

PDHonline Course M184 (3 PDH)

Material Data Sheets for the Construction of Piping Systems

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2012

PDH Online | PDH Center

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Rev. 3, June 2003

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 Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.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 with supported by OLF (The Norwegian Oil Industry Association) and TBL (Federation of Norwegian Manufacturing Industries). NORSOK standards are administered and published by NTS (Norwegian Technology Centre).

Introduction

This revision replace NORSOK standard M-630 rev 2, and the changes from rev. 2 to rev. 3 are only inclusion of 7 new MDS under material type P, Polymers including fibre reinforced.

MINOR DEVIATIONS FROM ASME B31.1 CODE REQUIREMENTS

The use of the piping materials according to NORSOK Standards (L-CR-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 subsize Charpy V-notch impact test specimens are used, the energy requirement is increased instead of lowering the test temperature.
- Impact testing is not required in the qualification of the welding procedures for weldments in austenitic stainless steel when used in the temperature range from – 29 °C to – 105 °C.
- Eddy current examination is accepted as replacement for spot radiography of stainless steel welds for wall thicknesses 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 proper safety level.

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1 Scope

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

2 Normative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements and guidelines of the standards referenced below.

3 Definitions

3.1.1

can

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

3.1.2

carbon steel type 235

carbon steel with SMYS ≥ 220MPa and not impact tested

3.1.3

carbon steel type 235LT

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

3.1.4

carbon steel type 360LT

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

3.1.5

may

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

3.1.6

MDS

material data sheet

3.1.7

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

3.1.8

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

3.1.9

SMYS

specified minimum yield strength

3.1.10

stainless steel type 316

alloys with approx. 2.5 % Mo of type AISI 316

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3.1.11

stainless steel type 6Mo

alloys with 6 % Mo and PRE > 40

3.1.12

stainless steel type 22Cr duplex

alloys with 22 % Cr according to UNS S31803

3.1.13

stainless steel type 25Cr duplex

alloys with 25 % Cr and PRE > 40, often also referred to as "super duplex".

4 Collection of material data sheets

4.1 General

Materials/components manufactured in accordance with M-CR-630 rev. 1 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.

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

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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	A790 UNS S32550, UNS S32750, UNS S32760	A312 UNS S31354, UNS N08367, UNS N08925, UNS N08926	B466 UNS C 70600	B705 UNS UNS N06625	B861 Gr 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 Class 1, 3, 5	A928 UNS S32550, UNS S32750, UNS S32760, Class 1, 3 and 5	A358 UNS S31254, UNS N08367, UNS N08925, UNS N08926 Class 1, 3, 5	B467 UNS C 70600	B705 UNS UNS N06625	B862 Gr 2	
Fittings	A234 Grade WPB	A420 Grade WPL 6	A860 Grade WPHY 52	A403 Grade WP 316 Class S, W, WX	A815 UNS S31803 Class S, W, WX	A815 UNS S32550, UNS S32750, UNS S32760, Class S, W, WX	A403 WP S31254, UNS N08367, UNS N08925, UNS N08926 Class S, W, WX	- UNS C 70600	B366 UNS UNS N06625	B363 Grade WPT2 / WPT2W	A234 AISI 4130
Forgings	A105	A350 Grade LF2	A694 Grade F52	A182 Grade F316	A182 Grade F51	A182 UNS S32550, F53 (UNS S32750), F55 (UNS S32760)	A182 Grade F44, UNS N08367, UNS N08925, UNS N08926	- UNS C 70600	B564 UNS UNS N06625	B381 Grade F2	ASTM A 788 AISI 4140 API 6A 60K (AISI 4130) A182 F22
Plate	A516 Grade 60, 70	A516 Grade 70	A516 Grade 70,	A240 Grade 316	A240 UNS S31803	A240 UNS S32550, UNS S32750, UNS S 32760	A 240 UNS S31254, UNS N08367, UNS N08925, UNS N08926	B171 UNS C 70600	B443 UNS UNS N06625	B265 Grade 2	

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Castings	A216 Grade	A352 Grade LCC	A352 Grade	A351 Grade CF8M	A890 UNS	A890	A 351	B148 UNS	B494	B367 Grade	ASTM A
	WCB		LCC	or CF3M	Grade 4	UNS J93404,	CK-3MCuN,	C 95800	Grade CW-	C2	487 Gr 2B
					(J92205)	UNS J93380	CN-3MN		6MC (UNS		ASTM A
									N06625)		487
									Grade		Gr 2B
									CX2MW		(÷46°C)
									(UNS		,
									N26022)		
Bars					A276	A276	A276		B446	B348	
					UNS S 31803	UNS S 32550	UNS S 31259		UNS N06625	Gr 2	
						UNS S 32750	UNS N08367				
						UNS S 32960	UNS N08925				
							UNS N08926				
Tubes				A269	A789	A789	A269		B444	B338	
				316	UNS S 31803	UNS S32550	UNS S 31259		UNS N06625	Gr 2	
						UNS S 32750	UNS N08367				
						UNS S 32760	UNS N08925				
							UNS N08926				

Type 235 should be used in piping systems with minimum design temperature above or equal to -15 $^{\circ}$ C and thicknesses less than approx.15 mm. The grades UNS N08367, N08925 and N08926 are considered equivalent to UNS S31254. The grade CN-3 MN is considered equivalent to CK-3MCuN. GOST VT-1-0 is considered equivalent. NOTE 1)

NOTE 2) NOTE 3)

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4.2 Referenced Standards and Corresponding MDS

MDS No.	Rev. No.	Standard and Grade (Note 1)	Products
		Carbon Steel Type 235	
C01 C01 C01 C01 C01 C01 C02	2 2 2 2 2 2 2 2	A 106 Grade B (1995) API 5L Grade B (1995) A 672 Grade CC60,CC70 (1994) A 234 Grade WPB (1996) A 105 (1995) A 516 Grade 60 (1990) A 216 Grade WCB (1993)	Seamless pipes Welded pipes Welded pipes Wrought fittings Forgings Plates Castings
		Carbon Steel Type 235LT	
C11 C11 C11 C11 C11 C12	2 2 2 2 2 2	A 333 Grade 6 (1994) A 671 Grade CC60, CC70 (1994) A 420 Grade WPL 6 (1996) A 350 Grade LF 2 (1996) A 516 Grade 70 (1990) A 352 Grade LCC (1993)	Seamless pipes Welded pipes Wrought fittings Forgings Plates Castings
		Carbon Steel Type 360LT	
C21 C21 C22	2 2 2	A 694 Grade 52 (1995) A 860 WPHY 52 (1996) API 5L Grade X52 (1995)	Forgings Wrought fittings Seamless pipes
		Ferritic/Austenitic Stainless Steel Type 22Cr	Duplex
D41 D42 D43 D44 D45 D46 D47 D48	2 2 2 2 2 2 2 2 2	A 790 UNS S31803 (1995) A 928 UNS S31803 (1994) A 815 UNS S31803 (1996) A 182 Grade F51 (1996) A 240 UNS S31803 (1996) A 890 Grade 4 (UNS J92205) (1994) A 276 UNS S31803 (1996) A 789 UNS S31803 (1994)	Seamless pipes Welded pipes Wrought fittings Forgings Plates Castings Bars Tubes
		Ferritic/Austenitic Stainless Steel Type 25Cr	Duplex
D51	2	A 790 UNS S32550 (1995) A 790 UNS S32750 (1995) A 790 UNS S32760 (1995)	Seamless pipes
D52	2	A 928 UNS S32550 (1994)	Welded pipes

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MDS No.	Rev. No.	Standard and Grade	Products
D53	2	A 928 UNS S32750 (1994) A 928 UNS S32760 (1994) A 815 UNS S32550 (1996) A 815 UNS S32750 (1996)	Wrought fittings
D54	2	A 815 UNS S32760 (1996) A 182 UNS S32550 (1996) A 182 Grade F53 (UNS S32750) (1996) A 182 Grade F55 (UNS S32760) (1996)	Forgings
D55	2	A 240 UNS S32550 (1996) A 240 UNS S32750 (1996) A 240 UNS S32760 (1996)	Plates
D56	2	A 890 UNS J93380 (1994) A 890 UNS J93404 (1994)	Castings
D57	2	A 276 UNS S32550 (1996) A 276 UNS S32750 (1996) A 276 UNS S32760 (1996)	Bars
D58	1	A 789 UNS S32760 (1995) A 789 UNS S32750 (1995) A 789 UNS S32760 (1995) A 789 UNS S32760 (1995)	Tubes
		Copper/Nickel 90/10	
K01	1	B 466 UNS C 70600 (1992) B 467 UNS C 70600 (1988) B 151 UNS C 70600 (1994) B 171 UNS C 70600 (1995) - UNS C 70600 (1995) - UNS C 70600 (1995)	Seaml. pipes & tubes Welded pipes Rod & bar Plates & sheets Fittings Flanges
		Aluminium - Bronze Sand Castings	
K02	1	B 148 UNS C 9580 (1993)	Castings
		Nickel Alloy Type 625	
N01 N01 N01 N01 N01 N01 N02 N02	2 2 2 2 2 2 2 2 2 2	B 366 UNS N06625 (1996) B 705 UNS N06625 (1995) B 564 UNS N06625 (1996) B 443 UNS N06625 (1993) B 446 UNS N06625 (1993) B 444 UNS N06625 (1995) A 494 Grade CW-6MC (1993) A 494 Grade CX 2MW (1993)	Wrought fittings Pipes Forgings Plates Bars Pipes and tubes Castings
		Polymers including fibre reinforced	
P01 P11 P12 P13 P14 P21	1 1 1 1 1	UK00A Hudrogenated Nitrile (HNBR) Fluorocarbon terpolymer (FKM) Fluorocarbon low T terpolymer (FKM GLT) Nitrile PEEK (Poly-ether-ether-ketone) PTFE (Poly-tetra-fluoro-ethylene)	GRP pipes and fittings O-ring O-ring O-ring O-ring Back-up rings and seal inserts Lipseals,back-up rings
P23	1	PTFE (Poly-tetra-iluoro-ethylene) PEEK (Poly-ether-ether-ketone) with PTFE added	and seal inserts Seal inserts
			'

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R11	2	A 312 UNS S31254 (1995) A 358 UNS S31254 (1995) A 403 UNS S31254 (1996) A 182 Grade F44 (1996) A 240 UNS S31254 (1996) A 351 Grade CK-3McuN (1994)	Seamless pipes
R12	2		Welded pipes
R13	2		Wrought fittings
R14	2		Forgings
R15	2		Plates
R16	2		Castings
R16	2	A 351 Grade CK-3Mcun (1994)	Castings
R17	2	A 276 UNS S31254 (1996)	Bars
R18	2	A 269 UNS S 31254 (1996)	Tubes

Austenitic Stainless Steel Type 6Mo

Austenitic Stainless Steel Type 316

S01	2	A 312 Grade TP 316 (1995)	Seamless & welded pipes
S01	2	A 358 Grade 316 (1995)	Welded pipes
S01	2	A 403 Grade WP 316 (1996)	Wrought fittings
S01	2	A 182 Grade F 316 (1996)	Forgings
S01	2	A 240 Grade 316 (1996)	Plates
S02	2	A 351 Grade CF8M (1994)	Castings
S02	2	A 351 Grade CF3M (1994)	Castings

Titanium Grade 2

T01	2	B 861 Grade 2 (1995)	Seamless pipes
T01	2	B 862 Grade 2 (1995)	Welded pipes
T01	2	B 363 Grade WPT2/WPT2W (1995)	Wrought fittings
T01	2	B 381 Grade F2 (1995)	Forgings
T01	2	B 265 Grade 2 (1995)	Plates
T01	2	B 348 Grade 2 (1995)	Bars
T01	2	B 338 Grade 2 (1995)	Tubes
T02	2	B 367 Grade C2 (1993)	Castings

High Strength Low Alloy Steel

X01	1	A 519 AISI 4130 (1994)	Seamless pipes
		A 234 AISI 4130 (1996)	Wrought fittings
		·	(seamless)
X02	2	A 788 AISI 4140 (1994)	Forgings
X03	2	A 487 Grade 2B (1993)	Castings
X04	1	API 6A 60K (AISI 4130) (1996)	Forgings
X05	1	A 182 F22 (1996)	Forgings
X06	1	A 487 Grade 2B (-46 °C) (1993)	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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MATERIAL DA	TA SHEET	MI	OS - C01	Rev. 2		
TYPE OF MATERIAL: Ca	arbon Steel Type 2	35		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings Welded pipes	ASTM A 234 API 5L ASTM A 672	WPB B CC60, CC70	- t ≤ 19 mm: Class 12 t > 19 mm: Class 22	- - -		
Seamless pipes Forgings Plates	ASTM A 106 ASTM A 105 ASTM A 516	B - 60, 70	-	- - -		
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	Welded pipes to AF	PI 5L: Electric resist	tance welded pipes are not	acceptable.		
2. HEAT TREATMENT	Welded pipes to AF	PI 5L: Stress relievi	ng when the nominal thick	ness $t \ge 19$ mm.		
3. CHEMICAL COMPOSITION		10 %; Mn = 0.50 -	$\frac{c}{1.35\%; S \le 0.025 \%; P \le 0}$			
4. TEST SAMPLING	Samples for production component.	ction testing shall re	alistically reflect the prope	erties in the actual		
5.DIMENSIONAL TOLERANCES	Fittings to A 234:		rence to MSS-SP-75 shall ndertolerance of 0.3 mm.	have maximum		
	Flanges to A 105:	to A 105: Flanges to MSS-SP-44 shall have a maximum wall thickness under tolerance of 0.3 mm for the hub at the welding end.				
6. NON DESTRUCTIVE TESTING	Pipes to API 5L:	RT of weld sean remaining weld.	n or RT at ends and US/Ed	dy Current of the		
	Fittings to A 234:	UT is not accepta	able as replacement of RT.			
7. CERTIFICATION	EN 10 204 Type 3.	1B				

MATERIAL DA	TA SHEET	MDS	5 - C02	Rev. 2		
TYPE OF MATERIAL: (Carbon Steel Type 23.	5		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Castings	ASTM A 216	WCB	-	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	$C \le 0.22$ % and $CE =$	$C + Mn/6 + 0.04 \le 0$	0.43 for castings with b	utt weld ends.		
3. EXTENT OF TESTING	One set of tensile test is required for each melt and heat treatment load.					
4. TEST SAMPLING	Samples for mechanical testing shall realistically reflect the properties in components.					
	For castings with weight 250 kg and above the test blocks shall be into with the casting. The test blocks shall be heat treated together with the represents.					
5. NON DESTRUCTIVE TESTING						
6. CERTIFICATION	EN 10 204 Type 3.1B	i.				

