NORSOK STANDARD

COMMON REQUIREMENTS

MATERIAL DATA SHEETS FOR PIPING

M-CR-630 Rev. 1, December 1994

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1 FOREWORD

This standard has been developed by the NORSOK standardisation work group and agreed by the Norwegian industry for the widest possible national and international application.

Note: Materials of Type 6Mo and 25 Cr duplex manufactured prior to 01.01.95 can be accepted provided the following is satisfied:

- Corrosion tests have been carried out with acceptance criteria for pitting and weight loss according to NORSOK MDS'es at 40 ° C.

- The microstructure is free from all grain boundary carbides and intermetallic phases.

2 SCOPE

This Standard is a collection of the Piping Material Data Sheets (MDS) applicable to selected material standards and grades for use in piping systems. The scope for the MDS's is as follows:

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.

3 NORMATIVE REFERENCES

As stated in the individual data sheets.

4 DEFINITIONS

MDS	Material data sheet
SMYS	Specified minimum yield strength
Carbon Steel Type 235	Carbon steel with SMYS >= 220MPa and not impact tested
Carbon Steel Type 235LT	Carbon steel with SMYS >= 220 MPa and impact tested at - 46 °C
Carbon Steel Type 360LT	Carbon steel with SMYS >= 350 MPa and impact tested at - 46 °C
Stainless Steel Type 316	Alloys with approx. 2.5 % Mo of type AISI 316
Stainless Steel Type 6Mo	Alloys with 6 % Mo and PRE > 40
Stainless Steel Type 22Cr duplex	Alloys with 22 % Cr according to UNS S31803
Stainless Steel Type 25Cr duplex	Alloys with 25 % Cr and PRE > 40, often also referred to as "super duplex"

5 COLLECTION OF MATERIAL DATA SHEETS

5.1 General

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 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
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.

Table 5.1 - 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 6Mo[2)]	Stainless steel Type 22Cr Duplex	Stainless steel Type 25Cr Duplex	Nickel alloy	Titanium
Pipes Seamless	A 106 Grade B	A 333 Grade 6	API 5L Grade X52	A 312 Grade TP 316	A 312 UNS S31354	A 790 UNS S31803	A790 UNS S32550 A790 UNS S 32750 A790 UNS S 32760	B775 UNS N06625	B 337 Grade 2
Pipes Welded	API 5L Grade B	A 671 Grade CC60 Class 12, 22	A 671 Grade CC70 Class 12, 22	A 312 Grade TP316 A 358 Grade 316 Class 1, 3, 4	A 358 UNS S31254 Class 1, 3, 5	A 358 UNS S31803 Class 1, 3, 5	A358 UNS S 32550 A358 UNS S 32750 A358 UNS S 32760 Class 1, 3 and 5	B775 UNS N06625	B 337 Grade 2
Fittings	A 234 Grade WPB	A 420 Grade WPL 6	A 860 Grade WPHY 52	A 403 Grade WP 316 Class S, W, WX	A 403 Grade WP S31254 Class S, W, WX	A 815 UNS S31803 Class S, W, WX	A815 UNS S32550 A815 UNS S 32750 A815 UNS S 32760 Class S, W, WX	B366 UNS N06625	B 363 Grade WPT2W B 363 Grade WPT2
Forgings	A 105	A 350 Grade LF2	A 694 Grade F52	A 182 Grade F316	A 182 Grade F44	A 182 Grade F51	A182 UNS S32550 A182 UNS S 32750 A182 UNS S 32760	B564 UNS N06625	B 381 Grade F2

Plate	A 516 Grade 60, 70	A 516 Grade 70	A 516 Grade 70,	A 240 Grade 316	A 240 UNS S31254	A 240 UNS S31803	A240 UNS S32550 A240 UNS S32750 A240 UNS S 32760	B443 UNS N06625	B 265 Grade 2
Castings	A 216 Grade WCB	A 352 Grade LCC	A 352 Grade LCC	A 351 Grade CF8M	A 351 CK-3MCuN	A 890 UNS J92205	A890 UNS J93404 A890 UNS J93380	B494 Grade CW-6MC Class 1	B 367 Grade C2

NOTE 1) Type 235 should be used in piping systems with minimum design temperature above or equal to -15°C and thicknesses less than 30 mm.

NOTE 2) The grades UNS N08367, N08925 and N08926 are considered equivalent to UNS S31254. The grade CN-3 MN is considered equivalent to CK-3MCuN.

5.2 Referenced Standards and Corresponding MDS

MDS No.	Rev. No.	Standard and Grade	Products
		Carbon Steel Type 235	
C01	1	A 106 Grade B	Seamless pipes
C01	1	API 5L Grade B	Welded pipes
C01	1	A 234 Grade WPB	Wrought fittings
C01	1	A 105	Forgings
C01	1	A 516 Grade 60	Plates
C02	1	A 216 Grade WCB	Castings
		Carbon Steel Type 235LT	
C11	1	A 333 Grade 6	Seamless pipes
C11	1	A 671 Grade CC60, CC70	Welded pipes
C11	1	A 420 Grade WPL 6	Wrought fittings
C11	1	A 350 Grade LF 2	Forgings
C11	1	A 516 Grade 70	Plates
C12	1	A 352 Grade LCC	Castings
		Carbon Steel Type 360LT	
C21	1	A 694 Grade F52	Forgings
C21	1	A 860 WPHY 52	Wrought fittings
C22	1	API 5L Grade X52	Seamless pipes

		Ferritic/Austenitic Stainless Steel Type 22Cr Duplex	
D41	1	A 790 UNS S31803	Seamless pipes
D42	1	A 358 UNS S31803	Welded pipes
D43	1	A 815 UNS S31803	Wrought fittings
D44	1	A 182 Grade F51	Forgings
D45	1	A 240 UNS S31803	Plates
D46	1	A 890 UNS J92205	Castings
D47	1	A 276 UNS S31803	Bars
D48	1	A 289 UNS S31803	Tubes
		Ferritic/Austenitic Stainless Steel Type 25Cr Duplex	
D51	1	A 790 UNS S32550	Seamless pipes
		A 790 UNS S32750	
		A 790 UNS S32760	
D52	1	A 358 UNS S32550	Welded pipes
		A 358 UNS S32750	
D53	1	A 358 UNS S32760	Wrought fittings
		A 815 UNS S32550	
		A 815 UNS S32750	
		A 815 UNS S32760	
D54	1	A 182 UNS S32550	Forgings
		A 182 UNS S32750	
		A 182 UNS S32760	
D55	1	A 240 UNS S32550	Plates
		A 240 UNS S32750	
		A 240 UNS S32760	
D56	1	A 890 UNS J93380 and UNS J93404	Castings
D57	1	A 276 UNS S32550	Bars
		A 276 UNS S32750	
		A 276 UNS S32760	
		Nickel Alloy Type 625	
N01	1	B 366 UNS N06625	Wrought fittings
N01	1	B 775 UNS N06625	Pipes
N01	1	B 564 UNS N06625	Forgings
N01	1	B 443 UNS N06625	Plates
N01	1	B 446 UNS N06625	Bars
N02	1	A 494 Grade CW-6MC	Castings

