Steel, Type 6Mo		Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Plates	ASTM A 240	UNS S31254 UNS N08367 UNS N08926	-	-	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.				
2. QUALIFICATION	Manufacturers of produ Standard M-650.	act to this MDS shall con	mply with the requirem	ent of NORSOK	
3. STEEL MAKING	The steel melt shall be	refined with AOD or eq	uivalent.		
4. HEAT TREATMENT	The plates shall be solu	ation annealed followed	by water quenching.		
5. TENSILE TESTING	$R_{P0,2} \ge 310 \text{ MPa, } R_{M} \ge$	655 MPa, $A_5 \ge 35$ %.			
6. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. Test specimens shall have the surfaces in the asdelivered condition (including pickling). Cut edges shall be prepared according to ASTM G 48, and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose the external and internal surfaces and a cross section surface in full wall thickness. The acceptance criteria are: - No pitting at 20 X magnification. - The weight loss shall be less than 4.0 g/m².				
7. EXTENT OF TESTING	Corrosion testing shall be carried out to the same extent as stated for mechanical tests in the referred standard.				
8. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.				
9. SURFACE FINISH	White pickled.				
10. REPAIR OF DEFECTS	Weld repair is not acceptable.				
11. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
12. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials				
	Heat treatment tempera certificate.	ture, soaking time and c	cooling medium should	be stated in the	

MATERIA	L DATA SHE	EET	MDS R16	Rev. 3	
TYPE OF MATERIA	AL: Austenitic Stain	less Steel, Type 61	Mo	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 351	CK-3MCuN CN-3MN	-	S5, S6	
1. SCOPE	This MDS specifies the requirements which shareferred standard.	ne selected options in all be added or sup	n the referred standard and a ersede the corresponding req	dditional uirements in the	
2. QUALIFICATION	Manufacturers of prod Standard M-650.	luct to this MDS sha	all comply with the requirem	ent of NORSOK	
3. STEEL MAKING			or equivalent process. Reme ecceptable. Use of internal scr		
4. HEAT TREATMENT	Solution annealed at to	emperature ≥ 1225 °	°C.		
5. CHEMICAL	$P \le 0.030 \%$				
6. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 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 G 48 and pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are:				
	 No pitting at 20 X magnification. The weight loss shall be less than 4.0 g/m². 				
7. EXTENT OF TESTING	Tensile test and corrosion test shall be made for each melt and heat treatment load. A test lot shall not exceed 5 000 kg.				
8. TEST SAMPLING	components. Thickness	ss of the test block s aximum thickness of	stically reflect the properties thall be equal to the thickness of 100 mm. For flanged comp	of the actual	
	Test specimens shall be thickness of the test be		Γ location from the surface w	here T is the	
	Test block shall be int the castings until after		d onto the castings and shall at treatment.	not be removed from	
9. NON DESTRUCTIVE TESTING	(including internal sur	faces) of all casting	requirement S6 shall apply to s. The testing shall be carried criteria shall be ASME VIII,	d out after final	
	 Radiographic testing: Supplementary requirement S5 shall apply to: Critical areas as per ANSI B 16.34 of the pilot cast of each pattern All butt weld ends of each casting Class 1500 psi and above; all critical areas to ANSI B16.34 of each casting. 				
	-			v uoviiig.	
	The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. NDT operator qualification shall be approved by a 3 rd party organization recognized by an EC member state.				
10. SURFACE FINISH	White pickled. Shall b surfaces.	oe carried out after a	ny blasting and shall include	finished machined	

