MST
your experienced partner in the Oil & Gas Industry

MANNESMANN
STAINLESS TUBES
A Member of the Salzgitter Group

Seamless stainless steel and nickel-based alloy pipes and tubes are our everyday passion and our history at Mannesmann Stainless Tubes. As early as 1885 Reinhard and Max Mannesmann invented a rolling process for the production of seamless steel tubes in Remscheid, Germany. In the 1890's they developed it further until it reached marketability: the production method they invented was the pilger process, which still is widely in use today.

For over two decades, Mannesmann Stainless Tubes (formerly DMV Stainless) has served the Oil & Gas industry as an established quality supplier of seamless pipes and tubes. Knowing that quality is the key issue in all Oil & Gas products, MST is known for being uncompromisingly thorough all along the project lifetime.

Our experts having already been actively involved in the early development of tubular products in duplex and super duplex grades, MST' products have subsequently become key components, particularly in challenging offshore territories, including deepwater environments. The company has earned its ranking and is today considered as one of the world's leading suppliers of tubular products to SURF (subsea, umbilicals, risers and flow lines) applications.

In addition to offshore applications, MST is also present and active at a similar level for onshore developments.

And it doesn't end there. MST is already building expertise in products for even more challenging territories, such as ultra deep and ultra cold conditions.

Over 250 projects completed during the past 20 years, for most of the major NOCs and IOCs worldwide contain our seamless pipes and tubes. From the reservoir (OCTG) through to sub surface and up to the topside, our pipes and tubes are present in the most critical Oil & Gas applications.

In the last 15 years, MST has also successfully supplied to the LNG-GTL industries.

Our experience extends all over the globe:
- starting in the North Sea in the 1980's and spreading to the Gulf of Mexico, Canada (including Newfoundland) South East Asia, Australia and the Middle East in the 1990's.
- the turn of the century presented us with new challenges in deep water fields off Asia, West Africa, Brazil throughout the Gulf of Mexico and also in the CIS countries.

The foundations of our know-how come from our own manufacturing processes and the combined experience of our people.

Manufacturing processes

The following processes, operated
by our highly skilled staff, are central:

Hot Extrusion

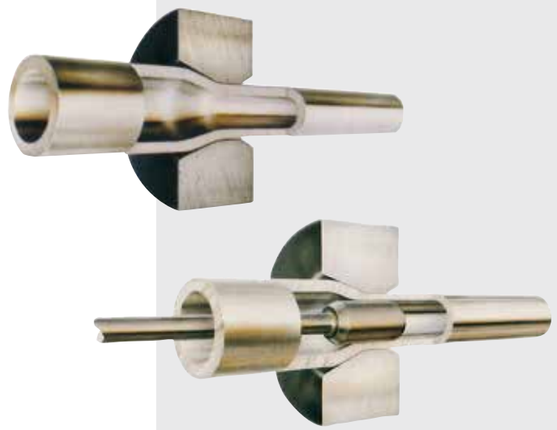
Manufacturing hot finished tubes, pipes, re-draw hollows and hollow bars in stainless steels and nickel-based alloys. Our Oil & Gas range of dimensions includes
- outside diameters from 32 up to 250 mm (1" NB up to 8" NB) and
- wall thicknesses from 2.7 up to 50 mm (0.105" up to 2")

Cold Pilgering

Production process for seamless, cold finished, high alloyed stainless steel and nickel-based alloy pipes and tubes. It provides a high forming rate, close tolerances and good productivity yields. Our production range for Oil & Gas covers
- outside diameters from 6 up to 219.1 mm (0.24" up to 8 5/8") and
- wall thicknesses from 0.5 up to 30 mm (0.020" up to 1.180")

Cold Drawing

Production process for seamless, cold finished, high alloyed stainless steel and nickel-based alloy pipes and tubes. It is mainly used for OCTG production.



The Oil & Gas industry – we understand the rules and your requirements – we're on your team.
Depletion of easily accessible reserves combined with the economics of the business are driving exploration into ever deeper and fiercer environments. This presents increasingly tougher challenges for materials and components.

As an established and responsible supplier to critical applications, we know that product quality and reliability are of paramount importance to our customers, so we take these challenges seriously; ensuring that we score highly and consistently.

E&P environments and well demands intensify and changes are brought about. HP/HT, Arctic Circle, Chlorides, Hydrogen sulphide, Sulphur and other aggressive media lead to ever increasing performance on all materials and processes involved – whether for subsea or topside, offshore or onshore developments.

Our position as a leading supplier is the result of long and close cooperation with the global Oil & Gas industry in R&D, in engineering and in supply. Our continued commitment to this market makes MST a constant, reliable and long-term player.

This is what sets us apart, and secures our place in the top league.