MATERIAL DAT	TA SHEET	MI	OS - C11	Rev. 2	
TYPE OF MATERIAL: Ca	rbon Steel Type 23:	5LT		Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings	ASTM A 420	WPL 6	-	S2,S4	
Welded pipes	ASTM A 671	CC60, CC70	t ≤ 19 mm: Class 12	S2, S7	
			t > 19 mm: Class 22	S2, S7	
Seamless pipes	ASTM A 333	6	-	-	
Forgings	ASTM A 350	LF2	Class 1	S7	
Plates	ASTM A 516	70		S5	
1. SCOPE 2. CHEMICAL COMPOSITION	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. $C \le 0.22 \%$; $Mn = 0.50 - 1.35 \%$; $S \le 0.025 \%$; $P \le 0.030 \%$;				
	CE = C + Mn/6 + 0	$CE = C + Mn/6 + 0.04 \le 0.43.$			
4. EXTENT OF TESTING	1 1 V	The minimum absorbed et 20 J single. Reduction factors 5 mm - 2/3. Equirement S2 shall apply all be carried out to the same	tors for subsize		
	Pipes to A 671:	testing (S2). Supplementary reas tensile testing.	equirement S2 shall apply	to the same extent	
	Forgings to A 350:	as tensile testing. A 350: One set of tensile and impact testing shall be carried of each heat and heat treatment load. A test lot shall not € 2000 kg for forgings with as forged weight ≤ 50 kg, an 5000 kg for forgings with as forged weight > 50 kg.			
5. TEST SAMPLING	All products: Fittings to A 420: Forgings to A350:				
6. DIMENSIONAL TOLERANCES	Flanges to A 350:	Fittings with refere thickness under to Flanges to MSS S	extraction of test specime ence to MSS SP-75 shall lerance of 0.3 mm in acco P-44 shall have a maximu 0.3 mm for the hub at the	have maximum wall ordance with standard am wall thickness	

MATERIAL DA	ATA SHEET	M	DS - C11	Rev. 2	
TYPE OF MATERIAL:	Page 2 of 2				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Wrought fittings	ASTM A 420	WPL 6	-	S2,S4	
Welded pipes	ASTM A 671	CC60, CC70	t ≤ 19 mm: Class 12	S2, S7	
			t > 19 mm: Class 22	S2, S7	
Seamless pipes	ASTM A 333	6	-	-	
Forgings	ASTM A 350	LF2	Class 1	S7	
Plates	ASTM A 516	70		S5	
		apply to 10 % of a mechanical testing of all fittings for a be carried out after ASME VIII, Div. D:Supplementary Reapply to 10 % of a mechanical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII, Div. 1, Appendix 10 % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine VIII % of a polytonical testing after final machine view final testing after final machine view final testing after final machine vi	equirement S7.1, magnetic all forgings (same test lot a g) with NPS > 2. The testing. The acceptance criteriendix 6.	defined for < 12.7mm and 100 % mm. The testing shance criteria shall be to particle testing shall as defined for ng shall be carried ou	
8. REPAIR OF DEFECTS	•	se material is not a	*		
9. MARKING	Heat treatment load number shall be permanently marked on the component where testing is required per. heat treatment load.				
10. CERTIFICATION	EN 10 204 Type should be stated i		nt temperature, soaking tim	e and cooling medium	

MATERIAL DA	TA SHEET	M	DS - C12	Rev. 2	
<i>TYPE OF MATERIAL:</i> C	arbon Steel Type 23	5LT		Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CL	ASS SUPPL. REQ.	
Castings	ASTM A 352	LCC	-	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	$C \le 0.22 \%$; $S \le 0.025 \%$; $P \le 0.030 \%$;				
	CE = C + Mn/6 + (C	r+Mo+V)/5+(C	$(u+Ni)/15 \le 0.43$		
3. IMPACT TESTING	The minimum absort single.	bed energy for fu	ll size specimens shal	l be 27 J average and 20 J	
4. EXTENT OF TESTING	One set of tensile and	d impact test is re	equired for each melt	and heat treatment load.	
	A test lot shall not exceed 5 000 kg.				
	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 from the 1/4 T location from the surface where T is the thickness of the test block.				
			gated onto the castings quality heat treatment	s and shall not be removed.	
6. NON DESTRUCTIVE TESTING	surfaces of all castin	gs. The testing sl	• •	shall apply to all accessible or final machining. The x 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. 				
7. REPAIR OF DEFECTS.	A cast plate shall be	used in the quali	fication of the repair v	welding procedure.	
8. MARKING	The component shall lot.	be marked to en	sure full traceability t	o melt and heat treatment	
9. CERTIFICATION	EN 10 204 Type 3.11 shall be stated in the		t temperature, soaking	time and cooling medium	

MATERIAL DA	TA SHEET	MD	S - C21	Rev. 2		
TYPE OF MATERIAL: C	Carbon Steel Type 3	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			in the referred standard an ersede the corresponding			
2. CHEMICAL COMPOSITION	Ti $\leq 0.05 \%$; Nb ≤ 0	0.04% ; Al $\leq 0.06 \%$; N	0-0.50 %; S \le 0.025 %; P N \le 0.015 %; V+Nb+Ti \le 0+V)/5 + (Cu+Ni)/15 \le 0.4	0.10 %;		
3. IMPACT TESTING	thicknesses ≥ 6 mm average and 30 J sin and 5 mm - 2/3.	n. The minimum absorngle. Reduction factor	"M A 370 at - 46 °C is requested energy for full size spaces for subsize specimens sl	hall be: 7.5 mm - 5/6		
4. EXTENT OF TESTING	Forgings to A 694: One set of tensile and impact testing shall be carried ou for each heat and heat treatment load. A test lot shall not exceed 2000 kg for forgings with as forged weigth ≤ 50 kg, and 5000 kg for forgings with as forged weigth > 50 kg.					
5. TEST SAMPLING	All products: Samples for production testing shall realistically reflect the properties in the actual component. Forgings to A694: 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. Test specimens shall be cut at the 1/4 T location from the surface where T is the thickness of the test samples as heat treated. Sketches shall be established showing type, size and location of test samples and extraction of test specimens.					
6. WELDING		The WPQ shall be qua 288-3.	lified in accordance with	ASME IX or EN		
7. DIMENSIONAL TOLERANCES	Flanges to A 694:	tings to A 860: Fittings with reference to MSS-SP-75 shall have maximum wall thickness under tolerance of 0.3 mm. nges to A 694: Flanges to MSS-SP-44 shall have a maximum wall thickness under tolerance of 0.3 mm for the hub at the welding end.				
8. NON DESTRUCTIVE TESTING	Fittings to A 860: Forgings to A 694:	Supplementary require to 10 % of all fittings testing) for nominal the for nominal thicknesse after calibration. 10 % of all forgings was mechanical testing) shas MSME V Article 7. The	ement S4, magnetic partic (same test lot as defined ficknesses < 12.7 mm and es ≥ 12.7 mm. The testing with NPS > 2 (same test lot all be magnetic particle to the testing shall be carried	le testing, shall apply for mechanical 100 % of all fittings shall be carried out as defiend for esting according to		
		machining. The acceptance criteri	a shall be to ASME VIII l	Div. 1, Appendix 6.		

MATERIAL DA	TA SHEET	MD	S - C21	Rev. 2
TYPE OF MATERIAL: C	arbon Steel Type 360	OLT		Page 2 of 2
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Wrought fittings Forgings		WPHY 52 F52	Seamless and welded -	
9. REPAIR OF DEFECTS	Weld repair of base m	naterial is not accept	able.	
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 should be stated in the		nperature, soaking time an	nd cooling medium

MATERIAL DA	TA SHEET	N	IDS - C22	Rev. 2	
TYPE OF MATERIAL: (Page 1 of 1				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	API 5L	X52	-	SR 4.3	
I. SCOPE			ons in the referred stan	dard and additional onding requirements in the	
2. STEEL MAKING	Fine grain treatmen	t shall be carried	out.		
3. HEAT TREATMENT/ DELIVERY CONDITION	Normalised or Quer	nched and Tempe	red.		
4. CHEMICAL COMPOSITION	$C \le 0.16\%$; $Mn = 0.90 - 1.60\%$; $Si = 0.10 - 0.50\%$; $S \le 0.025\%$; $P \le 0.035\%$; $Ti \le 0.05\%$; $Nb \le 0.04\%$; $Al \le 0.06\%$; $N \le 0.015\%$; $V + Nb + Ti \le 0.10\%$; $V + Nb \le 0.07\%$; $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Cu + Ni)/15 \le 0.43$				
5. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 6 mm. The minimum absorbed energy for full size specimens shall be 40 J average and 30 J single. Reduction factors for subsize specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
6. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual component.				
7. NON DESTRUCTIVE TESTING	Supplementary requirement SR 4.3 with notch calibration of 5 % of the nominal wall thickness shall apply for all thicknesses.				
8. SURFACE FINISH	The surface finish shall comply with ASTM A 106 para. 18.3.2.				
9. REPAIR OF DEFECTS	Weld repair is not a	cceptable.			
10. CERTIFICATION	EN 10 204 Type 3.1	1B			

MATERIAL DA	TA SHEET	N	IDS - D41	Rev. 2	
<i>TYPE OF MATERIAL:</i> F	erritic / Austenitic	Stainless Steel,	Type 22Cr duplex	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	ASTM A 790	UNS S 31803	-	-	
1. SCOPE	•	•	ons in the referred stand r supersede the correspo	ard and additional nding requirements in the	
2. QUALIFICATION	Manufacturers of pr Standard M-650.	roduct to this MD	S shall comply with the	requirement of NORSOK	
3. STEEL MAKING	The steel melt shall	be refined with A	AOD or equivalent.		
4. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
5. HARDNESS	The hardness shall b	oe maximum 28 I	HRC or alternatively 271	HB or 290 HV10.	
6. IMPACT TESTING	Charpy V-notch testing (3 specimens) according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for subsize 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		ed in the referred	standard. For batch furi	testing shall be carried out nace charges the specified	
9. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.				
10. SURFACE FINISH	White pickled.				
11. REPAIR OF DEFECTS	Weld repair is not acceptable.				
12. MARKING	The component shallot.	ll be marked to en	nsure full traceability to	melt and heat treatment	
13. CERTIFICATION	EN 10 204 Type 3.1 should be stated in t		nt temperature, soaking t	ime and cooling medium	

MATERIAL DA	TA SHEET	N	IDS - D42	Rev. 2		
<i>TYPE OF MATERIAL:</i> F	erritic/Austenitic S	tainless Steel, 7	Type 22Cr duplex	Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Welded pipes	ASTM A 928	UNS S31803	Class 1, 3 and 5	S3		
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 prestandard 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	be refined with	AOD or equivalent.			
4. HEAT TREATMENT	The pipes shall be s	olution annealed	followed by water quer	nching.		
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. TENSILE TESTING	Base material prope	erties: $R_{p0.2} \ge 450$	MPa; $R_m \ge 620$ MPa;	A ≥ 25 %.		
7. HARDNESS	The hardness shall material, HAZ and		HRC or alternatively 27	1 HB or 290 HV10 for base		
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 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 subsize 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 25-60 % for weld metal. The microstructure, as examined at 400 X magnification on a					
10. EXTENT OF TESTING	 suitably etched specimen, shall be free from intermetallic phases and precipitates. 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	***	tion testing shall	realistically reflect the	properties in the actual		
12. 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.					
13. TOLERANCES	The pipes shall have	e a max. underto	erance of 0.3 mm.			
14. NON DESTRUCTIVE TESTING	radiography for wal	ll thicknesses less	s than 4.0 mm.	e as replacement for spot		
	apply to the weld artesting) delivered.	rea of 10 % of the The testing shall b	etrant testing, according e pipes (same test lot as be carried out after calib E VIII, Div. 1 Appendix	ration and pickling.		

MATERIAL DA	TA SHEET	· N	IDS - D42	Rev. 2		
TYPE OF MATERIAL: 1	Ferritic/Austenitic S	Stainless Steel, T	Type 22Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Welded pipes	ASTM A 928	UNS S31803	Class 1, 3 and 5	S3		
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 marked to ensure full traceability to melt and heat treatment lot.					
18. CERTIFICATION	EN 10 204 Type 3. should be stated in		nt temperature, soaking	time and cooling medium		

MATERIAL DA	TA SHEET	' N	IDS - D43	Rev. 2		
<i>TYPE OF MATERIAL:</i> F	Perritic / Austenitic	Stainless Steel,	Type 22Cr duplex	Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings	ASTM A 815	UNS S 31803	WP-W, WP-S or WP-WX	S7		
1. SCOPE	_	_	ons in the referred standard an r supersede the corresponding			
2. QUALIFICATION	Manufacturers of pastandard 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	be refined with A	AOD or equivalent.			
4. HEAT TREATMENT	The fittings shall be	e solution anneale	d followed by water quenching			
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. HARDNESS	The hardness shall material, HAZ and		HRC or alternatively 271 HB o	r 290 HV10 for base		
7. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 6 mm. The minimum absorbed energy shall be 45 J average and 35 J single. Reduction factors for subsize 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 set, 3 specim	en.			
	Welded fittings:	Two sets, each 3	specimen, located in weld meta	al and fusion line.		
8. MICROGRAPHIC EXAMINATION	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 25 - 60 % 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	· •	eat treatment load	t and microstructure examinati I within a wall thickness range			
10. TEST SAMPLING	Samples for produc components.	tion testing shall	realistically reflect the propert	ies in the actual		
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.					
12. DIMENSIONAL TOLERANCES	Fitting with reference to MSS-SP-75 shall have maximum wall thickness under tolerance of 0.3 mm.					
13. NON DESTRUCTIVE TESTING	seamless (from the 2. The testing shall	test lot as defined be carried out aft	d penetrant testing, shall apply above) and 100 % of welded er calibration and pickling. For exaceptance criteria shall be A	fittings above NPS r welded fittings the		

MATERIAL DA	ATA SHEET	N	IDS - D43	Rev. 2		
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings	ASTM A 815	UNS S31803	WP-W, WP-S or WP-WX	S7		
14. SURFACE FINISH	White pickled. Mac	hined surfaces do	not require pickling.			
15. 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.				
16. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
17. CERTIFICATION	EN 10 204 Type 3.1 should be stated in		nt temperature, soaking time ar	nd cooling medium		

MATERIAL DA	TA SHEET	N	DS - D44	Rev. 2	
<i>TYPE OF MATERIAL:</i> F	Serritic / Austenitic	Stainless Steel, '	Type 22Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Forgings	ASTM A 182	F51	-	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. QUALIFICATION	Manufacturers of pr Standard M-650.	oduct to this MD	S shall comply with the re	equirement of NORSOK	
3. STEEL MAKING	The steel melt shall	be refined with A	AOD or equivalent.		
4. MANUFACTURING PROCESS	The Hot Isostatic Pr	ressed (HIP) proc	ess is an acceptable alterr	native to forging.	
5. HEAT TREATMENT	The forgings shall b	e solution anneal	ed followed by water que	enching.	
6. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
7. HARDNESS	The hardness shall b	be less than 28 HI	RC (or alternatively 271 I	HB or 290 HV10).	
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 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	specimens for mech shall be determined %. The microstructu	anical. The area s according to AST are, as examined a	be carried out at the same shall be minimum 10 x 10 FM E 562 or equivalent a at 400 X magnification or tallic phases and precipita	mm. The ferrite content nd shall be within 35 - 55 n a suitably etched	
10. 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. A test lot shall not exceed 2000 kg for forgings with as forged weight \leq 50 kg, and 5000 kg for forgings with as forged weight $>$ 50 kg.				
11. TEST SAMPLING	Samples for product components.	tion testing shall	realistically reflect the pro	operties 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 die forged components with as forged weight exceeding 50 kg. Integrated test blocks shall be used for HIP.				
	thickness of the test	samples as heat t	T location from the surface treated. Sketches shall be s and extraction of test sp	established showing	
12. DIMENSIONAL TOLERANCES	Flanges to MSS SP- for the hub at the we		ximum wall thickness und	der tolerance of 0.3 mm	