Polymers including fibre reinforced

P01	1	UK00A	GRP pipes and fittings

Austenitic Stainless Steel Type 6Mo

R11	1	A 312 UNS S31254	Seamless pipes
R12	1	A 358 UNS S31254	Welded pipes
R13	1	A 403 UNS S31254	Wrought fittings
R14	1	A 182 Grade F44	Forgings
R15	1	A 240 UNS S31254	Plates
R16	1	A 351 Grade CK-3MCuN	Castings
R17	1	A 276 UNS S31254	Bars
R18	1	A 269 UNS S 31254	Tubes

Austenitic Stainless Steel Type 316

S01	1	A 312 Grade TP 316	Seamless & welded pipes
S01	1	A 358 Grade 316	Welded pipes
S01	1	A 403 Grade WP 316	Wrought fittings
S01	1	A 182 Grade F 316	Forgings
S01	1	A 240 Grade 316	Plates
S02	1	A 351 Grade CF8M	Castings
S02		A 351 Grade CF3M	Castings

Titanium Grade 2

T01	1	B 337 Grade 2	Seamless & welded pipes
T01	1	B 363 Grade WPT2/WPT2W	Wrought fittings
T01	1	B 381 Grade F2	Forgings
T02	1	B 367 Grade C2	Castings
T01	1	B 265 Grade 2	Plates
T01	1	B 348 Grade 2	Bars
T01		B 338 Grade 2	Tubes

Low Alloy Steel Type AISI 4130

X02	1	A 788 AISI 4140	Forgings
X03	1	A 487 Grade 2B, 2D	Castings

MATERIAL DATA SHEET **MDS - C01, Rev. 1**				
TYPE OF MATERIAL: Carbon Steel Type 235				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittings Welded pipes Seamless pipes Forgings Plates	ASTM A 234 API 5L ASTM A 106 ASTM A 105 ASTM A 516	WPB B B - 60	- - - - -	- - - - -
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ **DELIVERY CONDITION**	*Welded pipes to API 5L:* Stress relieving when the nominal thickness t >= 19 mm.			
CHEMICAL COMPOSITION	C <= 0.22 %; Si >= 0.10 %; Mn = 0.50 - 1.35 %; S <= 0.025 %; P <= 0.030 %;CE = C + Mn/6 + 0.04 <= 0.43.			
TENSILE TESTING				
EXTENT OF TESTING				
TEST SAMPLING				
DIMENSIONAL TOLERANCES	*Fittings to A 234:* Fittings with reference to MSS-SP-75 shall have maximum wall thickness undertolerance of 0,3 mm. *Flanges 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.			
NON DESTRUCTIVE TESTING	*Pipes to API 5L* : RT of weld seam or RT at ends and US/Eddy Current of the remaining weld.			
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - C02, Rev. 1**				
TYPE OF MATERIAL: Carbon Steel Type 235				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 216	WCB	-	S4, S5
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	C <= 0.22 % and CE = C + Mn/6 + 0.04 <= 0.43 for castings with butt weld ends.			
TENSILE TESTING				
HARDNESS				
IMPACT TESTING				
EXTENT OF TESTING				
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast with the casting.			
NON DESTRUCTIVE TESTING	*Magnetic particle examination:* Supplementary requirement S4 shall apply to 10 % of delivered castings in pressure class 150/300 psi and to 100 % of delivered castings in pressure class 600 psi and above. All accessible surfaces, of the given percentage or minimum two off, of the castings from the same pattern and the same batch shall be examined. The acceptance criterias shall be ASME VIII, Div.1, Appendix 7. *Radiographic examination:* Supplementary requirement S5 shall apply to: - critical areas as per ANSI B16.34 of the pilot cast of each pattern - Class 600 and 900 psi; all butt weld ends - Class 1500 psi and above; all critical areas according to ANSI B16.34. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.			
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - C11, Rev. 1**				
TYPE OF MATERIAL: Carbon Steel Type 235LT				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittings Welded pipes Seamless pipes Forgings Plates	ASTM A 420 ASTM A 671 ASTM A 333 ASTM A 350 ASTM A 516	WPL 6 CC60, CC70 6 LF2 70	- t <= 19 mm: Class 12 t > 19 mm: Class 22 - -	S4 S2, S7 S2, S7 - S7 S5
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	C <= 0.22 %; Mn = 0.50 - 1.35 %; S <= 0.025 %; P <= 0.030 %;CE = C + Mn/6 + 0.04 <= 0.43.			
TENSILE TESTING				
HARDNESS				
IMPACT TESTING	*Plates to A 516:* Supplementary requirement S5 shall apply. *Pipes to A 671* : Supplementary requirement S2 shall apply. *All products:* The test temperature shall be - 46 °C. The minimum absorbed energy for full size specimens shall be 27 J average and 20 J single. Reduction factors for subsize specimens shall be: 7,5mm - 5/6 and 5 mm - 2/3.			
EXTENT OF TESTING				
TEST SAMPLING				
WELDING				
DIMENSIONAL TOLERANCES	*Fittings to A 420:* Fittings with reference to MSS SP-75 shall have maximum wall thickness under tolerance of 0,3 mm in accordance with standard. *Flanges to A 350:* Flanges to MSS SP-44 shall have a maximum wall thickness under tolerance of 0,3 mm for the hub at the welding end.			

NON DESTRUCTIVE TESTING	*Fittings to A 420:* Supplementary requirement S4, magnetic particle examination, shall apply to the weld area of 10 % of all fittings. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 6. *Forgings to A 350:* Supplementary Requirement S7.1, magnetic particle examination shall apply to 10 % of all forgings with NPS > 2. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 6.
SURFACE FINISH	
REPAIR OF DEFECTS	Weld repair of base material is not acceptable.
CERTIFICATION	EN 10 204 Type 3.1B