Your new challenges become our priority areas of focus:
- Deep water
- Ultra deep water
- Giant depth
- Arctic circle

Focus on the Oil & Gas industry

And of course, we continue to provide you with options for…
- Sour or wet gas,
- Mature Fields / Enhanced Oil Recovery (EOR),
- Natural Gas (GTL / LNG)

With MST from the well through FPSOs or fixed platforms to the shore and beyond

Piping and tubing in the Oil & Gas infrastructures play a highly critical role, therefore, operators and contractors need a reliable supplier of such key products.

MST is your partner throughout the upstream / downstream Oil & Gas chain, proposing pipes and tubes for:

Upstream

Reservoir
the base material for Sandscreens, OCTG tubing and casing

Seabed to surface
Base pipes for manifolds, spools, jumpers, flowloops
Flowlines, Umbilicals, Risers

Topside
Process pipes and tubes
Heat exchanger tubing
Instrumentation tubing

Downstream

Refineries
Furnace pipes
Heat exchanger tubing
Instrumentation tubing

Gas compression plants
Process pipes and tubes
Heat exchanger tubing
Instrumentation tubing

LNG / GTL
Process pipes and tubes
Cryogenic lines

Oil & Gas grade portfolio

Grade portfolio

Successful material selection is achieved through the combination of best material performance and optimized cost.

Our grade portfolio and range of sizes is one of the most comprehensive on the market, with an extensive and proven track record.

Austenitic Ferritic

MST Designation	Application			Nearest equivalent standard				Typical chemical composition [1]						Density		Min. mechanical properties at RT			
	Upstream	Downstream	LNG/GTL	UNS	EN	JIS		C_{max}	Cr	Ni	Mo	Cu	others			$Rp_{0.2}$ Yield Strength		R_m Tensile Strength.	
														g/cm³	lb/in³	MPa	ksi	MPa	ksi
DMV 18.5			■	S31500	1.4424			0.03	18.5	4.8	2.7		Si1.7; N 0.1	7.8	0.28	440	64	630	92
DMV 22.5	■	■	■	S31803	1.4462			0.03	22.0	5.5	3.0		N 0.17 [2]	7.8	0.28	450	65	620	90
DMV 25.7	■			S31260				0.03	25.0	6.5	3.0	0.5	N 0.20; W 0.5	7.8	0.28	450	65	690	100
DMV 25.7 Cu	■	■		S32550	1.4507			0.03	25.0	7.0	3.5	1.5	N 0.22 [2]	7.8	0.28	550	80	760	110
DMV 25.7 N	■	■	■	S32760	1.4501			0.03	25.0	7.0	4.0	0.5	N 0.25; W 0.5 [2]	7.8	0.28	550	80	750	109

[1] All figures in weight percentage. In case of order, the limits of the order specification will apply.
[2] Min PRE value controlled.

Austenitic

MST Designation	Application			Nearest equivalent standard				Typical chemical composition [1]						Density		Min. mechanical properties at RT			
	Upstream	Downstream	LNG/GTL	UNS	EN	JIS		C_{max}	Cr	Ni	Mo	Cu	others			$Rp_{0.2}$ Yield Strength		R_m Tensile Strength	
														g/cm³	lb/in³	MPa	ksi	MPa	ksi
Corrosion resistant:																			
DMV 304		■	■	S30400	1.4301	SUS 304		0.06	18.5	9.5				7.9	0.29	205	30	515	75
DMV 304 L		■	■	S30403	1.4306	SUS 304L		0.03	19.0	11.0				7.9	0.29	170	25	485	70
DMV 321		■	■	S32100	1.4541	SUS 321		0.08	18.5	10.5			Ti > 5 x C < 0.6%	7.9	0.29	170	25	485	70
DMV 347		■	■	S34700	1.4550	SUS 347		0.08	18.5	11.0			Nb > 10 x C < 1.0%	7.9	0.29	205	30	515	75
DMV 316		■	■	S31600	1.4401	SUS 316		0.06	17.0	11.5	2.25			8.0	0.29	205	30	515	75
DMV 316 L	■	■	■	S31603	1.4404			0.03	17.0	12.0	2.25			8.0	0.29	170	25	485	70
DMV 316 LMoS	■	■	■	S31603	1.4435	SUS 316L		0.03	17.0	12.5	2.75			8.0	0.29	170	25	485	70
DMV 317 L		■		S31703	1.4438	SUS 317L		0.03	18.0	14.5	3.5			8.0	0.29	205	30	515	75
DMV 316 LUG		■		S31603	1.4435			0.02	17.0	13.5	4.5			8.0	0.29	170	25	485	70
DMV 25.22.2		■		S31050	1.4466			0.02	25.0	22.0	2.0		N 0.12	7.9	0.29	255	37	540	78
DMV 904		■	■	N08904	1.4539			0.02	20.5	25.5	4.5	1.5		8.0	0.29	215	31	490	71
DMV 926	■	■		N08926	1.4529			0.02	20.0	25.0	6.5	0.8	N 0.20	8.0	0.29	295	43	650	94
DMV 954		■	■	S31254	1.4547			0.02	20.0	18.0	6.2		N 0.20	8.0	0.29	310	45	655	95
Heat resistant:																			
DMV 304 H		■		S30409	1.4948			0.08 [2]	18.5	9.5				7.9	0.29	205	30	515	75
DMV 321 H		■		S32109	1.4940			0.08 [2]	18.5	11.0			Ti > 4 x C < 0.6	7.9	0.29	170	25	480	70
DMV 347 H		■		S34709	1.4912			0.08 [2]	18.5	11.0			Nb > 8 x C < 1.0	7.9	0.29	205	30	515	75
DMV 310 H		■		S31009	1.4845	SUS 310 TB		0.10 [2]	25.0	20.0				8.0	0.29	205	30	515	75

[1] All figures in weight percentage. In case of order, the limits of the order specification will apply.
[2] Minimum level of carbon content is mandatory.