MATERIAL DA	TA SHEET	M	IDS - D44	Rev. 2		
<i>TYPE OF MATERIAL:</i> F	erritic / Austenitic S	Stainless Steel, '	Гуре 22Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Forgings	ASTM A 182	F51	-	S5		
13. NON DESTRUCTIVE TESTING	Supplementary requirement S5, liquid penetrant testing, shall apply to 10 % of forgings (from the lot as defined for mechinical 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.					
14. SURFACE FINISH	White pickled. Machined surfaces do not require pickling.					
15. REPAIR OF DEFECTS	Weld repair is not acceptable.					
16. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
17. CERTIFICATION	EN 10 204 Type 3.1 should be stated in t		t temperature, soaking time an	d cooling medium		

MATERIAL DA	TA SHEET	N	IDS - D45	Rev. 2		
TYPE OF MATERIAL: Fo	: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex Page 1 of 1					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Plates	ASTM A 240	UNS S 31803	-	-		
1. SCOPE	_	_	ons in the referred standard ar supersede the corresponding			
2. QUALIFICATION	Manufacturers of pr Standard M-650.	oduct to this MD	S shall comply with the require	rement of NORSOK		
3. STEEL MAKING	The steel melt shall	be refined with A	AOD or equivalent.			
4. HEAT TREATMENT	The plates shall be s	olution annealed	followed by water quenching			
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %					
6. HARDNESS	The hardness shall b	e maximum 28 I	HRC or alternatively 271 HB of	or 290 HV10.		
7. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 6 mm. 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.					
8. 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.					
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 testing shall realistically reflect the properties in the actual components.					
11. SURFACE FINISH	White pickled.					
13. REPAIR OF DEFECTS	Weld repair is not acceptable.					
14. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
15. CERTIFICATION	EN 10 204 Type 3.1 should be stated in t		nt temperature, soaking time a	nd cooling medium		

MATERIAL DA	TA SHEET	\mathbf{N}	DS - D46	Rev. 2			
TYPE OF MATERIAL: I	Ferritic / Austenitic	Stainless Steel, '	Гуре 22Cr duplex	Page 1 of 2			
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.			
Castings	ASTM A 890	4 (UNS J9225)	-	S2, S3, S33			
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 prestandard M-650.	oduct to this MD	S shall comply with the re	equirement of NORSOK			
3. STEEL MAKING	The steel melt shall	be with AOD or	equivalent refining.				
4. HEAT TREATMENT	The castings shall b	e solution anneal	ed followed by water quer	nching.			
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %						
6. HARDNESS	The hardness shall b	be maximum 28 H	IRC or alternatively 271 I	HB or 290 HV10.			
7. IMPACT TESTING	~ *	•	ecording to ASTM A 370 erage and 35 J single.	at - 46 °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 withi 35-55 %. The microstructure, as examined at 200 X and 400 X magnification on a suitably etched specimen, shall be free from intermetallic phases and precipitates.						
9. EXTENT OF TESTING			crostructure examinations ot shall not exceed 5 000 l				
10. 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 thickness of the test		1/4 T location from the su	rface where T is the			
			gated onto the castings an quality heat treatment.	d shall not be removed			
12. NON DESTRUCTIVE TESTING	Liquid penetrant testing: Supplementary requirement S3 shall apply to all accessible surfaces of all castings. The examination shall be carried out after final machining. Non-machined surfaces shall be pickled prior to the testing. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.						
	 Radiographic testing: Supplementary requirement S2 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 crite	eria shall be to AS	SME VIII, Div. 1 Append	ix 7.			

MATERIAL DA	TA SHEET	M	DS - D46	Rev. 2	
TYPE OF MATERIAL:	Page 2 of 2				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 890	4 (UNS J9225)	-	S2, S3, S33	
13. SURFACE FINISH	White pickled. Mac	hined surfaces do	not require pickling.		
14. REPAIR OF DEFECTS	Supplementary requirement S33 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 25-60 % 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.				
15. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
16. CERTIFICATION	EN 10 204 Type 3.1 should be stated in t		t temperature, soaking time ar	nd cooling medium	

MATERIAL DA	TA SHEET	N	IDS - D47	Rev. 2	
<i>TYPE OF MATERIAL:</i> F	**E OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Bars	ASTM A 276	UNS S 31803	-	-	
1. SCOPE	_	_	ons in the referred standard an r supersede the corresponding		
2. QUALIFICATION	Manufacturers of pr Standard M-650.	oduct to this MD	S shall comply with the requir	rement of NORSOK	
3. STEEL MAKING	The steel melt shall	be refined with A	AOD or equivalent.		
4. HEAT TREATMENT	The bars shall be so	lution annealed f	ollowed by water quenching.		
5. CHEMICAL COMPOSITION	N = 0.14 - 0.20 %				
6. HARDNESS	The hardness shall b	oe maximum 28 I	HRC or alternatively 271 HB o	r 290 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 speciemns 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	Impact test, hardness test and micrographic examination shall be carried out to the same extent as tensile test.				
10. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual components.				
11. SURFACE FINISH	White pickled. Macl	hined 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	EN 10 204 Type 3.1 should be stated in t		it temperature, soaking time ar	nd cooling medium	

MATERIAL DA	TA SHEET	MDS	- D48	Rev. 2	
<i>TYPE OF MATERIAL:</i> F	Ferritic / Austenitic Stainless Steel, Type 22Cr duplex Page 1				
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Tubes	ASTM A 789	UNS S 31803	-	-	
1. SCOPE	This MDS specifies the requirements which shall the referred standard.	•			
2. QUALIFICATION	Manufacturers of prod NORSOK Standard M		comply with the requ	irement of	
3. STEEL MAKING	The steel melt shall be	refined with AOD or	equivalent.		
4. HEAT TREATMENT	The tubes shall be solu	tion annealed follower	ed 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 (3 specimens) according to ASTM A 370 at - 46 $^{\circ}$ C is required for the thicknesses \geq 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for subsize 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.				
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. medium should be state		erature, soaking time a	and cooling	

MATERIAL DA	TA SHEET	MDS	5 - D 51	Rev. 2	
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 25Cr duplex Pa					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	ASTM A 790	UNS S 32550 UNS S 32750 UNS S 32760	-	-	
I. SCOPE	requirements which sl the referred standard.	hall be added or supe This MDS is based o	the referred standard a ersede the corresponding on the mechanical prope x listed in ASME B31.3	g requirements in erties of UNS S	
2. QUALIFICATION	Manufacturers of prod NORSOK Standard M		ll comply with the requ	irement of	
3. STEEL MAKING	The steel melt shall be	e refined with AOD	or equivalent.		
4. HEAT TREATMENT	The pipes shall be sol	ution annealed follow	wed by water quenching	5.	
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3 % M	$(10 + 16 \% N) \ge 40.0$			
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa; } R_{m}$	≥ 800 MPa;			
7. HARDNESS	The harness shall be r	max. 32 HRC (or alte	rnatively 301 HB or 33	0 HV 10).	
8. IMPACT TESTING	Charpy V-notch testing (3 specimen) according to ASTM A 370 at - 46 °C is required for thicknesses \geq 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for subsize 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.				
		ll be less than 4.0 g/r	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	be carried out for each	n lot as defined in the	ardness, corrosion and to referred standard. For out for each heat treatn	batch furnace	

MATERIAL D	ATA SHEET	Γ MD	S - D51	Rev. 2	
TYPE OF MATERIAL:	Ferritic / Austenitic	Stainless Steel, Typ	oe 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	-	-	
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.				
15. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
15. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
16. CERTIFICATION		.1B. Heat treatment ten stated in the certificat	mperature, soaking time e.	and cooling	

MATERIAL DA	TA SHEET	MI	DS - D52	Rev. 2	
TYPE OF MATERIAL: Fer	ritic / Austenitic Stai	inless Steel, Type 25	Cr 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	-	
I. SCOPE	requirements which the referred standar	shall be added or sud. This MDS is base	s in the referred standard apersede the corresponded on the mechanical proposex listed in ASME B3	ing requirements in operties of UNS S	
2. QUALIFICATION	Manufacturers of property NORSOK Standard		shall comply with the re-	quirement of	
3. STEEL MAKING	The steel melt shall	be refined with AO	D or equivalent.		
4. HEAT TREATMENT	The pipes shall be s	solution annealed fol	lowed by water quenchi	ing.	
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3 %	$Mo + 16 \% N) \ge 40$	0.0		
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa; R}$	$_{\rm m} \ge 795 \text{ MPa; A} \ge 13$	5 %		
7. HARDNESS	The hardness shall be maximum 32 HRC (or alternatively 301 HB or 330 HV10) fo base material, HAZ and weld metal.				
8. IMPACT TESTING	thicknesses ≥ 6 mm single. Two sets, ea	The minimum absorbed 3 specimens, share, respectively. Redu	STM A 370 at - 46 °C is orbed energy shall be 45 ll be carried out with no action factors for subsize	J average / 35 J tch located in weld	
9. CORROSION TEST	Corrosion test according to ASTM G 48 Method A is required. Test the shall be 50 °C and the exposure time 24 hours. The specimen shall have and external surfaces in the as-delivered condition (including pickling shall be prepared according to ASTM G48, and the whole specimen so (20 % HNO3 + 5 % HF, 60 °C, 5 minute). The test shall expose the einternal surfaces and a cross section surface including weld zone in furthickness. The acceptance criteria are:				
	- No pitting at 20 X	_	g/m^2		
10. MICROGRAPHIC EXAMINATION	- The weight loss shall be less than 4.0 g/m ² 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 55 % for base material and 25-60 % for weld metal. The microstructure, as examined at 400 X magnification on a suitably etched specimen, shall be free freintermetallic phases and precipitates.				
11. EXTENT OF TESTING	out for each lot. The	e lot is defined as force a lot is defined as	d microstructure examin llows: maximum 60 m of pipe		
		C	cce the lot definition in p	para 8.1 of the ASTM	

MATERIAL D	ATA SHEE	T MI	DS - D52	Rev. 2			
<i>TYPE OF MATERIAL:</i> F	Page 2 of 2						
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS S					
Welded pipes	ASTM A 928	UNS S 32550 UNS S 32750 UNS S 32760	Class 1, 3 and 5	-			
12. TEST SAMPLING	Samples for producomponents.	action testing shall rea	alistically reflect the proj	perties 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.						
14. TOLERANCES	The pipes shall ha	ave a max. undertolera	ance of 0.3 mm.				
15. NON DESTRUCTIVE TESTING		Eddy current testing according to ASTM A 450 is acceptable as replacement for spot radiography for wall thicknesses 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 testing shall be carried out after calibration and pickling. Acceptance criteria shall be to ASME VIII, Div 1, Appendix 8.						
16. SURFACE FINISH	White pickled.						
17. 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.						
18. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.						
19. CERTIFICATION	• •	31.B. Heat treatment to stated in the certification.	emperature, soaking tim	e and cooling			

MATERIAL D	ATA SHEE		MIDS - D53	Rev. 2	
TYPE OF MATERIAL: I	Ferritic / Austenitic S	Stainless Steel, Typ	pe 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	
I. SCOPE	_	ich shall be added o	ions in the referred standard are supersede the corresponding		
2. QUALIFICATION	Manufacturers of NORSOK Standa	_	OS shall comply with the requi	rement of	
3. STEEL MAKING	The steel melt sh	all be refined with	AOD or equivalent.		
4. HEAT TREATMENT	Solution annealir	ng followed by wate	er quenching.		
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3	% Mo + 16 % N) ≥	≥ 40.0		
6. TENSILE TESTING	Base material pro	operties: $R_{p0.2} \ge 55$	60 MPa ; R_m ≥ 800 MPa ;		
7. HARDNESS		all be maximum 32. AZ and weld metal.	HRC (or alternatively 301 HB	or 330 HV10) for	
8. IMPACT TESTING	Charpy V-notch testing according to ASTM A 370 at - 46 °C is required for the thicknesses ≥ 6 mm. The minimum absorbed energy shall be 45 J average / 35 J single. Reduction factors for subsize 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 set, (3 specimens). Welded fittings: Two sets, (each 3 specimen) located in weld metal and fusion				
9. CORROSION TEST	shall be 50 °C an and external surfashall be prepared (20 % HNO3 + 5 internal surfaces thickness. The ac	d the exposure time aces in the as-delive according to ASTM 4 % HF, 60 °C, 5 mi and a cross section eceptance criteria ar 20 X magnification.		have the internal ling). Cut edges en shall be pickled external and	
10. MICROGRAPHIC EXAMINATION	- The weight loss shall be less than 4.0 g/m². 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 25-60 % 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	examination shal	l be carried out for	ness testing, corrosion testing a each heat and heat treatment lo l with the same WPS.		

MATERIAL D	ATA SHE	ET I	MDS - D53	Rev. 2		
TYPE OF MATERIAL: I	Ferritic / Austenitic	Stainless Steel, Typ	pe 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 W	P-W S7		
12. TEST SAMPLING	Samples for proc	luction testing shall	realistically reflect the pr	operties 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.					
14. DIMENSIONAL TOLERANCES	Fittings with refetolerance of 0.3		75 shall have maximum wa	all thickness under		
15. NON DESTRUCTIVE TESTING	seamless (from t 2. The examinati fittings the exam	Supplementary requirements S7, liquid penetrant examination, 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 acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.				
16. SURFACE FINISH	White pickled.					
17. 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.				
18. MARKING	The component slot.	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
19. CERTIFICATION		3.1B. Heat treatme in the certificate.	ent temperature, soaking ti	me and cooling medium		

MATERIAL D	ATA SHEE	T MD	S - D54	Rev. 2		
TYPE OF MATERIAL	: Ferritic/Austeniti	c Stainless Steel, Type	25Cr duplex	Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Forgings	ASTM A 182	- UNS S 32550 F53 - UNS S 32750 F55 - UNS S 32760	-	S5		
I. SCOPE	requirements whi	ies the selected options in the shall be added or supe lard. This MDS is based on the only Type 25 Cr duple	ersede the correspondir on the mechanical prop	ng requirements in perties of UNS S		
2. QUALIFICATION	Manufacturers of NORSOK Standa	product to this MDS shand M-650.	all comply with the requ	uirement of		
3. STEEL MAKING	The steel melt sha	all be refined with AOD	or equivalent.			
4. MANUFACTURING PROCESS	The Hot Isostatic	Pressed (HIP) process is	an acceptable alternati	ive to forging.		
5. HEAT TREATMENT	Solution annealing	ng followed by water quer	nching.			
6. CHEMICAL COMPOSITION	PRE (% Cr + 3.3	% Mo + 16 % N) ≥ 40.0				
7. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa};$	$R_{\rm m} \ge 800 \text{ MPa}; A \ge 15 \text{ g}$	%.			
8. HARDNESS	The hardness sha	ll be less than 32 HRC (o	or alternatively 301 HB	or 330 HV10).		
9. IMPACT TESTING	thicknesses ≥ 6 m shall satisfy 45 J	Charpy V-notch testing according to ASTM A 370 at -46 °C is required for the thicknesses ≥ 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 mm - 2/3.				
10. MICROGRAPHIC EXAMINATION	specimens for me ferrite content shabe within 35 -55	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	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.					
	_	ss shall be less than 4.0 g	v/m^2			
12. EXTENT OF TESTING	One set of impact examination shall not exceed 2000	t, tensile, hardness, corrol be carried out for each has for forgings with as forged weight > 50 kg.	sion testing and micros	load. A test lot shall		