MATERIAL DATA SHEET ME			MDS R16	Rev. 3	
TYPE OF MATERIA	AL: Austenitic Stain	less Steel, Type 6Mo		Page 2 of 2	
PRODUCT	STANDARD	SUPPL. REQ.			
Castings	ASTM A 351	CK-3MCuN CN-3MN	-	S5, S6	
11. REPAIR OF DEFECTS	Repair welding shall be carried out with Ni-based consumables with alloying content: Mo ≥ 8.0 %; Cr ≥ 15.0 %; (Mo + Cr) ≥ 28 %; C ≤ 0.030 %; S ≤ 0.015 %; Welding consumables with matching chemical composition is acceptable provided solution annealing heat treatment after welding. The repair welding procedure shall be qualified in accordance with ASME IX or EN 288-3 and this MDS. - A cast plate shall be used for the test welding. - A macro and corrosion test as specified above shall be carried out. - Change specific make of filler metal (brand name) requires requalification. All casting with major repairs shall be given a solution heat treatment after welding. Welding shall be carried out by qualified welders according to qualified procedures approved by a 3 rd party organization recognized by an EC member State.				
12. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
13. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials.				
	Heat treatment tempore certificate.	erature, soaking time and	d cooling medium should	be stated in the	

MATERIA	L DATA SH	EET	MDS R17	Rev. 3	
TYPE OF MATERIA	AL: Austenitic Stainle	ess Steel, Type 6Mo		Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Bars	ASTM A 276	UNS S31254 UNS N08367 UNS N08926	-	-	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.				
		for bars with maximum tall be made in each case a M-650.			
2. QUALIFICATION	Manufacturers of prod Standard M-650.	luct to this MDS shall cor	mply with the requirem	ent of NORSOK	
3. STEEL MAKING	The steel melt shall be	refined with AOD or equ	uivalent.		
4. HEAT TREATMENT	Solution annealing fol	lowed by water quenchin	g.		
5. TENSILE TESTING	$R_{P0,2} \ge 300 \text{ MPa}, R_{M} \ge$	$\pm 650 \text{ MPa}, A_5 \ge 35 \%,$			
6. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. The corrosion test specimens shall be at the same location as those for mechanical testing. Cut edges shall be prepared according to ASTM and pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are: - No pitting at 20 X magnification. - The weight loss shall be less than 4.0 g/m ² .				
7. EXTENT OF TESTING	One tensile test and co	prrosion test shall be carrie	ed out for each heat an	d heat treatment load.	
8. TEST SAMPLING		n testing shall realistically tion and orientation shall		in the actual	
	For bars having maximum section thickness, T ≤ 50 mm, the test specimens shall be taken at mid thickness and its mid length shall be at least 50 mm from any second surface.				
	■ For bars having maximum section thickness, T > 50 mm, the test specimen shall be taken at least ½ T from the nearest surface and at least T or 100 mm, whichever is less, from any second surface.				
	■ The testing shall be carried out in longitudinal direction. For thickness exceeding 160 mm, the testing shall be carried out both in longitudinal and transverse (tangential) direction. All testing in longitudinal direction shall meet specified requirements (ASTM A 276 and this MDS). For testing in transverse (tangential) direction elongation shall be minimum 20 %.				
9. SURFACE FINISH	Finished product shall	be white pickled.			
10. REPAIR OF DEFECTS	Weld repair is not acco	eptable			

MATERIAL DATA SHEET			MDS R17	Rev. 3	
TYPE OF MATERI	TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				
PRODUCT	PRODUCT STANDARD GRADE ACCEPT. CLASS				
Bars	ASTM A 276	UNS S31254 UNS N08367 UNS N08926	-	-	
11. MARKING	The component sh	all be marked to ensure	e full traceability to melt an	d heat treatment lot.	
12. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.				