MATERIAL DATA SHEET **MDS - C12 Rev.1**				
TYPE OF MATERIAL: Carbon Steel Type 235LT				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 352	LCC	-	S4, S5
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	C <= 0.22 % ; S <= 0.025 %; P <= 0.030 %; CE = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15 <= 0.43			
TENSILE TESTING				
HARDNESS				
IMPACT TESTING	The minimum absorbed energy for full size specimens shall be 27 J average and 20 J single.			
EXTENT OF TESTING	If quenched and tempered heat treatment is applied, tensile and impact test is required for each melt and heat treatment load. Test blocks shall be heat treated with the castings they represents.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast with the casting.			
NON DESTRUCTIVE TESTING	*Magnetic Particle Examination:* Supplementary requirement S4 shall apply to 10 % of delivered castings in pressure class 150/300 psi and to 100 % of delivered castings in pressure class 600 psi and above. All accessible surfaces, of the given percentage or minimum two off, of the castings from the same pattern and batch shall be examined.The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. *Radiographic examination:* Supplementary requirement S5 shall apply to: - critical areas as per ANSI B16.34 of the pilot cast of each pattern - Class 600 and 900 psi; all butt weld ends - Class 1500 psi and above; all critical areas to ANSI B16.34.The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.			
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - C21, Rev. 1**				
TYPE OF MATERIAL: Carbon Steel Type 360LT				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittingsForgings	ASTM A 860 ASTM A 694	WPHY F52 F52	Seamless and welded -	
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	*Forgings to A 694:* C <= 0.20 %; Mn = 0.90 - 1.60 %; Si= 0.10-0.50 %; S <= 0.025 %; P <= 0.035 %; Ti <= 0.05 %; Nb <= 0.04 %; Al <= 0.06 %; N <= 0.015 %; V+Nb+Ti <= 0.07 %; CE = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15 <= 0.43 .			
TENSILE TESTING				
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 specimen 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.			
EXTENT OF TESTING	*Forgings to A 694:* Impact tests shall be taken to the same frequency as tensile test.			
TEST SAMPLING	*Forgings to A 694:* The test location shall be according to A 350 para 6.2.3.			
WELDING	*Fittings to A 860:* The WPQ shall be qualified in accordance with ASME IX or EN 288-3.			
DIMENSIONAL TOLERANCES	*Fittings to A 860:* Fittings with reference to MSS-SP-75 shall have maximum wall thickness under tolerance of 0,3 mm. *Flanges 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.			
NON DESTRUCTIVE TESTING	*Fittings to A 860:* Supplementary requirement S4, magnetic particle examination, shall apply to the weld area to 10 % of all fittings. *Forgings to A 694:* 10 % of all forgings with NPS > 2 shall be magnetic particle examined according to ASME V Article 7. *All products:* The acceptance criteria shall be to ASME VIII Div. 1, Appendix 6.			

SURFACE FINISH	
REPAIR OF DEFECTS	Weld repair of base material is not acceptable.
CERTIFICATION	EN 10 204 Type 3.1B

MATERIAL DATA SHEET **MDS - C22, Rev. 1**				
TYPE OF MATERIAL: Carbon Steel Type 360LT				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Seamless pipes	API 5L	X52	-	t > 25 mm : SR 4
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.			
MANUFACTURING PROCESS	Fine grain treatment shall be carried out.			
HEAT TREATMENT/ DELIVERY CONDITION	Normalised or Quenched and Tempered.			
CHEMICAL COMPOSITION	C <= 0.16 %; Mn = 0.90 - 1.60 %; Si= 0.10-0.50 %; S <= 0.025 %; P <= 0.035 %; Ti <= 0.05 %; Nb <= 0.04 %; Al <= 0.06 %; N <= 0.015 %; V+Nb+Ti <= 0.07 %; CE = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15 <= 0.43			
TENSILE TESTING				
HARDNESS				
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.			
EXTENT OF TESTING				
TEST SAMPLING				
NON DESTRUCTIVE TESTING	Supplementary requirement SR 4 shall apply for thicknesses > 25 mm.			
SURFACE FINISH	The surface finish shall comply with ASTM A 106 para. 18.3.2			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - D41, Rev. 1				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Seamless pipes	ASTM A 790	UNS S31803	-	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING				
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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 metal and 35 J single. Two sets, each 3 specimen, shall be carried out with notch located in weld metal and fusion line. Reduction factors for subsize specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
EXTENT OF TESTING	Charpy V-notch impact, microstructure, hardness and tensile testing shall be carried out for each lot as defined in the referred standard.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - D42, Rev. 1				
TYPE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Welded pipes	ASTM A 358	UNS S31803	Class 1, 3 and 5	S3
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING	Base material properties: Rp0.2 >= 450 MPa; Rm >= 620 MPa; A >= 25%.			
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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. Reduction factors for subsize specimens shall be: 7.5 mm - 5/6 and 5 mm - 2/3.			
MICROGRAPHIC EXAMINATION	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.			
EXTENT OF TESTING	Tensile, impact, hardness 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 60m of 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.			
TEST SAMPLING				
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.			
NON DESTRUCTIVE TESTING	Eddy current examination according to ASTM A 450 is acceptable as replacement for radiography for wall thicknesses less than 4.0 mm.Supplementary requirement S3, penetrant examination, according to ASME V Article 6 shall apply to the weld area of 10% of the pipes delivered. Acceptance criteria shall be to ASME VIII, Div. 1 Appendix 7.			
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds same requirements to PQR/WPAR shall apply as for production welding.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - D43, Rev. 1**				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittings	ASTM A 815	UNS S31803	WP-W, WP-S or WP-WX	S2, S7
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING	Supplementary requirement S2 shall apply.			
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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 specimen. Welded fittings: Two sets, each 3 specimen, located in weld metal and fusion line.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the surface 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 suitably etched specimen, shall be free from intermetallic phases and precipitates.			
EXTENT OF TESTING	Impact tensile, hardness testing, microstructure examination to the same extent as tensile testing defined in supplementary requirement S2 and for each heat treatment load.			
TEST SAMPLING				
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.			
DIMENSIONAL TOLERANCES	Fitting with reference to MSS-SP-75 shall have maximum wall thickness under tolerance of 0,3 mm.			
NON DESTRUCTIVE TESTING	Supplementary requirement S7, liquid penetrant examination, shall apply to 10 % of all fittings above NPS 2.For welded fittings the examination shall cover the weld area only. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.			
SURFACE FINISH	White pickled except for machined surfaces.			
REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds same requirements to PQR/WPAR shall apply as for production welding.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - D44, Rev. 1				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Forgings	ASTM A 182	F51	-	S5
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process. The Hot Isostatic Pressed (HIP) process is an acceptable alternative to forging.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING				
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
EXTENT OF TESTING	Impact tensile, hardness testing, microstructure examination to the same extent as tensile testing defined in supplementary requirement S2 and for each heat treatment load.			
TEST SAMPLING	For open die and ring rolled products all test samples shall be taken from a rough forging or a prolongation of the part. Separate test specimens is acceptable for products made by the HIP process.			
DIMENSIONAL TOLERANCES	Flanges to MSS SP-44 shall have maximum wall thickness under tolerance of 0.3 mm for the hub at the welding end.			
NON DESTRUCTIVE TESTING	Supplementary requirement S5, liquid penetrant examination, shall apply to 10 % of forgings above NPS 2. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.			
SURFACE FINISH	White pickled except for machined surfaces.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - D45, Rev. 1				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Plates	ASTM A 240	UNS S31803	-	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING				
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
EXTENT OF TESTING	Impact tensile, hardness testing, micrographic examination shall be carried out for each heat, size and heat treatment load.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - D46, Rev. 1**				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 890	UNS J92205	-	S2, S3, S33
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.			
MANUFACTURING PROCESS	The steel melt shall be with AOD or equivalent refining.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING				
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
EXTENT OF TESTING	A full set of mechanical tests and microstructure examinations shall be made for each heat and heat treatment charge. The test blocks shall be heat treated with the casting they represent.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast with the casting. All test blocks shall be treated together with the casting they represent.			
NON DESTRUCTIVE TESTING	*Liquid penetrant examination:* Supplementary requirement S3 shall apply to all accessible surfaces of all castings. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. *Radiographic examination:* Supplementary requirement S5 shall apply to: - Critical areas as per ANSI B16.34 of the pilot cast of each pattern. - Class 600 and 900 psi; all butt weld ends - Class 1500 psi and above; all critical areas to ANSI B16.34. The acceptance criteria shall be to ASME VIII, Div. 1 Appendix 7.			
SURFACE FINISH	White pickled for machined surfaces.			
REPAIR OF DEFECTS	Supplementary requirement S33 shall apply. The repair welding procedure qualification shall include the following: - qualified on a cast plate - examination of microstructure and Charpy V-notch testing as specified above.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - D47, Rev. 1**				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Bars	ASTM A 276	UNS S31803	-	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING				
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
EXTENT OF TESTING				
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH				
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - D48, Rev. 1				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 22Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Tubes	ASTM A 789	UNS 31803	-	S5
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	N = 0.14 - 0.20 %			
TENSILE TESTING				
HARDNESS	The hardness shall be measured and less than 28 HRC or alternatively 271 HB or 290 HV10.			
IMPACT TESTING				
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.			
EXTENT OF TESTING	Microstructure, hardness and tensile testing shall be carried out for each lot as defined in the referred standard.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - D51, Rev. 1**				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Seamless pipes	ASTM A 790	UNS S 32550 UNS S 32750 UNS S 32760	-	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION	The pipes shall be solution annealed followed by water quenching.			
CHEMICAL COMPOSITION	PRE (% Cr + 3.3% Mo + 16% N) >= 40.0			
TENSILE TESTING	Rp0.2 >= 550 MPa; Rm >= 750 MPa; A >= 15 %			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 271 HB or 290 HV10.			
IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at - 46 °C. 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.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the surfaces 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.			
EXTENT OF TESTING	Charpy V-notch impact, microstructure, hardness, corrosion and tensile testing shall be carried out for each lot as defined in the referred standard.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - D52, Rev. 1				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Welded pipes	ASTM A 358	UNS S 32550 UNS S 32750 UNS S 32760	Class 1, 3 and 5	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION	Post weld solution annealing is not required of pipes manufactured out of solution annealed plate material as stated in chapter 5.3.2.2 of A 358.			
CHEMICAL COMPOSITION	PRE (% Cr + 3.3% Mo + 16% N) >= 40.0			
TENSILE TESTING	Rp0.2 >= 550 MPa; Rm >= 750 MPa; A >= 15%			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 271 HB or 290 HV10.			
IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at - 46 °C. 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.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the surfaces and mid-thickness region. Both weld metal and 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.			
EXTENT OF TESTING	Tensile, impact, hardness, corrosion 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 a lot is defined as maximum 60 m of pipe of the same hat and size and which are heat treated the same day.			
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 PQR/WPAR shall be carried out on the same material grade as shall be welded. Change of filler metal brand names required requalification.			
NON DESTRUCTIVE TESTING	Eddy current examination according to ASTM A 450 is acceptable as replacement for radiography for wall thicknesses less than 4.0 mm.Supplementary requirement S3, penetrant examination, according to ASME V Article 6 shall apply to the weld area of 10% of the pipes delivered. Acceptance criteria shall be to ASME VIII, Div. 1 Appendix 7.			