MATERIAL DA	ATA SHEE	T MD	S - D54	Rev. 2		
TYPE OF MATERIAL:	Ferritic/Austenitic	Stainless Steel, Type	25Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS				
Forgings	ASTM A 182	- UNS S 32550 F53 - UNS S 32750 F55 - UNS S 32760	-	S5		
13. TEST SAMPLING	Samples for producomponents.	action testing shall realis	tically reflect the proper	rties in the actual		
	shall be used for d	be from prolongations of the forged components. In ponents with as forged and for HIP.	However, special agreen	nents may be made		
	Test specimens shall be cut at the ¼ T location from the surface where T is the thickness of the test samples as heat treated. Sketches shall be established showing type, size and location of test samples and extraction of test specimens.					
14. DIMENSIONAL TOLERANCES	Flanges to MSS S for the hub at the	P-44 shall have maximum welding end.	m wall thickness under	tolerance of 0.3 mm		
15. NON DESTRUCTIVE TESTING	Supplementary requirement S5, 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.					
16. SURFACE FINISH	White pickled incl	luding machined surface	s.			
17. REPAIR OF DEFECTS	Weld repair is not acceptable.					
18. MARKING	The component shot.	The component shall be marked to ensure full traceability to melt and heat treatment				
19. CERTIFICATION	EN 10 204 Type 3 should be stated in	3.1B. Heat treatment temn the certificate.	perature, soaking time a	and cooling medium		

MATERIAL DA	TA SHEET	Μ	DS - D55	Rev. 2		
TYPE OF MATERIAL: Fe	erritic/Austenitic	Stainless Steel, Typ	pe 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	requirements which the referred standard	ch shall be added or sard. This MDS is bas	ns in the referred standard supersede the correspondi sed on the mechanical pro uplex listed in ASME B 3	ng requirements in perties of UNS S		
2. QUALIFICATION	Manufacturers of NORSOK Standar		shall comply with the rec	quirement of		
3. STEEL MAKING	The steel melt sha	ll be refined with A	OD or equivalent.			
4. HEAT TREATMENT	Solution annealing	g followed by water	quenching.			
5. CHEMICAL COMPOSITION	PRE (%Cr + 3.3 %	% Mo + 16 % N) ≥ 4	0.0.			
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa};$	$R_{\rm m} \ge 750 \text{ MPa; A} \ge$	15%.			
7. HARDNESS	The hardness shal	l be maximum 32 HI	RC or alternatively 301 H	B or 330 HV10.		
8. 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 / 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 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.					
11. EXTENT OF TESTING	Test samples for i	-	structure, hardness, corrosat and heat treatment lot.	sion and tensile		
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	Repair welding is	not acceptable.				
15. MARKING	The component shot.	The component shall be marked to ensure full traceability to melt and heat treatment				
16. CERTIFICATION	EN 10 204 Type 3 should be stated in		temperature, soaking time	e and cooling medium		

MATERIAL DA	TA SHEET	MI)S - D56	Rev. 2	
TYPE OF MATERIAL: Fo	erritic/Austenitic Sta	ainless Steel, Type	25Cr duplex	Page 1 of 2	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM A 890	UNS J93404 UNS J93380	-	S2, S3, S33	
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 pro NORSOK Standard		hall be qualified in acc	ordance with	
3. STEEL MAKING	The steel melt shall	be refined with AOI	O or equivalent process	S.	
4. HEAT TREATMENT	According to Grade	5A (UNS J93404).			
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3 %	$Mo + 16 \% N) \ge 40$.0.		
6. TENSILE TESTING	$R_{p0.2} \ge 450 \text{ MPa; } R_n$	$_{\rm n} \ge 700 \text{ MPa; A} \ge 13$	5 %.		
7. HARDNESS	The hardness shall b	e less than 32 HRC	(or alternatively 301 H	(B or 330 HV10).	
8. IMPACT TESTING	~ *	•	rding to ASTM A 370 a 45 J average / 35 J sing		
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.				
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				
	- The weight loss sh	nall be less than 4.0	g/m ² .		
11. EXTENT OF TESTING			ests and microstructure t charge. A test lot sha		
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 cut from the 1/4 T location from the surface where T is the thickness of the test block.				
			ed onto the castings and final quality heat treat		

MATERIAL DA	ATA SHEET	ME)S - D56	Rev. 2		
TYPE OF MATERIAL:	Ferritic/Austenitic St	ainless Steel, Type	25Cr duplex	Page 2 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Castings	ASTM A 890	UNS J93404 UNS J93380	-	S2, S3, S33		
13. NON DESTRUCTIVE TESTING	accessible surfaces	of all castings. The to	requirement S3 shall a esting shall be carried of criteria shall be ASMI	out after final		
	Radiographic testin	g: Supplementary re	quirement S2 shall app	ly to:		
	- All butt weld ends	of each casting	ne pilot cast of each patereas to ANSI B16.34 or			
	The acceptance crite	eria shall be to ASM	E VIII, Div. 1 Appendi	x 7.		
14. SURFACE FINISH	White pickled shall machined surfaces.	White pickled shall be carried out after any blasting and shall include finished machined surfaces.				
15. REPAIR OF DEFECTS	be qualified in accor	_	oply. The repair welding X or EN 288-3 and this clude the following:			
	- qualified on a cast	plate of the same gra	ade (UNS number) whi	ch shall be welded		
	- change of specific	make of filler metal	(brand names) requires	s requalification		
			material and weld zone naterial and 25 - 60 % f			
		- 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 sp	- corrosion test as specified above. The specimen shall include weld zone.				
16. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
17. CERTIFICATION	EN 10 204 Type 3.1 medium should be s		emperature, soaking time.	e and cooling		

MATERIAL DA	TA SHEET	M	DS - D57	Rev. 2	
TYPE OF MATERIAL: Fe	erritic/Austenitic S	Stainless Steel, Typ	pe 25Cr duplex	Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Bars	ASTM A 276	UNS S 32550 UNS S 32750 UNS S 32760	-	-	
I. SCOPE	requirements which in the referred stan	h shall be added or soldard. This MDS is b	ns in the referred standar supersede the correspond based on the mechanical duplex listed in ASME	ding requirements properties of UNS	
2. QUALIFICATION	Manufacturers of p NORSOK Standar		shall comply with the re	equirement in	
3. STEEL MAKING	The steel melt shall	ll be refined with AC	OD or equivalent.		
4. HEAT TREATMENT	Solution annealing	g followed by water	quenching.		
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3 %	$\% \text{ Mo} + 16 \% \text{ N}) \ge 4$	10.0.		
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa; I}$	$R_{\rm m} \ge 800 \text{ MPa; A} \ge$	15 %.		
7. HARDNESS	The hardness shall	be less than 32 HR	C (or alternatively 301 H	IB or 330 HV10).	
8. 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 / 35 J single.				
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	0 g/m^2 .		
11. EXTENT OF TESTING	•		structure, hardness, correat and heat treatment lot		
12. TEST SAMPLING	Samples for produ actual components	-	ealistically reflect the pro	operties in the	
15. SURFACE FINISH	White pickled				
16. REPAIR OF DEFECTS	Weld repair is not	acceptable.			
17. MARKING	The component sh treatment lot.	all be marked to ens	sure full traceability to m	elt and heat	
18. CERTIFICATION		.1B. Heat treatment stated in the certific	temperature, soaking tin	ne and cooling	

MATERIAL DA	TA SHEET	MI	DS - D58	Rev. 1			
TYPE OF MATERIAL: Fe	erritic/Austenitic S	Stainless Steel, Typ	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	-	S5			
1. SCOPE	requirements which the referred standa	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 which is the only Type 25 Cr duplex listed in ASME B31.3.					
2. QUALIFICATION	Manufacturers of p		shall comply with the rec	uirement of			
3. STEEL MAKING	The steel melt shal	l be refined with AC	DD or equivalent.				
4. HEAT TREATMENT	The tubes shall be	solution annealed fo	llowed by water quenching	ng.			
5. CHEMICAL COMPOSITION	PRE (% Cr + 3.3 %	$6 \text{ Mo} + 16 \% \text{ N}) \ge 40$	0.0.				
6. TENSILE TESTING	$R_{p0.2} \ge 550 \text{ MPa; I}$	$R_{\rm m} \ge 750 \text{ MPa; A} \ge 1$	15 %.				
7. HARDNESS	The hardness shall	be max. 32 HRC (or	r alternatively 301 HB or	330 HV10).			
8. IMPACT TESTING	required for the thi	cknesses ≥ 6 mm T le. Reduction factors	according to ASTM A 37 The minimum absorbed er s for subsize specimens sh	nergy shall be 45 J			
9. CORROSION TEST	shall be 50 °C and and external surface shall be prepared a pickled (20 % HNO and internal surface acceptance criteria	the exposure time 24 tes in the as-delivered according to ASTM CO3 + 5 % HF, 60 °C, es and a cross section are:	8 Method A is required. 74 hours. The specimen shed condition (including pions 48, and the whole species, 5 minute). The test shall in surface in full wall thic	all have the internal ckling). Cut edges men shall be expose the external			
	- No pitting at 20		. , 2				
10 MICROGRAPHIC EXAMINATION	- The weight loss shall be less than 4.0 g/m ² . 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, hadefined in the refer		sting shall be carried out	for each lot as			
12. TEST SAMPLING	Samples for producomponents.	Samples for production testing shall realistically reflect the properties in the actual					
13. SURFACE FINISH	White pickled.	-					
14. MARKING	The component sh treatment lot.	all be marked to ensu	ure full traceability to me	lt and heat			
15. CERTIFICATION		.1B. Heat treatment t	temperature, soaking time	e and cooling			

MATERIAL DA	TA SHEET	Γ Ν	IDS - K01	Rev. 1	
TYPE OF MATERIAL: Co	pper/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 1. SCOPE	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	requirements which referred standard.	ch shall be added or	ns in the referred standar supersede the correspond	ling requirements in the	
2. DESIGN AND DIMENSIONAL STANDARDS	Applications " sha - EEMUA Publica - EEMUA Publica	all be used: ation No. 144: " Tub	"90/10 Copper/Nickel Fees, Seamless and Welderges, Composite and Solings".	1".	
3. MATERIALS	Materials for fittin MDS.	ngs and flanges shall	comply with the above l	isted standards and this	
4. MANUFACTURING PROCESS	in cooperation wi Welding:	not forming may be u th the material manu welding process sha		procedures established	
5. HEAT TREATMENT/ DELIVERY CONDITION	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	_	elding the chemical ≤ 0.02 % and C ≤ 0.0	composition shall be mod 5 %.	lified as 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, nominal size which are produced from the same heat of material and subject to the same finishing operation.				
8. TEST SAMPLING 9. WELDING	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. Welding procedures shall be established and qualified in accordance with ASME IX.				

MATERIAL DA	ATA SHEET	<u>Γ</u> Μ	IDS - K01	Rev. 1	
TYPE OF MATERIAL: (Copper/Nickel 90/10			Page 2 of 2	
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 radigraphed 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 completly 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 hydrostatictest in accordance with ASTM A 530.				
12. CERTIFICATION	EN 10 204 Type	3.1B.			

MATERIAL DA	TA SHEET		MDS - K02	Rev. 1	
TYPE OF MATERIAL: Aluı	ninium - Bronze Sand	Castings		Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Castings	ASTM B 148	UNS C95800	-	-	
I. SCOPE			ons in the referred standar supersede the correspond		
2 CHEMICAL COMPOSITION	$Pb \le 0.02 \%$.				
3. HEAT TREATMENT	Heat treatment shall 700 °C for 6 hours.	be carried out at	the discretion of the man	ufacturer, e.g. approx.	
4. EXTENT OF TESTING	One tensile test shall treatment load.	be carried out fo	r each lot, as defined by	the in B148, and heat	
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 from the 1/4 T location from the surface where T is the thickness of the test block.				
			gated onto the castings an quality heat treatment.	nd shall not be removed	
6. WELDING	Welding procedures	shall be establish	ed and qualified in accor	rdance with ASME IX	
	for all repair welding	Ţ.			
7. NON DESTRUCTIVE TESTING	100 % on all accessil	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	1		qualified in accordance		
	A cast plate of the sA macro test shall tRepairs by peeningChange of filler me	be carried out. and impregnatio			
9. CERTIFICATION	EN 10 204 Type 3.11	В.			

MATERIAL DA	ATA SHEET	N	IDS - N01	Rev. 2		
TYPE OF MATERIAL:	AL: Nickel alloy Type 625 Page 1 of 1					
PRODUCT	STANDARD GRADE ACCEPT. CLASS SUPPL.					
Wrought fittings Pipes Forgings Plates	ASTM B 366 ASTM B 705 ASTM B 564 ASTM B 443	UNS N06625 UNS N06625 UNS N06625 UNS N06625	- Class 1 -	S3 - -		
Bars Pipes and tubes	ASTM B 446 ASTM B 444	UNS N06625 UNS N06625	-	-		
1. SCOPE	_	shall be added or sup	in the referred standard a persede the corresponding			
2. QUALIFICATION	Manufacturers of pro NORSOK Standard		all comply with the requ	irement of		
3. HEAT TREATMENT/ DELIVERY CONDITION	Annealed.					
4. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual component.					
5. DIMENSIONAL TOLERANCES	Flanges to B 381: Flanges to MSS SP-44 shall have a maximum wall thickness under tolerance of 0.3 mm at weld end.					
6. NON DESTRUCTIVE TESTING	Fittings to B 366: Supplementary requirement S3, liquid penetrant testing, shall apply to the weld area at 10 % of seamless (from the same lot as defined for mechanical testing) and 100 % of welded fittings above NPS2. For welded fittings the testing shall cover the weld only.					
	Forgings to B 564: Liquid penetrant testing shall be performed at 10 % of forgings above NPS 2 (of same lot as defined for mechanical testing).					
7. SURFACE FINISH	White pickled. Shall be carried out after any blasting and shall include finished machined surfaces.					
8. REPAIR OF DEFECTS	Weld repair of base material is not acceptable.					
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		mperature, soaking time a	and cooling medium		

MATERIAL D	ATA SHEET	Γ M	DS - N02	Rev. 2		
TYPE OF MATERIAL	: Cast Nickel alloy			Page 1 of 2		
PRODUCT	STANDARD	SUPPL. REQ.				
Castings	ASTM A 494	Grade CW-6MC (UNS N06625) Grade CX2MW (UNS N26022)	Class 1 Class 1	S2, S3 S2, S3		
I. SCOPE		shall be added or super	the referred standard a rsede the corresponding			
2. QUALIFICATION	Manufacturers of pro NORSOK Standard M		l comply with the requ	irement of		
3. STEEL MAKING			r equivalent process. Racceptable. Use of inte	_		
4. HARDNESS	The hardness shall be	e maximum 35 HRC (o	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	_	2			
	- The weight loss sha	- The weight loss shall be less than 4.0 g/m ² .				
6. 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.				
7. 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 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.					
8. NON DESTRUCTIVE TESTING	Liquid penetrant testing: Supplementary requirement S3 shall apply to all accessible 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.					
			rement S2 shall apply			
	- All butt weld ends of	·	pilot cast of each patter	111.		
		_	s to ANSI B 16.34 of e	ach casting.		
		ria shall be ASME VII				
9. SURFACE FINISH	White pickled. Shall machined surfaces.	be carried out after an	y blasting and shall inc	clude finished		

MATERIAL D	Rev. 2						
TYPE OF MATERIAL	Page 2 of 2						
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.			
Castings	ASTM A 494	Grade CW-6MC (UNS N06625)	Class 1	S2, S3			
		Grade CX2MW (UNS N26022)	Class 1	S2, S3			
10. REPAIR OF DEFECTS	Repair welding shall be carried out in accordance with ASTM A 488. 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 be marked to ensure full traceability to melt and heat treatment lot.						
12. CERTIFICATION	• •	EN 10 204 Type 3.1B. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.					