MATERI	IAL DATA SH	IEET	MDS R18	Rev. 3		
TYPE OF MATERIA	AL: Austenitic stainles	s steel, Type 6Mo		Page 1 of 1		
PRODUCT	STANDARD	SUPPL. REQ.				
Tubes	ASTM A 269	UNS S31254 UNS N08367 UNS N08926	-	-		
1. SCOPE	requirements which sha referred standard. Mate	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. Material grades not included in A 269 shall comply with the test and tolerance requirements given to Grade UNS S31254.				
2. QUALIFICATION	Manufacturers of produ Standard M-650.	ect to this MDS shall co	mply with the requirem	ent of NORSOK		
3. STEEL MAKING	The steel melt shall be	refined by AOD or equi	ivalent.			
4. HEAT TREATMENT	The tubes shall be solut	The tubes shall be solution annealed followed by water quenching.				
5. CORROSION TESTING	Corrosion test according to ASTM G 48 Method A is required. Test temperature shall be 50 °C and the exposure time 24 hours. Test specimens shall have internal and external surfaces in an as-delivered condition (pickling or bright annealing). Cut edges shall be prepared according to ASTM G 48 and the whole specimen shall be pickled (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The acceptance criteria are:					
	- No pitting at 20 X		2			
		all be less than 4.0 g/m				
6. EXTENT OF TESTING	Corrosion testing shall the referred standard.	be carried out to the sar	me extent as stated for r	nechanical tests in		
7. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.					
9. REPAIR OF DEFECTS	Weld repair is not acceptable.					
10. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
11. CERTIFICATION	EN 10 204 Type 3.1B.	EN 10 204 Type 3.1B.				
	Heat treatment tempera certificate.	ture, soaking time and	cooling medium should	be stated in the		

MATERIAI	DATA SHE	ET	MDS S01	Rev. 3	
TYPE OF MATERIAL:	Austenitic Stainless	Steel, Type 316		Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings Welded pipes Seamless & welded pipes Forgings Plates Tubes Bars	ASTM A 403 ASTM A 358 ASTM A 312 ASTM A 182 ASTM A 240 ASTM A 269 ASTM A 276	WP 316 316 TP 316 F 316 316 316	W/S/WX Class 1, 3, 4 or 5 - -	- - - - -	
1. SCOPE	requirements which shreferred standard.	all be added or supers	he referred standard and sede the corresponding re	equirements in the	
2. MANUFACTURING PROCESS	_		ed out by qualified weld approved by a 3 rd party of member State.		
3. CHEMICAL COMPOSITION	All products: $C \le 0$. Welded pipes and plat		5 %		
4. TENSILE TESTING	Grade 316 L with Rp0.	$2 \ge 205 \text{ MPa}, \text{ Rm} \ge 51$	5 MPa and $A_5 > 35\%$ is	acceptable.	
5. TEST SAMPLING	Samples for productio component.	n testing shall realistic	cally reflect the propertie	es in the actual	
6. NON DESTRUCTIVE TESTING	Welded pipes to A 358 Welded tubes to A 269 All products:	acceptable as replation thickness less than Eddy current testin section 23 is requining NDT operator qua	ng according to ASTM A	aphy for wall A 450, ved by a 3 rd party	
7. SURFACE FINISH	White pickled. Machin				
	Tubes to A 269:	According to the s	tandard.		
8. REPAIR OF DEFECTS	Weld repair of base material is not acceptable.				
9. MARKING	The product shall be marked to ensure full traceability to melt and heat treatment lot.				
10. CERTIFICATION	10204 Type 3.1B prov	rided the manufacture	ne specification and shal r has a quality assurance and having undergone a	system certified by a	

MATERIA	L DATA SHE	EET	MDS S02	Rev. 3	
TYPE OF MATERIA	AL: Austenitic Stainles	ss Steel Castings		Page 1 of 1	
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS			
Castings	ASTM A 351	CF8M CF3M	-	S5, S6 S5, S6	
1. SCOPE		selected options in the r			
2. EXTENT OF TESTING	Tensile testing is requir	red for each heat and hear	t treatment load.		
3. TEST SAMPLING	For castings with weight 250 kg and above the test blocks shall be integrally cast with the casting. The test blocks shall be heat treated together with the castings they represents. Samples for mechanical testing shall realistically reflect the properties in the actual components.				
4. NON DESTRUCTIVE TESTING	Penetrant testing: Supplementary requirement S6 shall apply to all surfaces (including internal surfaces) of all castings. The testing shall be carried out after final machining and pickling. The acceptance criteria shall be ASME VIII, Div.1, Appendix 7.				
		Supplementary requireme			
	•	er ANSI B16.34 of the pi	lot cast of each pattern	ı	
	- All butt weld ends	of each casting. above; all critical areas	according to ANSI R1	6.34 of each casting	
	_	shall be to ASME VIII,	_	0.54 of each easting.	
		tion shall be approved by		on recognized by an	
5. REPAIR OF DEFECTS	Welding shall be carried out by qualified welders according to qualified procedures approved by a 3 rd party recognized by an EC member State.				
6. SURFACE FINISH	White pickled. Machined surfaces do not require pickling.				
7. CERTIFICATION	Certification shall affirm compliance with the specification and shall be according to EN 10204 Type 3.1B provided the manufacturer has a quality assurance system certified by a competent body established within the EC, and having undergone a specific assessment for materials				