SURFACE FINISH	White pickled.
REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds same requirements to PQR/WPAR shall apply as for production welding.
CERTIFICATION	EN 10 204 Type 3.1B

MATERIAL DATA SHEET MDS - D53, Rev. 1				
TYPE OF MATERIAL: Ferritic / Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittings	ASTM A 615	UNS S 32550 UNS S 32750 UNS S 32760	WP-S, WP-WX and WP-W	S2, S7
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION	Solution annealing followed by water quenching.			
CHEMICAL COMPOSITION	PRE (% Cr + 3.3% Mo + 16% N) >= 40.0			
TENSILE TESTING	Base material properties: Rp0.2 >= 550 MPa; Rm >= 750 MPa; A >= 15%			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 271 HB or 290 HV10.			
IMPACT TESTING	Charpy V-notch testing shall be carried out according to ASTM A 370 at -46 °C and the minimum absorbed energy shall be 45 J average / 35 J single. 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 line.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface including weld zone in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
EXTENT OF TESTING	Tensile, impact, hardness, corrosion testing, microstructure examnation to the same extent as tensile tessting defined in supplementary requirement S2 except that all tests also shall be carried out for each heat treatment load.			
TEST SAMPLING	According to supplementary requirement S2.			
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 PQR/WPAR shall be carried out on the same material grade as shall be welded. Change of filler metal brand names required requalification.			

NON DESTRUCTIVE TESTING	Supplementary requirements S7, penetrant examination, shall apply to 10 % of all type of fittings above NPS 2. For welded fittings the examination shall cover the weld area only. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.
SURFACE FINISH	White pickled.
REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds same requirements to PQR/WPAR shall apply as for production welding.
CERTIFICATION	EN 10 204 Type 3.1B