MATERIAL DA	TA SHEET MDS - P01	Rev.		
TYPE OF MATERIAL: G	lassfibre Reinforced Plastics (GRP)	Page 1 of 4		
PRODUCT	STANDARD	,		
Pipes, Fittings, Flanges, Adhesive and pre-fabricated spools	UKOOA: Specification and Recommended Practice for the Use Offshore. (UKOOA: United Kingdom Offshore Operators Association)	e of GRP Piping		
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. MANUFACTURING PROCESS	Pipes and fittings shall be made by filament winding or equivalent	ent methods.		
3. RESIN/HARDENER TYPE	Preferred resins are bisphenol A epoxies with aromatic or cyclo agents or vinylester.	paliphatic curing		
4. INNER LINER	The internal lining when transporting non-aggressive fluids sucresin rich layer of min. 0,5 mm with C-glass or synthetic veil re			
	For transporting concentrated sulphuric acid and hypochlorite, an internal li PVC of min. 3 mm should be used. Application of PVC liner shall be according the German standard KRV A984/82-02. C-glass or ECR-glass reinforcement be used in the structural part of the pipe wall. (KRV: Kunststoff Rohrverband).			
	For other agressive fluids such as acids, the internal lining shall of min. 3,0 mm with C-glass or syntetic veil reinforcement. C-g reinforcement should be used in the structural part of the pipe v	lass or ECR-glass		
5. QUALIFICATION TESTING	Qualification testing shall be performed according to UKOOA chapter 2 with the following additional requirements:	document, Part 2,		
	<u>Pressure rating</u> , (Section 2.1.2 or 2.1.3): Minimum requirements representative diameter of pipe, fittings and joints shall be qualitation 1. For qualification option 3 the factor $f_1 = 0.85$ shall be numerator.	ified according to		
	The qualification of flanges shall in addition to the UKOOA do ASTM D 4024, clauses 6, 7, 8 and 11 with the additional requirements.	• •		
	The pressure rating of the flanges multiplied by 4 shall be above confidence limit obtained from the <i>Short-Term Rupture Strengt</i>			
	The test assembly for the maximum bolt torque test shall be fitt gasket and steel flange intended to be used during fabrication at			
	No visual damage is allowed for the sealing test and the bolt to table 4.3.5 in UKOOA document.	rque test according		
	<u>Service Conditions Exceeding "Standard Conditions", (A new section 2.1.1.4, Standard Service Conditions)</u> : For design life excee following shall apply:			

MATERIAL DA'	TA SHEET MDS - P01	Rev.		
TYPE OF MATERIAL: G	lassfibre Reinforced Plastics (GRP)	Page 2 of 4		
PRODUCT	STANDARD			
Pipes, Fittings, Flanges, Adhesive and pre-fabricated spools	0.00.1			
5. QUALIFICATION TESTING (Cont.)	Assessment of previous well documented in-service experience. Qualification results from tests done according to Qualification Option 1 is section 2.1.2. or 2.1.3. Alternatively use a pipe with a pressure rating of minimum one class higher than for 20 years design.			
	c) Design calculations shall be re-evaluated and extrapolation the increased service life. **Adhesive/resin for bonded/laminated joints,* (A new section 2.1.9)* The adhesive used for bonded joints or resin used for laminated qualified according to section 2.1.2 or 2.1.3. The adhesive/resin properties for field assembly and fulfilling the following requir - The adhesive/resin shall have a suitable viscosity for applit temperature. The viscosity shall not be above 0.4 kPas at 2 rate of 10 rotations per second (absolute viscosity data). - The fracture elongation of the cured adhesive/resin in joint than that of the resin used in the piping. - The glass transition temperature (T _G) or the residual heat of cured adhesive/resin shall be determined by DSC according measurement of samples taken from joints of components testing. - Alternatively, for polyester and vinylester based products, monomer content for joints in components used in qualific determined. The measurement shall be performed according. **Component Data for Fabrication, Prefabrication and Installation Baselines.*(A new section 2.1.10): The manufacturer shall gener qualification programme baseline values including acceptance of fabrication and installation quality control programme. This includes measurement of degree of cure and glass content: - The degree of cure shall be determined by DSC in accordate by residual styrene content measurement in accordance with adhesive used in bonded joints and the resin used in lamina Reference to above new section 2.1.9. - The percentage of fibreglass reinforcement in laminated joint determined in accordance with ASTM D 2584. Three san from three locations situated 120° apart in the same joint contents.	I joints shall be a shall have suitable ements: cation at room 3°C with a shear as shall not be less of reaction of the g to Annex C, by used in qualification the residual styrene ation testing may be ag to ISO 4901. Son Quality Control ate from the criteria for the criteria for the ated joints. int shall be aples shall be taken		

MATERIAL DA'	TA SHEET MDS - P01	Rev.			
TYPE OF MATERIAL: G	lassfibre Reinforced Plastics (GRP)	Page 3 of 4			
PRODUCT	STANDARD				
Pipes, Fittings, Flanges, Adhesive and pre-fabricated spools	UKOOA: Specification and Recommended Practice for the Use Offshore. (UKOOA: United Kingdom Offshore Operators Association)	e of GRP Piping			
5. QUALIFICATION TESTING (Cont.)	<u>Chemical Resistance</u> , (Delete section 2.2.5 and replace with): For tother than the water used in the testing according to section 2.1 resistance of the material shall be determined. The tests shall be	, the chemical			
	ASTM D 3681. The test duration and conditions shall be relevant for the service conditions, life time requirements and the criticality of the system and the safety risks of the conveyed fluid. Alternatively, well documented in-service experience under similar conditions can be used. Examples of typical fluids that can require specific documentation of compatibility if transported in GRP pipes are:				
	hydraulic fluids, scale inhibitors, corrosion inhibitors (also diluted), injection chemicals (i.e. acid stimulation, etc.), completion fluids, packer fluids and methanol				
	Component Properties for System Design (section 2.4) All listed properties shall be determined by the Manufacturer (Delete "Where applicable in UKOOA document)				
	Test Method for Determination of Degree of Cure by Differential Scanning Calorimetry (DSC) (Annex C)				
	C.5.3 (Delete sentence and replace with:) Obtain the T_{G1} (midpoint of the inflection in the DSC curve) and heat of reaction from the first scan and second scan. (Sample no				
	C.6.5 (Delete sentence and replace with:) Record of glass transition temperature (inflection value) as $T_{\rm G1}$ of reaction for both the first and second scan.	and /or residual heat			
6. ELECTRIC CONDUCTIVITY	If conductive components are specified, the conductivity in the shall not be accomplished by adding carbon black to the resin.	structural layers			
7. PRODUCTION TESTING	Production testing shall be performed according to UKOOA do Chapter 4 with the following additional requirements.	cument, Part 2,			
	Hydrostatic Mill Test (Section 4.3.1): 10 % of produced pipes and 100 % of all prefabricated spools shall be pressure tested to 1.5 times their nominal static pressure rating and pressure shall be maintained for a minimum of 15 minutes in order to ascertain there is no leakage.				
	<u>Degree of Cure</u> (Section 4.3.2, Add following sentences after last pa If the residual heat of reaction exceeds 10% of the measured va component variant in the qualification tests, then the production rejected, subject to the retest option of Section 4.3.8.	lue on the qualified			
	Alternatively, vinylester or polyester based products may be tes with ISO 4901. The residual styrene content shall be maximum level measured during component qualification but not above 2	10 % above the			

MATERIAL DA	TA SHEET MDS - P01	Rev.				
TYPE OF MATERIAL: Glassfibre Reinforced Plastics (GRP) Page 4						
PRODUCT	STANDARD					
Pipes, Fittings, Flanges, Adhesive and pre-fabricated spools	UKOOA: Specification and Recommended Practice for the Use of GRP Piping Offshore. (UKOOA: United Kingdom Offshore Operators Association)					
8. FLANGES	Allowable bolt torque and flange mis-alignment shall be defined by manufacturer.					
9. NDT/VISUAL TESTING	According to UKOOA, Part 4 or BS 7159.					
10. CERTIFICATION	EN 10 204 Type 3.1B containing: - Hydrostatic mill test Degree og cure Short time failure pressure Glass content Visual inspection Wall thickness Resistivity (If conductive pipe is specified)	- - - - -				

MATERIAL DATA SHEET MDS - P11 Rev. 1						
TYPE OF MATERIAL: Hydrogenated Nitrile (HNBR)						
PRODUCT	O-ring TEMPERATURE - 46°C to + 150°C. Only short time exposure					
			below - 20°C accepta	ble.		
1. SCOPE				HNBR O-ring material.		
2. PURCHASE INFORMATION	dimension	ns, tolerances and / or	in the following information referenced drawing(s) a			
3. CHEMICAL COMPOSITION		6 acrylonitrile conten				
4. QUALIFICATION TEST REQUIREMENTS	the follow are change compositing qualificates the compress of the compression of the c	ving minimum requires in the production ration or properties of the ion testing (each manution test requirements ion, text fixture, 70 – test temperature 100° beles of: 24h), repressurisation: 70 backnown rest time re-pressurisation beakage test ge shall occur in a leaf following the 10 deco	ements. The qualification oute, manufacturing product which exceed ufacturer and seal type search of the product which exceeds a construction of the product which exceeds a construction of the product which exceeds a construction of the product o	ds the limits defined from shall be qualified): itameter 5.33 mm, 20% edium 10% CO ₂ in at full pressure, followed		
	Hardness Tensile st Elongatio Compress (% max.2	24 hr. 150°C) properties	ASTM D 2240 ASTM D 412/ 1414 ASTM D 412/ 1414 ASTM D 395 ASTM D 792	90 +/- 5 20 MPa 100% 25% 1.24 – 1.27 g/cm ³		
5. DIMENSIONS	BS 4518	•		Ŭ		
6. PRODUCTION TEST	The below	w properties shall be coisfy the requirements		or each production batch		
REQUIREMENTS	Specific g Hardness Tensile and	gravity nd elongation properti	(AS' (AS' (AS' (AS' (AS' (AS' (AS' (AS'	TM D 792) TM D 2240) TM D 412/ 1414)		
7. MARKING & PACKAGING	Tensile and elongation properties (ASTM D 412/1414) 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 to sunlight.					
8. CERTIFICATION	Inspection	n certificate to EN 10	204 3.1 B shall contain	ID no. and all test results.		

MATERIA	L DA	TA SHEET	MDS – P12	2 Rev. 1		
TYPE OF MATERIAL: Fluorocarbon terpolymer (FKM)						
PRODUCT	O-ring	TEMPERATURI		Only short time exposure		
1. SCOPE	This MD	S specifies the techn	ical requirements for the	e FKM O-ring material.		
2. PURCHASE INFORMATION			rain the following inform or referenced drawing(s)			
3. CHEMICAL COMPOSITION	Vinylidene fluoride (VF2), hexafluoropropylene (HFP), and tetrafluoroethylene (TFE) with necessary fillers, stabilisers, cross-link agents.					
4. QUALIFICATION TEST REQUIREMENTS	the follow are change compositing qualificate the following compositing qualificate the following the following the following the following the following the following are change the following the f	ving minimum requites in the production ion or properties of ion testing (each mattion test requiremention, text fixture, 70 test temperature 10 teles of: 20 bar (24h), repressurisation: 70 behour rest time	rements. The qualification route, manufacturing properties the product which exceed and facturer and seal types the configuration of the product which exceed the configuration of the product which exceeds the configuration of the product of the p	eds the limits defined from e shall be qualified): diameter 5.33 mm, 20% nedium 10% CO ₂ in k at full pressure, followed erature and service		
	Hardness Tensile st Elongatio Compress (% max. 2 Physical Specific §	24 hr. 200°C) properties	ASTM D 2240 ASTM D 412/ 1414 ASTM D 412/ 1414 ASTM D 395 ASTM D 792			
5. DIMENSIONS	BS 4518					
6. PRODUCTION TEST REQUIREMENTS	and sat Specific g Hardness Tensile an	isfy the requirement gravity nd elongation proper	s listed above. (As (As tries)			
7. MARKING & PACKAGING 8. CERTIFICATION	Tensile and elongation properties (ASTM D 412/ 1414) 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 to sunlight. Inspection certificate to EN 10204 3.1 B shall contain ID no. and all test results.					

PRODUCT 1. SCOPE 2. PURCHASE INFORMATION 3. CHEMICAL COMPOSITION	O-ring This MDS material. The purch dimension 36 – 40% The mater the follow	TEMPERATURE Sespecifies the technical assessment of the second of the se	below - 20°C acceptal al requirements for the I in the following informate referenced drawing(s) a	olly short time exposure ble. FKM-GLT O-ring tion: Product form,	
PRODUCT 1. SCOPE 2. PURCHASE INFORMATION 3. CHEMICAL COMPOSITION	O-ring This MDS material. The purch dimension 36 – 40% The mater the follow	TEMPERATURE Sespecifies the technical assessment of the second of the se	- 46°C to + 200°C. On below - 20°C acceptal al requirements for the I in the following informate referenced drawing(s) a	olly short time exposure ble. FKM-GLT O-ring tion: Product form,	
2. PURCHASE INFORMATION 3. CHEMICAL COMPOSITION	material. The purch dimension $36 - 40\%$ The mater the follow	hase order shall contains, tolerances and / or a crylonitrile content	al requirements for the land the following informative ferenced drawing(s) a	FKM-GLT O-ring tion: Product form,	
INFORMATION 3. CHEMICAL COMPOSITION	dimension $36 - 40\%$ The mater the follow	ns, tolerances and / or a acrylonitrile content	referenced drawing(s) a		
COMPOSITION	The mater		(ACN)		
	the follow	rial shall be rapid pres			
TEST REQUIREMENTS 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	compositi qualificati qualificati qualificati ED-test Qualificat compressi Methane, by 10 Cyc • 20 • De • 1 h • Re • Le No leakag pressure f longer that test. Mechanic Hardness Tensile sti	ring minimum requirer es in the production roon or properties of the fon testing (each manufactor) testing (each manufactor) test requirements: fon, text fixture, 70 – 8 test temperature 100°C eles of: 0 bar (24h), expressurisation: 70 bar four rest time expressurisation always test ge shall occur in a leak following the 10 decompts 50 % of the sample eal properties (Shore A) rength (min.) in at break (min.)	ments. The qualification oute, manufacturing product which exceed a facturer and seal type s O-ring cross section dia 35% groove fill, test me C. 72 hours initial soak a minimum.	s the limits defined from hall be qualified): ameter 5.33 mm, 20% dium 10% CO ₂ in at full pressure, followed rature and service	
1	Physical _l	24 hr. 200°C) properties			
	Specific g	ravity	ASTM D 792	$1.65 - 1.72 \text{ g/cm}^3$	
	BS 4518	, 1 111 1	. 11	1 1 2 1 4	
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) Hardness (ASTM D 2240) Tensile and elongation properties (ASTM D 412/1414)				
7. MARKING & S PACKAGING i	Tensile and elongation properties (ASTM D 2240) 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 to sunlight.				