MATERI	AL DATA SHI	EET	MDS T01	Rev. 3	
TYPE OF MATERI	Page 1 of 1				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes Welded pipes Wrought fittings Forgings Plates Bars Tubes	ASTM B 861 ASTM B 862 ASTM B 363 ASTM B 381 ASTM B 265 ASTM B 348 ASTM B 338	2 2 WPT2/WPT2W F2 2 2 2	- - - -	- - - - - -	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard. Equivalent Titanium grade (GOST VT 1-0) is acceptable provided the requirements in the referred standard and this MDS is fulfilled.				
2. CHEMICAL COMPOSITION	Chemical composition of	other than Grade 2 (GC	OST VT 1-0) is acceptable	ole.	
3. HEAT TREATMENT	Wrought fittings to B 36 Annealed condition if n formed condition.	0 0			
4. EXTENT OF TESTING	Fittings to B 363: Tensile test shall be carried out for each heat, heat treatment load, type and size. Products to B 381/B 348: Tensile test specimen shall be taken from each lot. A lot is defined as all products of the same heat and heat treatment load with a maximum deviation from the test block thickness of 10 mm.				
5. TEST SAMPLING	All products: Samples for production testing shall realistically reflect the properties in the actual component.				
6. WELDING	Welded pipes to B 862:	• •	shall be qualified in acc	cordance with ASME	
7. CERTIFICATION	EN 10 204 Type 3.1B.				

MATERIA	AL DATA SI	HEET	MDS T02	Rev. 3		
TYPE OF MATERI	AL: Titanium Grad	le 2		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Castings	ASTM B 367	C2	-	S1, S2		
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.					
	Equivalent Titanium this MDS is fulfille	•	1-0) are acceptable provided	d the requirements in		
2. QUALIFICATION	Manufacturers of p Standard M-650.	roduct to this MDS	shall be qualified in accordan	ce with NORSOK		
3 HOT ISOSTATIC PRESSING	required heat treatn	All castings shall be subject to Hot Isostatic Pressing (HIP). HIP may be substituted for required heat treatment provided all requirements are met and the temperature is not detrimental to the material.				
4. CHEMICAL COMPOSTION	Chemical composit	Chemical composition other than Grade 2 (GOST VT 1-0) is acceptable.				
5. EXTENT OF TESTING	Tensile testing is re	equired for each heat	and heat treatment load.			
6. TEST SAMPLING	Samples for mecha components.	nical testing shall rea	alistically reflect the properti	es in the actual		
	For castings with w casting.	eight 150 kg and ab	ove the test blocks shall be in	ntegrally cast with the		
			ngs through any heat treatme alter metallurgical or mecha			
7. NON DESTRUCTIVE TESTING	process or any other operation that may alter metallurgical or mechanical properties. Penetrant testing: Supplementary requirement S2 shall apply to all accessible surfaces o all castings. The testing shall be carried out after final machining. The acceptance criteris shall be ASME VIII, Div.1, Appendix 7.			accessible surfaces of		
	Radiographic testir	g: Supplementary re	equirement S1 shall apply to:			
	- Critical areas a	as per ANSI B16.34 ends of each casting.	of the pilot cast of each patte	rn		
	•	•	al areas according to ANSI I IE VIII, Div. 1, Appendix 7.	o 10.54 of each casting.		
8. MARKING	<u> </u>		re full traceability to melt an	d heat treatment lot.		
9. CERTIFICATION	EN 10 204 Type 3.	1B	•			