MATERIAL DATA SHEET MDS - D54, Rev. 1				
TYPE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Forgings	ASTM A 182	UNS S 32550 UNS S 32750 UNS S 32760	-	S5
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process. The Hot Isostatic Pressed (HIP) process is an acceptable alternative to forging.			
HEAT TREATMENT/ DELIVERY CONDITION	Solution annealing followed by water quenching.			
CHEMICAL COMPOSITION	PRE (%Cr + 3.3% Mo + 16% N) >= 40.0.			
TENSILE TESTING	Rp0.2 >= 550 MPa; Rm >= 750 MPa; A >= 15%.			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m^2.			
EXTENT OF TESTING	Test samples for impact testing, microstructure, hardness, corrosion and tensile testing shall be carried out for each heat and heat treatment lot.			
TEST SAMPLING	All test samples shall be taken from a rough forging or prolongation of the part representing the heaviest wall thickness.			
NON DESTRUCTIVE TESTING	Supplementary requirement S5, liquid penetrant examination, shall apply to 10 % of forgings above NPS 2. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 8.			
SURFACE FINISH	White pickled including machined sealing surfaces.			
REPAIR OF DEFECTS	Weld repair.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - D55, Rev. 1**				
TYPE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Plates	ASTM A 240	UNS S 32550 UNS S 32750 UNS S 32760	-	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process.			
HEAT TREATMENT/ **DELIVERY CONDITION**	Solution annealing followed by water quenching.			
CHEMICAL COMPOSITION	PRE (%Cr + 3.3% Mo + 16% N) >= 40.0.			
TENSILE TESTING	Rp0.2 >= 550 MPa; Rm >= 750 MPa; A >= 15%.			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m^2.			
EXTENT OF TESTING	Test samples for impact testing, microstructure, hardness, corrosion and tensile testing shall be carried out for each heat and heat treatment lot.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Repair welding is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - D56, Rev. 1**				
TYPE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 890	UNS J93404 UNS J93380	-	S2, S3, S33
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process.			
HEAT TREATMENT/ **DELIVERY CONDITION**	According to Grade 5A (UNS J93404).			
CHEMICAL COMPOSITION	PRE (%Cr + 3.3% Mo + 16% N) >= 40.0.			
TENSILE TESTING	Rp0.2 >= 450 MPa; Rm >= 700 MPa; A >= 15%.			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 271 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the surface and mid-thickness region of the test blocks. On WPQ's both the weld and the 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.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m^2.			
EXTENT OF TESTING	A full set of mechanical and corrosion tests and microstructure examinations shall be made for each heat and heat treatment charge.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast with the casting. All test blocks shall be heat treated together with the castings they represent.			

NON DESTRUCTIVE TESTING	*Liquid penetrant examination:* Supplementary requirement S3 shall apply to all accessible surfaces of all castings in machined condition. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 7. *Radiographic examination (RT):* Supplementary requirement S5 shall apply to: - Critical areas as per ANSI B16.34 of the pilot cast of each pattern. - Class 600 and 900 psi; all butt weld ends - Class 1500 psi and above; all critical areas to ANSI B16.34. The acceptance criteria shall be to ASME VIII, Div. 1 Appendix 7.
SURFACE FINISH	White pickled shall be carried out after any blasting and shall include finished machined sealing surfaces.
REPAIR OF DEFECTS	Supplementary requirement S33 shall apply. The repair welding procedure shall be qualified in accordance with ASME IX or EN 288-3 and this MDS. The repair welding procedure qualification shall include the following: - qualified on a cast plate of the same material grade - change of filler metal brand names requires requalification - examination of microstructure - corrosion and Charpy V-notch testing as specified above.
CERTIFICATION	EN 10 204 Type 3.1B

MATERIAL DATA SHEET **MDS - D57, Rev. 1**				
TYPE OF MATERIAL: Ferritic/Austenitic Stainless Steel, Type 25Cr duplex				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Bars	ASTM A 276	UNS S 32550 UNS S 32750 UNS S 32760	-	-
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process.			
HEAT TREATMENT/ **DELIVERY CONDITION**	Solution annealing followed by water quenching.			
CHEMICAL COMPOSITION	PRE (%Cr + 3.3% Mo + 16% N) >= 40.0.			
TENSILE TESTING	Rp0.2 >= 550 MPa; Rm >= 750 MPa; A >= 15%.			
HARDNESS	The hardness shall be measured and shall be less than 28 HRC or alternatively 2715 HB or 290 HV10.			
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.			
MICROGRAPHIC EXAMINATION	The micrographic examination shall cover the 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.			
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 be with the surface in the as-delivered condition. The test shall expose the external, internal and cross section surface in full wall thickness. No pitting is acceptable at 20 X magnification. The weight loss shall be less than 4.0 g/m^2.			
EXTENT OF TESTING	Test samples for impact testing, microstructure, hardness, corrosion and tensile testing shall be carried out for each heat and heat treatment lot.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	Finished product shall be white pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - N01, Rev. 1**				
TYPE OF MATERIAL: Nickel alloy Type 625				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittings Pipes Forgings Plates Bars	ASTM B 366 ASTM B 775 ASTM B 564 ASTM B 443 ASTM B 446	UNS N06625 UNS N06625 UNS N06625 UNS N06625 UNS N06625	- - - - -	S3 - - - -
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION	Annealed.			
CHEMICAL COMPOSITION				
TENSILE TESTING				
EXTENT OF TESTING				
TEST SAMPLING				
FORMING				
NON DESTRUCTIVE EXAMINATION (NDE)	*Fittings to B 366:* Supplementary requirement S3, liquid penetrant, shall apply to the weld area at 10% of all fittings above NPS2, or 2 off of all fittings of each type. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 6. *Forgings to B 564:* Liquid penetrant examination shall be performed at 10% of forgings above NPS 2. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 6.			
SURFACE FINISH	Bright annealed or descaled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET MDS - N02, Rev. 1				
TYPE OF MATERIAL: Nickel alloy Type 625				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 494	CW-6MC	Class 1	S2, S3
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.			
MANUFACTURING PROCESS	-			
HEAT TREATMENT/ DELIVERY CONDITION	-			
CHEMICAL COMPOSITION	-			
TENSILE TESTING				
MICROGRAPHIC EXAMINATION	The specimen shall be taken on a crossection from surface to mid-thickness. The microstructure, as examined at 200 X magnification on a suitably etched specimen, shall be free from grain bondary carbides and intermetallic phases.			
EXTENT OF TESTING	Tensile test and micrographic examination for each melt and heat treatment load.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast.			
NON DESTRUCTIVE EXAMINATION (NDE)	*Liquid penetrant examination:* Supplementary requirement S3 shall apply to all accessible surfaces of all castings. The acceptance criteria shall be ASME VIII, Div.1, Appendix 7. *Radiographic examination (RT):* Supplementary requirement S2 shall apply to: - Critical areas as per ANSI B 16.34 of the pilot cast of each pattern. - Class 600 and 900 psi; all butt weld ends. - Class 1500 psi and above; all critical areas to ANSI B 16.34. The acceptance criteria shall be ASME VIII, Div. 1, Appendix 7.			
SURFACE FINISH	White pickled and passivated. Shall be carried out *after* any blasting.			
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 and this MDS. - A cast plate shall be used for the test welding. - A macro examination shall be carried out. - Change of filler metal brand name require requalification. All casting with major repairs shall be given a solution heat treatment after welding.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS P01, Rev. 1**	
TYPE OF MATERIAL: Glassfibre Reinforced Plastics (GRP)	
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)
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.
MANUFACTURING PROCESS	Pipes and fittings shall be made by filament winding or equivalent methods.
RESIN/HARDENER TYPE	Preferred resins are bisphenol A epoxies with aromatic or cycloaliphatic curing agents or vinylester.
INNER LINER	The internal lining when transporting non-aggressive fluids such as water, shall be a resin rich layer of min. 0,5 mm with C-glass or synthetic veil reinforcement.For transporting concentrated sulphuric acid and hypochlorite, an internal liner of PVC of min. 3 mm should be used. Application of PVC liner shall be according to the German standard KRV A984/82-02. C-glass or ECR-glass reinforcement should be used in the structural part of the pipe wall. (KRV: Kunststoff Rohrverband).For other agressive fluids such as acids, the internal lining shall be a resin rich layer of min. 3,0 mm with C-glass or syntetic veil reinforcement. C-glass or ECR-glass reinforcement should be used in the structural part of the pipe wall.
QUALIFICATION TESTING	Qualification testing shall be performed according to UKOOA document, Part 2, chapter 2 with the following additional requirements: *Pressure rating*, (Section 2.1.2 or 2.1.3): Minimum requirements are that one representative diameter of pipe, fittings and joints shall be qualified according to option 1. For qualification option 3 the factor f1 = 0,85 shall be moved to the numerator. *The qualification of flanges* shall in addition to the UKOOA document comply with ASTM D 4024, clauses 6, 7, 8 and 11 with the additional requirements below. The pressure rating of the flanges multiplied by 4 shall be above the 97.5% confidence limit obtained from the *Short-Term Rupture Strength* test. The test assembly for the maximum bolt torque test shall be fitted together using gasket and steel flange intended to be used during fabrication and installation. No visual damage is allowed for the sealing test and the bolt torque test according to table 4.3.5 in UKOOA document. *Service Conditions Exceeding "Standard Conditions"*, (A new section 2.1.1.5 after section 2.1.1.4, Standard Service Conditions): For design life exceeding 20 years, the following shall apply: a) Assessment of previous well documented in-service experience.