MATERIAL DATA SHEET MDS – P14 Rev. 1							
TYPE OF MA	TYPE OF MATERIAL: Nitrile (NBR)						
PRODUCT	O-ring	TEMPERATURE	/	nly short time exposure ble.			
1. SCOPE	This MDS specifies the technical requirements for the NBR O-ring material.						
2. PURCHASE	The purchase order shall contain the following information: Product form,						
INFORMATION	dimensions, tolerances and / or referenced drawing(s) and grade designation.						
3. CHEMICAL	36 - 40%	36 – 40% acrylonitrile content (ACN)					
COMPOSITION 4. QUALIFICATION	The mete	The material shall not be used for gas service or gas containing fluids and hence,					
TEST			oressure reduction testing				
REQUIREMENTS			wing minimum requiren				
			nanges in the production				
			tion or properties of the				
			cation testing (each many				
	shall be q	ualified):	•	- 1			
		ance test					
			: O-ring cross section di				
	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 bar.						
	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 $+20\%/-5\%$.						
	Mechani	cal properties					
		(Shore A)	ASTM D 2240	70 +/- 5			
		trength (min.)	ASTM D 412/ 1414	15 MPa			
		on at break (min.)	ASTM D 412/ 1414	350%			
	Compress		ASTM D 395	25%			
	(% max. 2	24 hr. 100°C)					
		.•					
		properties	ACTM D 702	1.24 1.27 -/3			
5. DIMENSIONS	Specific g	gravity	ASTM D 792	1.24 - 1.27 g/cm ³			
6. PRODUCTION	BS 4518 The helpsy gran artist shall be decorrected by testing for each graduation batch						
TEST	The below properties shall be documented by testing for each production batch and satisfy the requirements listed above.						
REQUIREMENTS	Specific gravity (ASTM D 792)						
	Hardness (ASTM D 2240)						
	Tensile and elongation properties (ASTM D 412/ 1414)						
7. MARKING &	Seals shall be supplied in sealed airtight bags. Markings on the bags shall clearly						
PACKAGING	indicate batch number, and such markings shall ensure traceability through the						
	-	~ 5		d manufacturing details. In			
				elf life assuming storage			
			ut direct exposure to sur				
8. CERTIFICATION	Inspection certificate to EN 10204 3.1 B shall contain ID no. and all test results.						

TYPE OF MATERIAL: PEEK (Poly-ether-ether-ketone) PRODUCT	MATERIA	L DATA SHEE	T MDS	S – P21 I	Rev. 1	
Inserts	TYPE OF MA	ATERIAL: PEEK (P	oly-ether-ethe	er-ketone)		
The purchase order shall contain the following information: Product form, dimensions, tolerances and / or referenced drawing(s) and grade designation. 3. CHEMICAL COMPOSITION 4. QUALIFICATION TEST REQUIREMENTS Mechanical properties Tensile strength ASTM D 638 HDT @ 1.81 MPa HDT @ 1.81 MPa HDT @ 1.81 MPa (notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) 5. DIMENSIONS BS 4518 The purchase order shall contain the following information: Product form, dimensions, tolerances and / or referenced drawing(s) and grade designation. Product form, dimensions, tolerances and / or referenced drawing(s) and grade designation. Product form, dimensions, tolerances and / or referenced drawing(s) and grade designation. Product form, dimensions, tolerances and / or referenced drawing(s) and grade designation. Poly-ether-ether-ketone polymer with necessary stabilisers and processing aids composition or properties of the product on route, manufacturing procedures, specified composition or properties of the product on which exceeds the limits defined from qualification testing: Werp in Mechanical properties Tensile strength ASTM D 638 ASTM D 638 ASTM D 648 ASTM D 648 ASTM D 648 BS 4518 The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density ASTM D 638 The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density ASTM D 638 The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density ASTM D 638 Components shall be supplied in suitable packaging as to protect the items from	PRODUCT		TEMPERATU	RE -100°C to	+250°C	
INFORMATION					material.	
### The material shall 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: Mechanical properties Tensile strength ASTM D 638 95 MPa >150 MPa		Product form, dimensions and grade designation.	s, tolerances and /	or referenced dra		
The material shall 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: Mechanical properties Tensile strength ASTM D 638 75 MPa 7150 MPa		Poly-ether-ether-ketone p	olymer with nece	ssary stabilisers a	nd processing aids.	
Tensile strength Tensile Modulus Compressive strength HDT @ 1.81 MPa HDT @ 1.81 MPa ASTM D 695 Impact strength (notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) S. DIMENSIONS 6. PRODUCTION TEST REQUIREMENTS Tensile strength ASTM D 638 ASTM D 638 ASTM D 638 ASTM D 695 ASTM D 696 ASTM D 696 ASTM D 697 ASTM D 698 ASTM D 792 ASTM 3418 ASTM D 570 ASTM D 698 ASTM D 570 ASTM D 698 ASTM D 698 ASTM D 792 Tensile strength ASTM D 698 Components shall be supplied in suitable packaging as to protect the items from	4. QUALIFICATION TEST	qualification shall be repe manufacturing procedures	eated if there are c s, specified compo	changes in the pro- position or propert	duction route,	
Tensile strength Tensile Modulus Compressive strength HDT @ 1.81 MPa HDT @ 1.81 MPa ASTM D 695 Impact strength (notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) S. DIMENSIONS 6. PRODUCTION TEST REQUIREMENTS Tensile strength ASTM D 638 ASTM D 638 ASTM D 638 ASTM D 695 ASTM D 696 ASTM D 696 ASTM D 697 ASTM D 698 ASTM D 792 ASTM 3418 ASTM D 570 ASTM D 698 ASTM D 570 ASTM D 698 ASTM D 698 ASTM D 792 Tensile strength ASTM D 698 Components shall be supplied in suitable packaging as to protect the items from		Mechanical properties		Virgin	Glass filled	
Tensile Modulus Compressive strength HDT @ 1.81 MPa HDT @ 1.81 MPa ASTM D 695 Impact strength (notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) 5. DIMENSIONS BS 4518 C. PRODUCTION TEST REQUIREMENTS Tensile Modulus ASTM D 638 ASTM D 695 I10 MPa 150 MPa 160°C 300°C 370 J/m ASTM D 638 ASTM D 792 I.3 - 1.33 340°C 0.15 % 0.15 % 0.15 % In below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density ASTM D 792 Tensile strength ASTM D 638 Ultimate elongation (%) ASTM D 638 Components shall be supplied in suitable packaging as to protect the items from			ASTM D 638			
HDT @ 1.81 MPa Impact strength (notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) 5. DIMENSIONS 6. PRODUCTION TEST REQUIREMENTS 6. PRODUCTION TEST REQUIREMENTS 7. MARKING & Components shall be supplied in suitable packaging as to protect the items from		- C		>3000MPa		
Impact strength (notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) 5. DIMENSIONS REQUIREMENTS BS 4518 Components shall be documented by testing for each production batch and satisfy the requirements listed above. Density ASTM D 638 >7. MARKING & Components shall be supplied in suitable packaging as to protect the items from		Compressive strength	ASTM D 695	110 MPa	150 MPa	
(notched) Ultimate elongation (%) Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) 5. DIMENSIONS BS 4518 6. PRODUCTION TEST REQUIREMENTS Tensile strength Ultimate elongation (%) ASTM D 638 ASTM D 792 ASTM 3418 ASTM D 570 ASTM D 570 0.15 % 0.15 % 0.15 % ASTM D 792 Tensile strength ASTM D 792 Tensile strength ASTM D 638 Ultimate elongation (%) ASTM D 638 Components shall be supplied in suitable packaging as to protect the items from		HDT @ 1.81 MPa	ASTM D 648	160°C	>300°C	
Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) S. DIMENSIONS 6. PRODUCTION TEST REQUIREMENTS Density ASTM D 792 ASTM D 570 ASTM D 570 1.3 - 1.33 340°C 0.15 % 0.15 % 1.46 - 1.55 340°C 0.15 % 0.15 % ASTM D 792 The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density ASTM D 792 Tensile strength ASTM D 638 Ultimate elongation (%) ASTM D 638 7. MARKING & Components shall be supplied in suitable packaging as to protect the items from			ASTM D 256	>70 J/m	>70 J/m	
Physical properties Density (g/cm³) Melting point Water absorbtion (24 hrs.) 5. DIMENSIONS BS 4518 6. PRODUCTION TEST REQUIREMENTS The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density Tensile strength Ultimate elongation (%) 7. MARKING & Components shall be supplied in suitable packaging as to protect the items from		Ultimate elongation (%)	ASTM D 638	> 60 %	> 5 %	
Melting point Water absorbtion (24 hrs.) S. DIMENSIONS BS 4518 6. PRODUCTION TEST REQUIREMENTS Density Tensile strength Ultimate elongation (%) ASTM 3418 ASTM D 570 ASTM D 570 ASTM D 570 ASTM D 570 ASTM D 638 Components shall be supplied in suitable packaging as to protect the items from						
5. DIMENSIONS BS 4518 6. PRODUCTION TEST REQUIREMENTS Density ASTM D 792 Tensile strength ASTM D 638 Ultimate elongation (%) ASTM D 638 7. MARKING & Components shall be supplied in suitable packaging as to protect the items from		Melting point Water absorbtion	ASTM 3418	340°C	340°C	
6. PRODUCTION TEST REQUIREMENTS The below properties shall be documented by testing for each production batch and satisfy the requirements listed above. Density Tensile strength Ultimate elongation (%) 7. MARKING & Components shall be supplied in suitable packaging as to protect the items from	5 DIMENSIONS	` '				
and satisfy the requirements listed above. Density Tensile strength Ultimate elongation (%) ASTM D 792 Tensile strength ASTM D 638 Ultimate elongation (%) ASTM D 638 Components shall be supplied in suitable packaging as to protect the items from			l be documented	by testing for each	h production batch	
7. MARKING & Components shall be supplied in suitable packaging as to protect the items from		and satisfy the requirements listed above. Density ASTM D 792 Tensile strength ASTM D 638				
indicate material batch number, and such markings shall ensure traceability through the producers QC system to raw materials, formulation and manufacturing details. 8. CERTIFICATION Inspection certificate to EN 10204 3.1 B shall contain ID no. and all test results	PACKAGING	Ultimate elongation (%) ASTM D 638 Components shall be supplied in suitable packaging as to protect the items from physical damage prior to installation. Markings on the packaging shall clearly indicate material batch number, and such markings shall ensure traceability through the producers QC system to raw materials, formulation and manufacturing details.				

MATERIA	L DATA SHEE	T MDS	S - P22	Rev.	1
	ATERIAL: PTFE (P				
PRODUCT	Lip-seals, back-up rings and seat inserts	TEMPERATU		0°C to +200°C	
1. SCOPE	This MDS specifies the te	chnical requireme	ents for the	e PTFE mater	ial.
2. PURCHASE INFORMATION	The purchase order shall of Product form, dimensions and grade designation.				
3. CHEMICAL COMPOSITION	Carbon and fluorine, poly stabilisers and process aid lip-seal must be energised similar.	ls. Also with grap	hite, glass	or carbon fibi	re fillers. The
4. QUALIFICATION TEST REQUIREMENTS	The material shall satisfy shall be repeated if there a procedures, specified com the limits defined from qu	are changes in the apposition or prope	production production	n route, manu	facturing
	Mechanical properties		Virgin	25%Glass	25%Graph
	Tensile strength (MPa)	ASTM D 638	>25	> 15	> 15
	Hardness (Shore D)	ASTM D 785	50 - 60	50 - 60	60-70
	Compressive strength (1%) (MPa) Compressive modulus	ASTM D 695	4	6	6
	(MPa)	ASTM D 695	> 400	> 600	>600
	HDT @ 1.81 MPa	ASTM D 648	54°C	110°C	95°C
	Impact strength			1	
	(notched) (J/m)	ASTM D 256	>145	>130	140
	Ultimate elongation (%)	ASTM D 638	>180	>180	>65
	Physical properties				
	Density (g/cm ³)	ASTM D 792	2 - 2.2	2- 2.24	1.9- 2.1
	Melting point (°C)	ASTM 3418	325	325	325
	Water absorbtion (24 hrs.)	ASTM D 570	0.01 %	0.02%	0.01%
5. PRODUCTION	The below properties shall	l be documented	by testing	for each produ	uction batch
TEST REQUIREMENTS	and satisfy the requirement Hardness (Shore D)	nts listed above. ASTM D7	'85		
	Density ASTM D792 Tensile strength ASTM D638 Ultimate elongation (%) ASTM D638				
6. MARKING & PACKAGING	Components shall be supplied in suitable packaging as to protect the items from physical damage prior to installation. Markings on the packaging shall clearly indicate material batch number, and such markings shall ensure traceability through the producers QC system to raw materials, formulation and manufacturing details.				
7. CERTIFICATION	Inspection certificate to E	N 10204 3.1 B sh	all contair	n ID no. and a	ll test results.

MATEDIA	I DATA CHEE	T MDC I	002 Day 1					
	L DATA SHEE		P23 Rev. 1					
	\		etone) with PTFE added					
PRODUCT	Seat inserts	TEMPERATURE	-100°C to +200°C					
1. SCOPE			or the PEEK/ PTFE material.					
2. PURCHASE INFORMATION		The purchase order shall contain the following information:						
INFORMATION	Product form, dimensions	, tolerances and / or re	ferenced drawing(s)					
3. CHEMICAL	and grade designation.	1 '/1	4 1 22 1 2 2 1					
COMPOSITION	and 10 to 20 % PTFE (Po		stabilisers and processing aids					
4. QUALIFICATION	The material shall satisfy	•	,					
TEST			es in the production route,					
REQUIREMENTS			n or properties of the product					
	which exceeds the limits of	defined from qualificat	ion testing:					
	Mechanical properties	[Virgin					
	Tensile strength	ASTM D 638	> 80 MPa					
	Hardness (Shore D)	ASTM D 030	82- 88					
	Tensile Modulus	ASTM D 783	>3000MPa					
	Compressive strength	ASTM D 695	100 MPa					
	HDT @ 1.81 MPa	ASTM D 693 ASTM D 648	150°C					
	Impact strength	ASTM D 048 ASTM D 256	HOLD J/m					
	(notched)	ASTWID 230	HOLD J/III					
	Ultimate elongation (%)	ASTM D 638	> 20 %					
	Physical properties		20 70					
	Density (g/cm ³⁾	ASTM D 792	1.36 - 1.40					
	Melting point	ASTM 3418	340 °C					
	Water absorbtion	ASTM D 570	0.10 %					
	(24 hrs.)							
5. DIMENSIONS	BS 4518							
6. PRODUCTION TEST			sting for each production batch					
REQUIREMENTS	and satisfy the requirement Hardness	its listed above. ASTM D 785						
	Density ASTM D 783 ASTM D 783							
	Tensile strength ASTM D 638							
	Ultimate elongation (%)	ASTM D 638						
7. MARKING &			ing as to protect the items from	n				
PACKAGING	physical damage prior to	installation. Markings	on the packaging shall clearly					
			gs shall ensure traceability					
	through the producers QC	system to raw materia	ils, tormulation and					
8. CERTIFICATION	manufacturing details.	N 10204 2 1 D aball as	untain ID no and all test results					
o. CENTIFICATION	Inspection certificate to EN 10204 3.1 B shall contain ID no. and all test results.							