MATERIA	AL DATA SHEE	T N	MDS X01	Rev. 1		
TYPE OF MATERIA	AL: Low Alloyed Steel Ty	pe AISI 4130		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Seamless pipes Wrought fittings (seamless)	ASTM A 519 ASTM A 234	AISI 4130 AISI 4130		S2		
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.					
2. HEAT TREATMENT	Fittings and pipes shall be d tempering temperature shall			ed condition. The		
3. MANUFACTURING PROCESS	Pipes shall be manufactured Only seamless fittings are a	by means of the ho		ethod.		
4. CHEMICAL COMPOSITION	Max. sulphur content: $S \le$ Max. phosphorous content:					
5. TENSILE TESTING	Minimum yield strength: Reh \geq 415 MPa Minimum tensile strength: Rm \geq 620 MPa Minimum elongation: A5 \geq 18 % Minimum red. of area: $Z \geq$ 35 %					
6. IMPACT TESTING	Charpy V-notch impact test t ≥ 6 mm. Full sized Charpy shall be perpendicular to the absorbed energy for full size factors for subsize specimen	V-notch specimens e surface. The test te e specimens shall be	s shall be used wherever emperature shall be - 30 e 42 J average and 30 J s	possible. The notch °C. The minimum		
7. EXTENT OF TESTING						
8. TEST SAMPLING	Samples for production test component.			n the actual		
9. NON DESTRUCTIVE TESTING	Fittings: According to supplementary requirement S2. Pipes: All pipes shall be 100 % tested in accordance with API 5L supplementary requirement 4 (SR4). Alternatively, ultrasonic testing according to SEL 1915 may be carried out. Fittings: Fittings shall be 100 % magnetic particle tested in accordance with ASME VIII, div. 1, Appendix 6.					
10. REPAIR OF DEFECTS	Weld repair is not acceptable	e.				
11. MARKING	The component shall be ma	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
12. CERTIFICATION	EN 10 204 Type 3.1B. Heat be stated in the certificate	treatment temperat	ure, soaking time and co	poling medium should		

MATERIA	AL DATA SHEE	ET	MDS X02	Rev. 2			
TYPE OF MATERIA	AL: High Strength Low A	lloyed Steel Typ	pe AISI 4140	Page 1 of 1			
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.			
Forgings	ASTM A 788	AISI 4140	-	S18			
1. SCOPE		This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.					
2. MANUFACTURING PROCESS	The forgings shall be finished hot-worked.						
3. HEAT TREATMENT	The forgings shall be auster	nitised, liquid que	enched and tempered.				
4. CHEMICAL COMPOSITION	According to ASTM A 29,	AISI 4140					
5. TENSILE TESTING	Minimum yield strength: Rimimum tensile strength: Minimum elongation: A5	Rm ≥ 850 MPa					
6. IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at - 30 °C. The nocth shall be perpendicular to the surface. The minimum absorbed energy for full size specimens shall be 42 J average and 30 J single.						
7. EXTENT OF TESTING	One set of tensile and impa and heat treatment load.	ct test shall be ca	rried out for each melt, see	ction thickness +/- 25 %			
8. TEST SAMPLING	Samples for production test component.	ing shall realistic	ally reflect the properties	in the actual			
	Test samples shall be from used for die forged components with as forged	ents. However, s	pecial agreements may be	~ ~			
	Test specimens shall be cut the test samples as heat trea of test samples and extraction	ted. Sketches sha	all be established showing				
9. NON DESTRUCTIVE TESTING	Supplementary Requirement, S18, magnetic particle tested, shall apply to 10 % of all forgings (from the lot as defined for mechanical testing). The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 6.						
10. REPAIR OF DEFECTS	Weld repair is not acceptab	le.					
11. MARKING	The component shall be ma	rked to ensure fu	ll traceability to melt and	heat treatment lot.			
12. CERTIFICATION	EN 10 204 Type 3.1B						
	Heat treatment temperature certificate.	, soaking time an	d cooling medium should	be stated in the			