	b) Qualification results from tests done according to Qualification Option 1 in 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 performed to verify 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 joints shall be qualified according to section 2.1.2 or 2.1.3. The adhesive/resin shall have suitable properties for field assembly and fulfilling the following requirements: - The adhesive/resin shall have a suitable viscosity for application at room temperature. The viscosity shall not be above 0.4 kPas at 23°C with a shear rate of 10 rotations per second (absolute viscosity data). - The fracture elongation of the cured adhesive/resin in joints shall not be less than that of the resin used in the piping. - The glass transition temperature (T_G) or the residual heat of reaction of the cured adhesive/resin shall be determined by DSC according to Annex C, by measurement of samples taken from joints of components used in qualification testing. - Alternatively, for polyester and vinylester based products, the residual styrene monomer content for joints in components used in qualification testing may be determined. The measurement shall be performed according to ISO 4901. *Component Data for Fabrication, Prefabrication and Installation Quality Control Baselines*. *(A new section 2.1.10)*: The manufacturer shall generate from the qualification programme baseline values including acceptance criteria for the 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 accordance with Annex C or by residual styrene content measurement in accordance with ISO 4901 for the adhesive used in bonded joints and the resin used in laminated joints. Reference to above new section 2.1.9. - The percentage of fibreglass reinforcement in laminated joint shall be determined in accordance with ASTM D 2584. Three samples shall be taken from three locations situated 120° apart in the same joint cross section. *Chemical Resistance*, (*Delete section 2.2.5 and replace with):* For transported media other than the water used in the testing according to section 2.1, the chemical resistance of the material shall be determined. The tests shall be based on: 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/or the residual heat of reaction from the first scan and second scan. (Sample not powdered).