MATERIAL D	ATA SHEE	ET N	IDS - R11	Rev. 2	
TYPE OF MATERIAL	: Austenitic stainle	ess steel, Type 6Mo		Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	ASTM A 312	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-	
1. SCOPE	requirements whice the referred standar	h shall be added or suj	in the referred standard persede the correspondir t included in A 312 shal de UNS S31254.	ng requirements in	
2. QUALIFICATION	Manufacturers of J NORSOK Standar	•	nall comply with the requ	uirement of	
3. STEEL MAKING	The steel melt shall	ll be refined by AOD o	or equivalent .		
4. HEAT TREATMENT	The pipes shall be	solution annealed foll	owed by water quenchin	g.	
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 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.			
	- The weight loss	shall be less than 4.0 g	g/m.		
6. EXTENT OF TESTING	Corrosion test shall the referred standar		same extent as stated for	r mechanical tests in	
7. TEST SAMPLING	Samples for produ components.	ction testing shall real	istically reflect the propo	erties in the actual	
8. SURFACE FINISH	White pickled.				
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 should be stated in		mperature, soaking time	and cooling medium	

MATERIAL DATA SHEET MDS - R12 Rev. 2							
TY	YPE OF MATERIAL:	Austenitic Stainles	ss Steel, Type 6Mo		Page 1 of 2		
PF	RODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
W	elded Pipes	ASTM A 358	UNS S31254 UNS N08367 UNS N08925 UNS N08926	Class 1, 3 and 5.	S3		
1.	SCOPE	requirements which	s the selected options in the shall be added or superstructed. Material grades not in requirements given to Gra	sede the corresponding cluded in A 240 shall o	requirements in		
2.	QUALIFICATION	Manufacturers of p NORSOK Standard	product to this MDS shall d M-650.	comply with the requi	rement of		
3.	STEEL MAKING	Steel melt shall be	refined with AOD or equ	ivalent refining.			
4.	HEAT TREATMENT	The pipes shall be solution annealed followed by water quenching. Post weld solution annealing is not required of pipes with nominal wall thickness up to 7.11 mm manufactured out of solution annealed plate material as stated in chapter 5.3.2.2 of A 358.					
5.	CHEMICAL COMPOSITION	UNS N08925 and 1	UNS N08925 and N08926: N = 0.18 - 0.22 %.				
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 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/m².					
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		ction testing shall realistic	-			
9.	WELDING	this MDS: - The weld consu %; Cr ≥ 15.0 % - The PQR/WPA The qualification s	hall be qualified in accordanable shall be Ni-base and $(Mo + Cr) \ge 28\%$; $C \le R$ shall be corrosion testerable hall be carried out on the Change of specific make ation.	and the alloying content 0.030 %; $S \le 0.015$ % d as specified above.	shall be: Mo \geq 8.0 and Nb < 0.5 %.		

MATERIAL D	ATA SHEE	CT' M	DS - R12	Rev. 2		
TYPE OF MATERIAL	TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Welded Pipes	ASTM A 358	UNS S31254 UNS N08367 UNS N08925 UNS N08926	Class 1, 3 and 5.	S3		
10. NON DESTRUCTIVE TESTING	radiography for w Supplementary re Article 6, to the w mechanical testin	Eddy current testing according to ASTM A 450 is acceptable as replacement for radiography for wall thicknesses less than 4,0 mm. 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 testing shall be carried out after calibration and pickling. Acceptance criteria shall be to ASME VIII Div. 1 Appendix 8.				
11. SURFACE FINISH	White pickled.					
12. REPAIR OF DEFECTS	•	Weld repair of base material is not acceptable. For repair of welds same requirements to PQR/WPAR as for production welding.				
13. MARKING	The component sllot.	The component shall be marked to ensure full traceability to melt and heat treatment				
14. CERTIFICATION	EN 10 204 Type 3 should be stated i		emperature, soaking time a	and cooling medium		

MATERIAL D	ATA SHEE	T	MDS - R13	Rev. 2		
TYPE OF MATERIAL:	Austenitic Stainle	ess Steel, Type 6	Mo	Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings	ASTM A 403	WP S31254 UNS N08367 UNS N08925 UNS N08926	WP-S, WP-WX and WP-W	S2, S7		
I. SCOPE	requirements wh	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 403 shall comply with the test and tolerance requirements given to Grade UNS S31254.				
2. QUALIFICATION	Manufacturers of NORSOK Stand	-	IDS shall comply with the require	rement of		
3. STEEL MAKING	Steel melt shall b	oe refined with AC	DD or equivalent.			
4. HEAT TREATMENT	The fittings shall	be solution annea	led followed by water quenchin	g.		
	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 magnification. - The weight loss shall be less than 4.0 g/m².					
6. EXTENT OF TESTING	Tensile and corre	osion testing shall	be performed for each heat, hear n and welded with the same WP			
7. TEST SAMPLING			ll realistically reflect the propert			
8. WELDING	and this MDS: - The weld con	sumable alloying	alified in accordance with ASM content shall be: Mo ≥ 8.0 %; Co			
			$S \leq 0.015 \%$; Nb $< 0.5 \%$.			
	- 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.					
9. DIMENSIONAL TOLERANCES	Fittings with refetolerance of 0.3 i		75 shall have maximum wall thi	ickness under		
10. NON DESTRUCTIVE TESTING	seamless fittings above NPS 2. Fo shall be carried of	Supplementary requirement S7, liquid 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 resting shall be carried out after calibration and pickling. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 8.				

MATERIAL DA	ATA SHEE	T	MDS - R13	Rev. 2	
TYPE OF MATERIAL:	TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS S			
Wrought fittings	ASTM A 403	WP S31254 UNS N08367 UNS N08925 UNS N08926	WP-S, WP-WX and WP-W	S2, S7	
11. SURFACE FINISH	White pickled.				
12. REPAIR OF DEFECTS	*		acceptable. For repair of welds pply as for production testing.	the same	
13. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
14. CERTIFICATION	EN 10 204 Type should be stated		ent temperature, soaking time ar	nd cooling medium	

MATERIAL DA	TA SHEE	T	MDS - R14	Rev. 2		
TYPE OF MATERIAL: Aust	tenitic Stainless S	Steel, Type 6Mo		Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Forgings	ASTM A 182	F44 UNS N08367 UNS N08925 UNS N08926	-	S5		
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. Material grades not included in A 182 shall comply with the test and tolerance requirements given to Grade F44.					
2. QUALIFICATION	Manufacturers of NORSOK Stand	-	IDS shall comply with the rec	quirement of		
3. STEEL MAKING	The steel melt sl	hall be refined with	n AOD or equivalent.			
4. MANUFACTURING PROCESS	The Hot Isostati	The Hot Isostatic Pressed (HIP) process is an acceptable alternative to forging.				
5. HEAT TREATMENT	The forgings sha	The forgings shall be solution annealed followed by water quenching.				
6. CHEMICAL COMPOSITION	UNS N08925 and N08926: N = 0.18 - 0.22 %					
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.					
8. EXTENT OF TESTING	- The weight loss shall be less than 4.0 g/m ² . One set of tensile test and corrosion test shall be carried out for each heat and heat treatment 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 pro- actual componer	•	ll realistically reflect the prop	perties in the		
	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 blocks shall be used for HIP.					
Test specimens shall be cut at the 1/4 T location from the sur thickness of the test samples as heat treated. Sketches shall be showing type, size and location of test samples and extraction				stablished		
10. DIMENSIONAL TOLERANCES	Flanges to MSS mm at the weldi		maximum wall thickness unde	er tolerance of 0.3		

MATERIAL DA	ATA SHEE	ET	MDS - R14	Rev. 2		
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				Page 2 of 2		
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS				
Forgings	ASTM A 182	F44 UNS N08367 UNS N08925 UNS N08926	-	S5		
11. NON DESTRUCTIVE TESTING	forgings (from shall be carried	Supplementary requirement S5, liquid 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.				
12. SURFACE FINISH	White pickled i	ncluding machine	ed surfaces.			
13. REPAIR OF DEFECTS	Weld repair is r	Weld repair is not acceptable.				
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. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.					

MATERIAL DA'	TA SHEE	Γ	MDS - R15	Rev. 2		
TYPE OF MATERIAL: Aust	enitic Stainless St	teel, Type 6Mo		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Plates	ASTM A 240	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-		
1. SCOPE	requirements whi	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 240 shall comply with the test and tolerance requirements given to Grade UNS S31254.				
2. QUALIFICATION	Manufacturers of NORSOK Standa	_	IDS shall comply with the re	quirement of		
3. STEEL MAKING	The steel melt sh	all be refined with	n AOD or equivalent.			
4. HEAT TREATMENT	The plates shall b	e solution anneal	ed followed by water quench	ning.		
5. CHEMICAL COMPOSITION	UNS N08925 and	<i>l N08926:</i> N = 0.1	8 - 0.22 %			
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 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 in full wall thickness. The acceptance criteria are:					
	- No pitting at 20	X magnification				
	- The weight loss	s shall be less than	1.0 g/m^2 .			
7. EXTENT OF TESTING	Corrosion testing tests in the referre		out to the same extent as state	ed for mechanical		
8. TEST SAMPLING	Samples for prod	-	ll realistically reflect the pro	perties in the		
9. SURFACE FINISH	White pickled.					
10. REPAIR OF DEFECTS	Weld repair is no	t acceptable.				
11. MARKING	The component s treatment lot.	The component shall be marked to ensure full traceability to melt and heat				
CERTIFICATION	* *	3.1B. Heat treatmee stated in the cer	ent temperature, soaking tim	ne and cooling		

MATERIAL D	ATA SHEE	T MDS -	R16	Rev. 2		
TYPE OF MATERIAL	: Austenitic Stainle	ess Steel, Type 6Mo		Page 1 of 2		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Castings	ASTM A 351	CK-3MCuN CN-3MN	-	S5, S6		
1. SCOPE	requirements which	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 NORSOK Standard		nall comply with the requi	rement of		
3. STEEL MAKING			or equivalent process. Re is acceptable. Use of inter			
4. HEAT TREATMENT	Solution annealed a	at temperature ≥ 1225	°C.			
5. CHEMICAL	P ≤ 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). Th acceptance criteria are:					
	- No pitting at 20	-	,2			
7. EXTENT OF TESTING			ade for each melt and hea	t treatment load. A		
8. TEST SAMPLING	Samples for mecha components. Thick	nical testing shall real ness of the test block a maximum thickness	istically reflect the proper shall be equal to the thick of 100 mm. For flanged co	ness of the actual		
	Test specimens sha thickness of the tes		T location from the surface	ce where T is the		
		integrally cast or gate ntil after the final qua	ed onto the castings and sh lity heat treatment.	all not be removed		
9. NON DESTRUCTIVE TESTING	71 17 1 0 1 0 1 0 1 0 1					
	- All butt weld end	ls of each casting	ne pilot cast of each patter reas to ANSI B16.34 of ea			
	The acceptance crit	teria shall be to ASMI	E VIII, Div. 1, Appendix 7	1.		
10. SURFACE FINISH	White pickled. Sha machined surfaces.		any blasting and shall incl	ude finished		

MATERIAL D	ATA SHEET	MDS - R	16	Rev. 2		
TYPE OF MATERIAL	TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo					
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	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 %; Nb < 0.5 %. 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.					
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 should be stated in the		erature, soaking time an	d cooling medium		

MATERIAL D	ATA SHEET	MD	S - R17	Rev. 2		
TYPE OF MATERIAL:	Austenitic Stainless Ste	eel, Type 6Mo		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Bars	ASTM A 276	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-		
1. SCOPE	requirements which sl the referred standard.	ne selected options in the hall be added or supers Material grades not incurrements given to UN	ede the corresponding cluded in A 276 shall	g requirements in		
2. QUALIFICATION	Manufacturers of prod NORSOK Standard M	duct to this MDS shall 4-650.	comply with the requi	rement of		
3. STEEL MAKING	The steel melt shall be	e refined with AOD or	equivalent.			
4. HEAT TREATMENT	Solution annealing for	Solution annealing followed by water quenching.				
5. CHEMICAL COMPOSITION	UNS N08925 and N08	UNS N08925 and N08926: N = 0.18 - 0.22 %				
6. CORROSION TESTING	shall be 50 °C and the at the same location a	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 n	nagnification.				
	- The weight loss sha	ll be less than 4.0 g/m ²				
7. EXTENT OF TESTING	One tensile test and cotreatment load.	orrosion test shall be ca	arried out for each hea	at and heat		
8. TEST SAMPLING	Samples for production components.	on testing shall realistic	cally reflect the proper	rties in the actual		
9. SURFACE FINISH	Finished product shall	Finished product shall be white pickled.				
10. REPAIR OF DEFECTS	Weld repair is not acc	Weld repair is not acceptable				
11. MARKING	The component shall lot.	The component shall be marked to ensure full traceability to melt and heat treatment				
12. CERTIFICATION	EN 10 204 Type 3.1B should be stated in the	. Heat treatment tempe e certificate.	erature, soaking time a	nd cooling medium		

MATERIAL D	ATA SHEET	MI	OS - R18	Rev. 2		
TYPE OF MATERIAL	: Austenitic stainless	steel, Type 6Mo		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Tubes	ASTM A 269	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-		
1. SCOPE	requirements which si referred standard. Ma	hall be added or super	the referred standard are sede the corresponding ded in A 269 shall comes S S31254.	requirements in the		
2. QUALIFICATION	Manufacturers of processing Manufacturers of processing Standard M-650.	duct to this MDS shal	l comply with the requi	rement of NORSOK		
3. STEEL MAKING	The steel melt shall b	e refined by AOD or e	equivalent.			
4. HEAT TREATMENT	The tubes shall be sol	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 (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 acceptance criteria are: - No pitting at 20 X magnification. - The weight loss shall be less than 4.0 g/m².					
6. EXTENT OF TESTING	Corrosion testing shalin the referred standar		same extent as stated f	For mechanical tests		
7. TEST SAMPLING	Samples for production components.	on testing shall realist	ically reflect the proper	ties in the actual		
8. SURFACE FINISH	White pickled.					
9. REPAIR OF DEFECTS	Weld repair is not acc	ceptable.				
10. MARKING	The component shall lot.	be marked to ensure f	ull traceability to melt	and heat treatment		
11. CERTIFICATION	EN 10 204 Type 3.1E should be stated in the		perature, soaking time a	nd cooling medium		