MATERIA	AL DATA SHEE	T M	DS X03	Rev. 2		
TYPE OF MATERIA	AL: High Strength Low All	oy Steel		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Castings	ASTM A 487	Grade 2B, 2C	-	S4, S5		
1. SCOPE	This MDS specifies the select which shall be added or super					
2. IMPACT TESTING	Charpy V-notch testing is reperpendicular to the surface. specimens) and 30 J single v	The minimum absorb				
3. EXTENT OF TESTING	One set of tensile and impac shall not exceed 5000 kg.	t test is required for ea	ach melt and heat treatn	nent load. A test lot		
4. TEST SAMPLING	Samples for mechanical testing shall realistically reflect the properties in the actual components. Thickness of the test block shall be equal to the thickness of the actual components up to a maximum thickness of 100 mm. For flanged components the largest flange thickness shall apply.					
	Test specimens shall be cut fof the test block.	from the 1/4 T location	n from the surface when	re T is the thickness		
	Test block shall be integrally the castings until after the fir	_	_	be removed from		
5. NON DESTRUCTIVE TESTING	Magnetic particle testing: Susurfaces of all castings. The criteria shall be to ASME VI	examination shall be o	carried out after machin			
	 Radiographic testing: Supplementary requirement S5 shall apply to: Critical areas as per ANSI B16.34 of the pilot cast of each pattern. All butt weld ends of each casting. Class 1500 psi and above; all critical areas to ANSI B16.34 of each casting. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. 					
6. REPAIR OF DEFECTS	All weld repairs shall be pos shall include the following:			dure qualification		
	- qualification on a cast plate	•	an from wald matal and	fusion line		
7 MADKING	<u> </u>	- one set of impact test (3 specimens), shall be taken from weld metal and fusion line. The component shall be marked to ensure full traceability to melt and heat treatment lot.				
7. MARKING 8. CERTIFICATION	EN 10 204 Type 3.1B. Heat be stated in the certificate.					

MATERIA	AL DATA SH	IEET N	MDS X04	Rev. 1		
TYPE OF MATERIA	4L: High Strength Lo	w Alloyed Steel Type	AISI 4130	Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Forgings	API 6A	60K (AISI 4130)	Product Specification Level (PSL) 3	-		
1. SCOPE		e selected options in the or supersede the correspo				
2. MANUFACTURING PROCESS	The flanges shall be for accepted.	orged to shape. Flanges n	nachined out of bar and o	or plate are not		
3. HEAT TREATMENT/ DELIVERY CONDITION	The flanges shall be an	ustenitised, liquid quench	ned and tempered.			
4. CHEMICAL COMPOSITION	_	all comply with the requequirements PSL 3 given greed.				
5. IMPACT TESTING		Charpy V-notch testing at - 30 °C is required. The minimum absorbed energy for full size specimens shall be 42 J average and 30 J single.				
6. EXTENT OF TESTING		impact test shall be carrie PSL 3, and heat treatmen				
7. TEST SAMPLING	Samples for productio component.	n testing shall realisticall	y reflect the properties i	n the actual		
	used for die forged con	from prolongations on ac imponents. However, spec orged weight exceeding 5	cial agreements may be			
	-	treated. Sketches shall traction of test.				
8. DIMENSIONAL TOLERANCES	Flanges to MSS SP-44 mm for the hub at the	shall have a maximum welding end.	wall thickness under tole	rance of 0.3		
9. NON DESTRUCTIVE TESTING	NDT shall be carried out after final heat treatment: - 100 % MT according to ASME VIII, Div.1, App.6, shall be carried out. - 100 % UT according to ASTM A 388, shall be carried out. The acceptance criteria shall be according to ASTM A 388 para 8.					
10. REPAIR OF DEFECTS	Weld repair is not acco	eptable.				
11. MARKING	The component shall be	pe marked to ensure full t	traceability to melt and h	eat treatment lot.		
12. CERTIFICATION	EN 10 204 Type 3.1B be stated in the certific	. Heat treatment tempera cate	ture, soaking time and co	poling medium should		