	C.6.5 (*Delete sentence and replace with:)* Record of glass transition temperature (inflection value) as T_{G1} and /or residual heat of reaction for both the first and second scan.
ELECTRIC CONDUCTIVITY	If conductive components are specified, the conductivity in the structural layers shall not be accomplished by adding carbon black to the resin.
PRODUCTION TESTING	Production testing shall be performed according to UKOOA document, Part 2, Chapter 4 with the following additional requirements. *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. *Degree of Cure (Section 4.3.2, Add following sentences after last paragraph):* If the residual heat of reaction exceeds 10% of the measured value on the qualified component variant in the qualification tests, then the production lot shall be rejected, subject to the retest option of Section 4.3.8. Alternatively, vinylester or polyester based products may be tested in accordance with ISO 4901. The residual styrene content shall be maximum 10% above the level measured during component qualification but not above 2% total content.
FLANGES	Allowable bolt torque and flange mis-alignment shall be defined by manufacturer.
NDT/VISUAL TESTING	According to UKOOA, Part 4 or BS 7159.
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 - R11, Rev. 1**				
TYPE OF MATERIAL: Austenitic stainless steel, Type 6Mo				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Seamless pipes	ASTM A 312	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-
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 312 shall comply to the test and tolerance requirements given to Grade UNS S31254.			
MANUFACTURING PROCESS	The steel melt shall be refined by AOD or equivalent treatment.			
HEAT TREATMENT/ **DELIVERY CONDITION**				
CHEMICAL COMPOSITION				
TENSILE TESTING				
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 be with the surfaces in the as-delivered condition. The test shall expose the external and internal surface and a cross section surface in full wall thickness. No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
EXTENT OF TESTING	Corrosion test shall be carried out to the same extent as stated for mechanical tests in the referred standard.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R12, Rev. 1**				
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
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 240 shall comply with the test and tolerance requirements given to Grade UNS S31254.			
MANUFACTURING PROCESS	Steel making in electric furnace with AOD or equivalent refining.			
HEAT TREATMENT/ DELIVERY CONDITION	Post weld solution annealing is not required of pipes manufactured out of solution annealed plate material as stated in chapter 5.3.2.2 of A 358.			
CHEMICAL COMPOSITION				
TENSILE TESTING				
HARDNESS				
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 be with the surfaces in the as-delivered condition. The test shall expose the external and internal surface and a cross section surface including weld zone in full wall thickness. No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
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.			
TEST SAMPLING				
WELDING	The PQR/WPAR shall be qualified in accordance with ASME IX or EN 288-3 and this MDS: - The weld consumable shall be Ni-base and the alloying content shall be: Mo >= 8.0 %; Cr >= 15.0 %; (Mo + Cr) >= 28 %; C <= 0.030 %; S <= 0.015 % and Nb < 0.5. - The PQR/WPAR shall be corrosion tested as specified above.			
NON DESTRUCTIVE TESTING	Eddy current examination according to ASTM A 450 is acceptable as replacement for radiography for wall thicknesses less than 4,0 mm.Supplementary requirement S3, penetrant examination , shall apply according to ASME V Article 6, to the weld area of 10 % of the pipes. Acceptance criteria shall be to ASME VIII Div. 1 Appendix 8.			
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds same requirements to PQR/WPAR as for production welding.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R13, Rev. 1**				
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				
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
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 403 shall comply with the test and tolerance requirements given to Grade UNS S31254.			
MANUFACTURING PROCESS	Steel making in electric furnace with AOD or equivalent refining.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION				
TENSILE TESTING				
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 be with the surfaces in the as-delivered condition. The test shall expose the external and internal surfaces and a cross section surface including weld zone in full wall thickness.No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
EXTENT OF TESTING	Corrosion testing shall be performed for each type, size, wall thickness, heat of material and heat treatment load.			
TEST SAMPLING				
WELDING	The weld repair procedure shall be qualified in accordance with ASME IX or EN 288-3 and this MDS: - The weld consumable alloying content shall be: Mo >= 8.0 %; Cr >= 15.0 %; (Mo + Cr) >= 28 %; C <= 0.030 %; S <= 0.015 %; Nb < 0.5 %. - The PQR/WPAR shall be corrosion tested as specified above.			
DIMENSIONAL TOLERANCES	Fittings with reference to MSS-SP-75 shall have maximum wall thickness under tolerance of 0,3 mm.			
NON DESTRUCTIVE TESTING	Supplementary requirement S7, liquid penetrant examination, shall apply to the weld area at 10 % of all fittings above NPS 2. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 8.			
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair of base material is not acceptable. For repair of welds same requirement to PQR/WPAR shall apply as for production testing.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R14, Rev. 1**				
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Forgings	ASTM A 182	F44 UNS N08367 UNS N08925 UNS N08926	-	S5
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent. The Hot Isostatic Pressed (HIP) process is an acceptable alternative to forging.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	*UNS N08925 and N08926:* N = 0.18 - 0.22 %			
TENSILE TESTING				
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 be with the surface in the as-delivered condition. Test samples shall be taken from the thickest part of the product. For products with NPS <= 4 the samples shall cover external/internal surface and full wall section. For products with NPS > 4 the samples shall cover at least one external/internal surface and a cross section to the mid-thickness. No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
EXTENT OF TESTING	One tensile test and corrosion test shall be carried out for each heat and heat treatment load.			
TEST SAMPLING	For open die and ring rolled products all test samples shall be taken from a rough forging or prolongation of the part. Separate test specimens is acceptable for products made by the HIP process.			
DIMENSIONAL TOLERANCES	Flanges to MSS SP-44 shall have maximum wall thickness under tolerance of 0,3 mm at the welding end.			
NON DESTRUCTIVE TESTING	Supplementary requirement S5, liquid penetrant examination, shall apply to 10 % of all fittings above NPS 2. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 8.			
SURFACE FINISH	White pickled including machined sealing surfaces.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R15, Rev. 1**				
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Plates	ASTM A 240	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-
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 240 shall comply with the test and tolerance requirements given to Grade UNS S31254.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent.			
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	*UNS N08925 and N08926:* N = 0.18 - 0.22 %			
TENSILE TESTING				
HARDNESS				
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 be with the surfaces in the as-delivered condition. The test shall expose the external and internal surface and a cross section surface in full wall thickness. No pitting is acceptable internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
EXTENT OF TESTING	Corrosion testing shall be carried out to the same extent as stated for mechanical tests in the referred standard.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R16, Rev. 1**				
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
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.			
MANUFACTURING PROCESS	The steel melt shall be refined with AOD or equivalent process. Remelting of AOD or VOD steel in an electric furnace is acceptable.			
HEAT TREATMENT/ DELIVERY CONDITION	Solution annealed at temperature >= 1225 °C.			
CHEMICAL COMPOSITION	P <= 0.030 %			
TENSILE TESTING				
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 be with the surfaces in the as-delivered condition. The test shall expose the external and internal surface and a cross section surface in full wall thickness. No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
EXTENT OF TESTING	Tensile test and corrosion test for each melt and heat treatment load. The test blocks shall be heat treated with the castings they represents.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast.			
NON DESTRUCTIVE TESTING	*Liquid penetrant examination:* Supplementary requirement S6 shall apply to all accessible surfaces of all castings in machined condition.The acceptance criteria shall be ASME VIII, Div.1, Appendix 7. *Radiographic examination:* Supplementary requirement S5 shall apply to: - critical areas as per ANSI B 16.34 of the pilot cast of each pattern - Class 600 and 900 psi; all butt weld ends - Class 1500 psi and above; all critical areas to ANSI B16.34.The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.			
SURFACE FINISH	White pickled. Shall be carried out *after* any blasting and shall include finished machined sealing surfaces.			
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 %.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 of filler metal brand name require requalification. All casting with major repairs shall be given a solution heat treatment after welding.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R17, Rev. 1**				
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 6Mo				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Bars	ASTM A 276	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-
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 276 shall comply with the test and tolerance requirements given to UNS S31254.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	*UNS N08925 and N08926:* N = 0.18 - 0.22 %			
TENSILE TESTING				
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 be with the surfaces in the as-delivered condition. The test shall expose the external and internal surface and a cross section surface in full wall thickness. No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4,0 g/m^2.			
EXTENT OF TESTING	One tensile test and corrosion test shall be carried out for each heat and heat treatment load.			
TEST SAMPLING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	Finished product shall be white pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - R18, Rev. 1**				
TYPE OF MATERIAL: Austenitic stainless steel, Type 6Mo				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Tubes	ASTM A 269	UNS S31254 UNS N08367 UNS N08925 UNS N08926	-	-
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 269 shall comply to the test and tolerance requirements given to Grade UNS S31254.			
MANUFACTURING PROCESS	The steel melt shall be refined by AOD or equivalent treatment.			
HEAT TREATMENT/ **DELIVERY CONDITION**				
CHEMICAL COMPOSITION				
TENSILE TESTING				
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 be with the surfaces in an as-delivered condition. The specimen shall include the full wall thickness. No pitting is acceptable at internal and external surfaces at 20 X magnification. The weight loss shall be < 4.0 g/m^2.			
EXTENT OF TESTING	Corrosion testing shall be carried out to the same extent as stated for mechanical tests in the referred standard.			
TEST SAMPLING				
FORMING				
NON DESTRUCTIVE TESTING				
SURFACE FINISH	White pickled.			
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - S01, Rev. 1**				
TYPE OF MATERIAL: Austenitic Stainless Steel, Type 316				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Wrought fittings Welded pipesSeaml. & welded pipesForgingsPlates	ASTM A 403 ASTM A 358 ASTM A 312 ASTM A 182 ASTM A 240	WP 316 316 TP 316 F 316 316	W/S/WX Class 1, 3, 4 or 5 - -	- - - - -
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION	C <= 0.035 % *Plates to A 240 :* S <= 0.015 %			
TENSILE TESTING	Grade 316L with $Rp_{0.2}$>= 205 MPa and R_m>= 515 MPa is acceptable.			
EXTENT OF TESTING				
TEST SAMPLING				
FORMING				
WELDING				
DIMENSIONAL TOLERANCE	*Flanges to A 182:* Flanges to MSS SP-44 shall have a maximum wall thickness under tolerance of 0,3 mm at the weld end.			
NON DESTRUCTIVE TESTING	*Pipes to A 358* : Eddy current examination according to ASTM A 450 is acceptable as replacement for radiography for wall thicknesses less than 4,0 mm.			
SURFACE FINISH	White pickled except for machined surfaces.			
REPAIR OF DEFECTS	Weld repair of base material is not acceptable			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - S02, Rev. 1**				
TYPE OF MATERIAL: Austenitic Stainless Steel Castings				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 351	CF8M CF3M	- - 	S5, S6 S5, S6
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION				
TENSILE TESTING				
EXTENT OF TESTING	Tensile test for each melt and heat treatment load. The test blocks shall be heat treated with the castings they represents.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast.			
NON DESTRUCTIVE TESTING	*Liquid penetrant examination:* Supplementary requirement S6 shall apply to 10 % of castings with pressure rating 150/300 psi and 100 % to castings with pressure rating 600 psi and above. All accessible surfaces. of the given percentage or minimum two off, of the castings from the same pattern and batch shall be examined. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7. *Radiographic examination:* Supplementary requirement S5 shall apply to: - critical areas as per ANSI B 16.34 of the pilot cast of each pattern- Class 600 and 900 psi; all butt welds - Class 1500 psi and above; all critical areas to ANSI B16.34. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.			
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - T01, Rev. 1**				
TYPE OF MATERIAL: Titanium Grade 2				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Pipes Wrought fittings Forgings Plates Bars Tubes	ASTM B 337 ASTM B 363 ASTM B 381 ASTM B 265 ASTM B 348 ASTM B 338	2 WPT2/WPT2W F 2 2 2 2	- - - - - -	- - - - - -
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION	*All products:* Shall be supplied in annealed condition. *Welded products:* Acceptable as welded from annealed plates.			
CHEMICAL COMPOSITION				
TENSILE TESTING				
EXTENT OF TESTING	*Forgings to B 381* :Tensile test specimen shall be taken from each lot. A lot is defined as all products of the same nominal size and wall thickness produced from the same heat and subject to the same finishing operation.			
TEST SAMPLING				
WELDING	*Welded pipes to B 337:* Welding procedures shall be qualified in accordance with ASME IX.			
DIMENSIONAL TOLERANCE	*Flanges to B 381:* Flanges to MSS SP - 44 shall have maximum wall thickness under tolerance of 0,3 mm at the welding end.			
NON DESTRUCTIVE TESTING	*Pipes to B 337:* Eddy current examination according to ASTM A 450 is acceptable as replacement for radiography for welded pipes with wall thickness less than 4,0 mm.			
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - T02, Rev. 1**				
TYPE OF MATERIAL: Titanium Grade 2				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM B 367	C2	-	S1, S2
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.			
MANUFACTURING PROCESS				
HEAT TREATMENT/ DELIVERY CONDITION				
CHEMICAL COMPOSITION				
TENSILE TESTING				
EXTENT OF TESTING				
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast.			
NON DESTRUCTIVE TESTING	*Liquid penetrant examination:* Supplementary requirement S2 shall apply to all accessible surfaces of all castings. The acceptance criteria shall be to ANSI B16.34 except no cracks are acceptable. *Radiographic examination* : Supplementary requirement S5 shall apply to: - critical areas as per ANSI B 16.34 of the pilot cast of each pattern - Class 600 and 900 psi; all butt welds - Class 1500 psi and above; all critical areas to ANSI B16.34. The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.			
SURFACE FINISH				
REPAIR OF DEFECTS				
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - X02, Rev. 1**				
TYPE OF MATERIAL: High Strength Low Alloy Steel				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Forgings	ASTM A 788	AISI 4140		
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.			
MANUFACTURING PROCESS	Forgings to be finished hot-worked.			
HEAT TREATMENT/ DELIVERY CONDITION	Forgings shall be austenitised, liquid quenched and tempered.			
CHEMICAL COMPOSITION	According to ASTM A 29, AISI 4140.			
TENSILE TESTING	Minimum yield strength : Reh >= 620 Mpa Minimum tensile strength: Rm >= 850 Mpa Minimum elongation : A5 >= 15 %			
HARDNESS				
IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at - 30 °C. The notch shall be perpendicular to the surface. Acceptable absorbed energy values: Min. average of 3 specimens: 42 Joules; specimen size 10x10mm Min. single value: 30 Joules			
EXTENT OF TESTING	One set of tensile and impact tests shall be taken from each melt, section thickness ± 25 % and heat treatment load			
TEST SAMPLING	According to ASTM A 350.			
NON DESTRUCTIVE TESTING	Supplementary requirement S18, magnetic particle examination, shall apply to 10 % of all forgings.			
SURFACE FINISH				
REPAIR OF DEFECTS	Weld repair is not acceptable.			
CERTIFICATION	EN 10 204 Type 3.1B			