MATERIAL D	ATA SHEET	MI	OS - R18	Rev. 2		
TYPE OF MATERIAL	: Austenitic stainless	steel, Type 6Mo		Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Tubes	ASTM A 269	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-		
1. SCOPE	requirements which si referred standard. Ma	hall be added or super	the referred standard are sede the corresponding ded in A 269 shall comes S S31254.	requirements in the		
2. QUALIFICATION	Manufacturers of processing Manufacturers of processing Standard M-650.	duct to this MDS shal	l comply with the requi	rement of NORSOK		
3. STEEL MAKING	The steel melt shall b	e refined by AOD or e	equivalent.			
4. HEAT TREATMENT	The tubes shall be sol	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 (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 acceptance criteria are: - No pitting at 20 X magnification. - The weight loss shall be less than 4.0 g/m².					
6. EXTENT OF TESTING	Corrosion testing shalin the referred standar		same extent as stated f	For mechanical tests		
7. TEST SAMPLING	Samples for production components.	on testing shall realist	ically reflect the proper	ties in the actual		
8. SURFACE FINISH	White pickled.					
9. REPAIR OF DEFECTS	Weld repair is not acc	ceptable.				
10. MARKING	The component shall lot.	be marked to ensure f	ull traceability to melt	and heat treatment		
11. CERTIFICATION	EN 10 204 Type 3.1E should be stated in the		perature, soaking time a	nd cooling medium		

MATERIAL DA	l'A SHEET		MDS - S01	Rev. 2		
TYPE OF MATERIAL: A	ıstenitic Stainless S	Steel, Type 310	6	Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Wrought fittings Welded pipes Seamless & welded pipes Forgings Plates Tubes	ASTM A 403 ASTM A 358 ASTM A 312 ASTM A 182 ASTM A 240 ASTM A 269	WP 316 316 TP 316 F 316 316 316	W/S/WX Class 1, 3, 4 or 5 - -	- - - -		
1. SCOPE	requirements which the referred standar	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	All products: C = Plates to A 240:	$S \le 0.035 \%$ $S \le 0.015 \%$				
3. TENSILE TESTING	Grade 316 L with 1	$Rp0.2 \ge 205 MP$	a and $R_m \ge 515$ MPa is acc	eptable.		
4. TEST SAMPLING	Samples for production component.	ction testing sh	all realistically reflect the p	roperties in the actual		
5. DIMENSIONAL TOLERANCES	Flanges to A 182:		S SP-44 shall have a maxin e of 0.3 mm at weld end.	num wall thickness		
6. NON DESTRUCTIVE TESTING	Welded pipes to A 358: Eddy current testing according to ASTM A450 is acceptable as replacement for spot radiography for wall thicknesses less than 4.0 mm. Welded tubes to A269: Eddy current testing according to ASTM A 450, section 23 is required.					
7. SURFACE FINISH	White pickled. Ma	White pickled. Machined surfaces do not require pickling.				
8. REPAIR OF DEFECTS	Weld repair of base	Weld repair of base material is not acceptable.				
9. CERTIFICATION	EN 10 204 Type 3.	.1B				

MATERIAL D	ATA SHEET	· N	MDS - S02	Rev. 2		
TYPE OF MATERIAL:	TYPE OF MATERIAL: Austenitic Stainless Steel Castings					
PRODUCT	STANDARD	STANDARD GRADE ACCEPT. CLASS				
Castings	ASTM A 351	CF8M CF3M	-	S5, S6 S5, S6		
I. SCOPE	-	shall be added	tions in the referred stand or supersede the correspo			
2. EXTENT OF TESTING	Tensile testing is re	equired for each l	heat and heat treatment lo	oad.		
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					
4. NON DESTRUCTIVE TESTING	components. Liquid penetrant testing: Supplementary requirement S6 shall apply to all accessible surfaces of all castings. The testing shall be carried out after final maching and pickling. The acceptance criteria 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.					
5. SURFACE FINISH	White pickled. Mad	chined surfaces d	lo not require pickling.			
6. CERTIFICATION	EN 10 204 Type 3.	1B				

MATERIAL DAT	TA SHEET	M	DS - T01	Rev. 2	
TYPE OF MATERIAL: Ti	tanium Grade 2			Page 1 of 1	
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.	
Seamless pipes	ASTM B 861	2	-	-	
Welded pipes	ASTM B 862	2	-	-	
Wrought fittings	ASTM B 363	WPT2/WPT2	W -	-	
Forgings	ASTM B 381	F2	-	-	
Plates	ASTM B 265	2	-	-	
Bars	ASTM B 348	2	_	-	
Tubes	ASTM B 338	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 compos	ition other than G	rade 2 (GOST VT 1-0) is	acceptable.	
3. HEAT TREATMENT	0 0	on if not the tensil	to B 381, Plates to B 265 to properties in the referred		
4. EXTENT OF TESTING	Wrought fittings to		e test shall be carried out the test	for each heat, heat	
	Forgings to B 381: Tensile test specimen shall be taken from each lot. A is defined as all products of the same heat and heat treatment load with a maximum deviation from the to block thickness of 10 mm				
	Bars to B 348:	is defir treatme	e test specimen shall be ta ned as all products of the ent load with a maximum hickness of 10 mm.	same heat and heat	
5. TEST SAMPLING	All products:		es for production testing s	hall realistically reflect	
		the pro	perties in the actual comp	oonent.	
6. WELDING	Welded pipes to B		ng procedures shall be qua SME IX.	alified in accordance	
7. DIMENSIONAL TOLERANCES	Flanges to B 381:		s to MSS SP-44 shall haves under tolerance of 0.3		
8. CERTIFICATION	EN 10 204 Type 3	3.1B.			

MATERIAL DA	TA SHEET	MDS	S - T02	Rev. 2
TYPE OF MATERIAL: T	itanium Grade 2			Page 1 of 1
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.
Castings	ASTM B 367	C2	-	S1, S2
1. SCOPE	requirements which so the referred standard.	hall be added or supe grades (GOST VT 1-	the referred standard a ersede the correspondin 0) are acceptable provi	g requirements in
2. QUALIFICATION	1	duct to this MDS sha	all be qualified in accord	dance with
3. CHEMICAL COMPOSTION	Chemical composition	n other than Grade 2	(GOST VT 1-0) is acce	eptable.
4. EXTENT OF TESTING	Tensile testing is requ	ired for each heat an	d heat treatment load.	
5. 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.			
6. NON DESTRUCTIVE TESTING	Liquid penetrant testing: Supplementary requirement S2 shall apply to all accessible surfaces of all castings. The testing shall be carried out after final machining. The acceptance criteria shall be ASME VIII, Div.1, Appendix 7.			
	 Radiographic testing: Supplementary requirement S1 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. 			
7. MARKING			full traceability to melt	
8. CERTIFICATION	EN 10 204 Type 3.1B	,		

MATERIAL DAT	A SHEET	MD	S - X01	Rev. 1	
TYPE OF MATERIAL: Lo	w Alloyed Steel Ty	ype 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	-	shall be added or s	is in the referred standa upersede the correspon		
2. HEAT TREATMENT	Fittings and pipes si The tempering temp		the liquid quenched an nimum 650 °C.	d tempered condition.	
3. MANUFACTURING PROCESS	1	ifactured by means	of the hot finished (HF)) sizing method.	
4. CHEMICAL COMPOSITION	Max. sulphur conte	· 	%		
5. TENSILE TESTING	Max. phosphorous content: $P \le 0.025 \%$ Minimum yield strength: $Reh \ge 415 MPa$ Minimum tensile strength: $Rm \ge 620 MPa$ Minimum elongation: $A5 \ge 18 \%$ Minimum red. of area: $Z \ge 35 \%$				
6. IMPACT TESTING	Charpy V-notch impact testing shall be carried out according to ASTM A 370 for thicknesses $t \ge 6$ mm. Full sized Charpy V-notch specimens shall be used wherever possible. The notch shall be perpendicular to the surface. The test temperature shall be - 30 °C. The minimum absorbed energy for full size specimens shall be 42 J average and 30 J single. Reduction factors for subsize specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.				
7. EXTENT OF TESTING	One set of tensile and impact test shall be carried out for each lot. A lot is defiened as all products of the same type, nominal size and wall thickness, produced from the same heat and heat treatment load. For pipes heat treated in continous furnace the maximum lot size shall be 60 m.				
8. TEST SAMPLING	Samples for production testing shall realistically reflect the properties in the actual component.				
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 a	acceptable.			
11. MARKING	The component shalot.	ll be marked to ensu	ure full traceability to n	nelt and heat treatment	
12. CERTIFICATION	EN 10 204 Type 3. should be stated in		temperature, soaking tii	me and cooling medium	

MATERIAL DAT	'A SHEET	M	DS - X02	Rev. 2		
TYPE OF MATERIAL: Hig	gh Strength Low Alloyed Steel Type AISI 4140			Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLAS	SS SUPPL. REQ.		
Forgings	ASTM A 788	AISI 4140	-	S18		
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. MANUFACTURING PROCESS	The forgings shall b	be finished hot-v	vorked.			
3. HEAT TREATMENT	The forgings shall be	be austenitised, l	iquid quenched and ter	mpered.		
4. CHEMICAL COMPOSITION	According to ASTN	M A 29, AISI 41	40			
5. TENSILE TESTING	Minimum yield stre Minimum tensile st Minimum elongatio	erength: $Rm \ge 8$	50 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 a +/- 25 % and heat t		nall be carried out for e	each melt, section thickness		
8. TEST SAMPLING	Samples for production component.	ction testing shal	l realistically reflect th	e properties in the actual		
	shall be used for di	e forged compor		onents. Sacrificial forgings l agreements may be made ag 50 kg.		
	thickness of the tes	t samples as hea		l be established showing		
9. NON DESTRUCTIVE TESTING	type, size and location of test samples and extraction of test specimens. 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 a	acceptable.				
11. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.					
12. CERTIFICATION	EN 10 204 Type 3.	1B				
	Heat treatment tem certificate.	perature, soakin	g time and cooling med	lium should be stated in the		

MATERIAL D	ATA SHEET	MDS	- X03	Rev. 2		
TYPE OF MATERIAL	: 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 requirements which shall referred standard.	_				
2. IMPACT TESTING	Charpy V-notch testing be perpendicular to the s (3 specimens) and 30 J s	surface. The minimun				
3. EXTENT OF TESTING	One set of tensile and in lot shall not exceed 5000	_	for each melt and heat t	reatment load. A test		
4. TEST SAMPLING	components. Thickness	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 thickness of the test block		cation from the surface	where T is the		
	Test block shall be integ from the castings until a	• •		l not be removed		
5. NON DESTRUCTIVE TESTING	surfaces of all castings.	Magnetic particle testing: Supplementary requirement S4 shall apply to all accessible surfaces of all castings. The examination shall be carried out after 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. 					
6. REPAIR OF DEFECTS	All weld repairs shall be qualification shall include		ed. The repair welding p	procedure		
	- qualification on a cast	plate of the same grad	le			
	- one set of impact test (3 specimens), shall be taken from weld metal and fusion line.					
7. MARKING	The component shall be	marked to ensure full	I traceability to melt an	d heat treatment lot.		
8. CERTIFICATION	EN 10 204 Type 3.1B. I should be stated in the c	_	ature, soaking time and	cooling medium		

MATERIAL DAT	A SHEET	MD	S - X04	Rev. 1	
TYPE OF MATERIAL: Hig	th Strength Low Al	loyed 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	_	shall be added or s	s in the referred standard upersede the correspondir		
2. MANUFACTURING PROCESS	The flanges shall be accepted.	e forged to shape. Fl	langes machined out of ba	r and or plate are not	
3. HEAT TREATMENT/ DELIVERY CONDITION	The flanges shall be	austenitised, liquic	I quenched and tempered.		
4. CHEMICAL COMPOSITION	•	nce with the require	the requirements of AISI 4 tements PSL 3 given in tableed.		
5. IMPACT TESTING	Charpy V-notch tessize specimens shall	•	quired. The minimum absord 30 J single.	orbed energy for full	
6. EXTENT OF TESTING		-	be carried out for each me reatment load. A test lot s		
7. TEST SAMPLING	Samples for produc component.	tion testing shall rea	alistically reflect the propo	erties in the actual	
	shall be used for die	e forged component	ns on actual components. s. However, special agree ed weight exceeding 50 kg	ments may be made	
	thickness of the test	samples as heat tre	location from the surface ated. Sketches shall be estand extraction of test.		
8. DIMENSIONAL TOLERANCES	Flanges to MSS SP- mm for the hub at the		ximum wall thickness und	er tolerance 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 criterias shall be according to ASTM A 388 para 8.				
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	EN 10 204 Type 3.1 should be stated in t		emperature, soaking time	and cooling medium	

MATERIAL DA	ATA SHEET	MI	OS - X05	Rev. 1		
TYPE OF MATERIAL:	High Strength Low A	Alloyed Steel Type	e F22	Page 1 of 1		
PRODUCT	STANDARD	GRADE	ACCEPT. CLASS	SUPPL. REQ.		
Forgings	ASTM A 182	F22	3	S4		
I. SCOPE	_	ch shall be added or	ons in the referred standar supersede the correspon			
2. HEAT TREATMENT	Normalized and te	empered.				
3. IMPACT TESTING	size specimens sha		required. The minimum a and 20 J single. Reduction 5 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 producomponent	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.				
	shall be used for d					
	thickness of the te	est samples as heat t	T location from the surreated. Sketches shall be and extraction of test s	e established showing		
6. DIMENSIONAL TOLERANCES	Flanges to MSS S mm for the hub at		naximum wall thickness	under tolerance of 0.3		
7. NON DESTRUCTIVE TESTING	of all forgings (fro	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 bas	se material is not ac	ceptable.			
9. MARKING	The component shlot.	The component shall be marked to ensure full traceability to melt and heat treatment lot.				
10. CERTIFICATION	EN 10 204 Type 3 should be stated in		t temperature, soaking ti	me and cooling medium		

MATERIAL D	ATA SHEET	MDS	S - X06	Rev. 1
TYPE OF MATERIAL: High Strength Low Alloy Steel for application 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	$C \leq 0.14$ %; Si ≤ 0.50 %; Mn = 1.30-1.60 %; Cr ≤ 0.20 %; Ni = 0.90-1.10 % and Mo = 0.15-0.25 %			
3. IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at -46 °C. The notch shall be perpendicular to the surface. The minimum absorbed energy shall be 42 J average (of (3 specimens) and 30 J single value.			
4. EXTENT OF TESTING	One set of tensile and impact test is required for each melt and heat treatment load. A test lot shall not exceed 5000 kg.			
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 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 before after the final quality heat treatment.			
6. NON DESTRUCTIVE TESTING	Magnetic particle testing: Supplementary requirement S4 shall apply to all accessible surfaces of all castings. The examination shall be carried out after 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 testing The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7				
7. REPAIR OF DEFECTS	All weld repairs shall be post weld heat treated. The repair welding procedure qualification shall include the following:			
	1 -	- qualification on a cast plate of the same grade- one set of impact test (3 specimens) shall be taken from weld metal and fusion line.		
8. MARKING	The component shall be marked to ensure full traceability to melt and heat treatment lot.			
9. CERTIFICATION	EN 10 204 Type 3.1B. Heat treatment temperature, soaking time and cooling medium should be stated in the certificate.			