MATERIAL DAT	TA SHEET	MD	S - X05	Rev. 1	
TYPE OF MATERIAL: Hig	gh Strength Low Al	loyed Steel Type	F22	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Forgings	ASTM A 182	F22	3	S4	
1. SCOPE		shall be added or si	s in the referred standard upersede the correspondi		
2. HEAT TREATMENT	Normalized and tem	npered.			
3. IMPACT TESTING		l be 27 J average an	quired. The minimum about 20 J single. Reduction mm - 2/3.		
4. EXTENT OF TESTING	One set of tensile and impact test shall be carried out for each heat and heat treatment load. A test lot shall not exceed 2000 kg.				
5. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual component				
	Test samples shall be from prolongations on actual components. Sacrificial forgings shall be used for die forged components. However, special agreements may be made for die forged components with as forged weight exceeding 50 kg.				
	thickness of the test	samples as heat trea	location from the surfactated. Sketches shall be extraction of test special	stablished showing	
6. DIMENSIONAL TOLERANCES	Flanges to MSS SP mm for the hub at the		ximum wall thickness ur	nder tolerance of 0.3	
7. NON DESTRUCTIVE TESTING	Supplementary Requirement, S4, Magnetic Particle testing, shall apply to 10 % of all forgings (from the lot as defined for mechanical testing). The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 6.				
8. REPAIR OF DEFECTS	Weld repair of base	material is not acce	ptable.		
9. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
10. CERTIFICATION	EN 10 204 Type 3.1 should be stated in t		emperature, soaking time	e and cooling medium	

MATERIAL	DATA SHEET	MDS	X06	Rev. 1	
TYPE OF MATERIA	AL: High Strength Low All	oy Steel for applica	tion down to -46 °C	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 487	Grade 2B, 2C	-	S4, S5	
1. SCOPE	This MDS specifies the selected options in the referred standard and additional requirements which shall be added or supersede the corresponding requirements in the referred standard.				
2. CHEMICAL COMPOSITION	$C \le 0.14 \%$; $Si \le 0.50 \%$; $Mr 0.25 \%$	$n = 1.30-1.60 \%$; $Cr \le$	0.20 %; Ni = 0.90-1.10	0 % and Mo = 0.15-	
3. IMPACT TESTING	Charpy V-notch testing is receptive perpendicular to the surface. specimens) and 30 J single v	The minimum absorb			
4. EXTENT OF TESTING	One set of tensile and impact shall not exceed 5000 kg.	t test is required for ea	ach melt and heat treatr	ment load. A test lot	
5. TEST SAMPLING	Samples for mechanical testing shall realistically reflect the properties in the actual components. Thickness of the test block shall be equal to the thickness of the actual components as heat treated up to a maximum thickness of 100 mm. For flanged components the largest flange thickness apply.				
	Test specimens shall be cut f of the test block.	From the 1/4 T location	n from the surface whe	re T is the thickness	
	Test block shall be integrally the castings before after the	•	•	be removed from	
6. NON DESTRUCTIVE TESTING	Magnetic particle testing: Su all accessible surfaces of all The acceptance criteria shall	castings. The examina	ation shall be carried ou	ut after machining.	
	Radiographic testing: Supplementary requirement S5 shall apply to: - critical areas as per ANSI B16.34 of the pilot cast of each pattern - all butt weld ends of each casting - Class 1500 psi and above; all critical areas to ANSI B16.34 of each casting. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.				
7. REPAIR OF DEFECTS					
	- qualification on a cast plate	e	in from wold motal and	fusion line	
0.16(PV	- one set of impact test (3 spo				
8. MARKING	The component shall be mar				
9. CERTIFICATION	EN 10 204 Type 3.1B. Heat be stated in the certificate.	u eaunem temperature	z, soaking time and coo	mig medium snould	