MATERIAL DATA SHEET **MDS - X03, Rev. 1**				
TYPE OF MATERIAL: High Strength Low Alloy Steel				
PRODUCT	**STANDARD**	**GRADE**	**ACCEPT. CLASS**	**SUPPL. REQ.**
Castings	ASTM A 487	Grade 2B, 2D	-	S4, S5
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.			
HEAT TREATMENT/ DELIVERY CONDITION				
HARDNESS				
IMPACT TESTING	Charpy V-notch testing is required according to ASTM A 370 at - 30 °C. The notch shall be perpendicular to the surface. Acceptable absorbed energy values: Min. average of 3 specimens: 42 Joules; specimen size 10x10mm Min. single value: 30 Joules			
EXTENT OF TESTING	One set of tensile and impact tests shall be carried out for each heat and heat treatment load.			
TEST SAMPLING	For castings with weight 250 kg and above the test coupons shall be integrally cast with the casting. All test blocks shall be heat treated together with the casting they represent.			
NON DESTRUCTIVE TESTING	The testing shall be carried out after final heat treatment, including PWHT after repair. Radiography may be carried out prior to PWHT. *Magnetic Particle Examination* : 100 % according to ASME VIII, Div. 1, Appendix 7. *Radiograhpic examination:* Critical sections, as defined by ANSI B16.34 shall be 100 % tested on the first two castings of each pattern. Provided these two castings fulfil the requirements, radiography may be omitted on the rest of the castings of the same pattern. Otherwise, radiography shall be carried out until 2 successive castings satisfy the specified requirements.All butt weld ends shall be 100 % tested.The acceptance criteria shall be to ASME VIII, Div. 1, Appendix 7.			
REPAIR OF DEFECTS	All weld repairs shall be post weld heat treated. The repair welding procedure qualification shall include the following: - qualified on a casting of the same material grade. - one set of impact tests, 3 specimens, shall be taken from weld metal, fusion line.			
CERTIFICATION	EN 10 204 Type 3.1B			