Oil & Gas grade portfolio

Nickel and Nickel-based alloys

MST Designation	Application			Nearest equivalent standard		Typical chemical composition [1]						Density		Min. mechanical properties at RT			
	Upstream	Downstream	LNG/GTL	UNS	EN	C_{max}	Cr	Ni	Mo	Cu	others			$Rp_{0.2}$ Yield Strength		R_m Tensile Strength	
												g/cm³	lb/in³	MPa	ksi	MPa	ksi
Corrosion resistant:																	
DMV 920	■	■		N08020	2.4660	0.02	20.0	37.0	2.5	3.5	Nb + Ta	8.1	0.29	240	35	550	80
DMV 8020	■	■		N08020		0.02	20.0	34.0	2.5	3.5	Nb + Ta	8.1	0.29	240	35	550	80
DMV 928	■	■		N08028	1.4563	0.02	27.0	31.0	3.5	1.2	N 0.10	8.0	0.29	210	31	500	73
DMV 931	■			N08031	1.4562	0.015	27.0	31.0	6.5	1.2	N 0.20	8.1	0.29	280	41	650	94
DMV 800 L		■		(N08800)	1.4558	0.025	21.0	32.0			Ti 0.30; Al 0.30	8.0	0.29	180	26	450	65
DMV 800		■		N08800	1.4876	0.08	21.0	32.0			Ti < 0.40	8.0	0.29	210	31	500	73
DMV 825	■	■	■	N08825	2.4858	0.03	22.0	42.0	3.0	2.0	Ti 0.80; Al 0.10	8.1	0.29	180	26	530	75
DMV 600 L		■	■	N06600	2.4817	0.025	16.0	76.0			Fe 8	8.4	0.30	180	26	550	80
DMV 690		■		N06690	2.4642	0.02	29.0	60.0			Fe 9	8.2	0.29	205	30	585	85
DMV 625	■	■	■	N06625 Gr.1	2.4856	0.025	22.0	63.0	9.0		Nb 3.5	8.5	0.31	414	60	827	120
DMV G3	■			N06985	2.4619	0.015	22.0	48.0	7.0	2.0	Co. W	8.3	0.30	205	30	585	85
DMV C 276	■			N10276	2.4819	0.01	16.0	57.0	16.0		W	8.4	0.30	350	51	750	109
Heat resistant:																	
DMV 800 H		■		N08810	1.4958	0.10 [2]	21.0	32.0			(Al. Ti) 0.15 - 0.60	8.0	0.29	170	25	500	73
DMV 811		■		N08811	1.4959	0.10 [2]	21.0	32.0			0.85 < Ti + Al < 1.20	8.0	0.29	170	25	500	73
DMV AC 66		■		S33224	1.4877	0.06	27.0	32.0			Ce 0.07; Nb 0.8	8.0	0.29	185	27	500	73
DMV 600 H		■		N06600	2.4816	0.07	16.0	76.0			Fe 8	8.4	0.30	240	35	550	80
DMV 625	■	■	■	N06625 Gr.2	2.4856	0.025	22.0	63.0	9.0		Nb 3.5	8.4	0.30	276	40	690	100
DMV 601		■		N06601	2.4851	0.08	23.0	62.0			Al 1.2; Ti 0.3	8.1	0.29	240	35	600	87
Nickel-Copper:																	
DMV 400		■		N04400	2.4360	0.15		65.0		30.0	Fe 2; Mn 1.5	8.8	0.32	180	26	450	65
Pure Nickel:																	
DMV 200		■		N02200	2.4066	0.05		99.4				8.9	0.32	103	15	379	55
DMV 201		■		N02201	2.4068	0.02		99.4				8.9	0.32	83	12	345	50

[1] All figures in weight percentage. In case of order, the limits of the order specification will apply.
[2] Minimum level of carbon content is mandatory.

In OCTG application the possible corrosive attack is essentially caused by the presence of aqueous phase, and it can be intensified by the presence of salts – above all chlorides – and/or dissolved gases as CO_2 and H_2S.
The combination of these compounds, the increase in concentration of either one or both and the temperature in the well has an influence of the corrosiveness of the environment.

Other factors that can influence the corrosiveness of the environment are the total pressure, the flow velocity, the pH level.
Also, other corrosive elements can be introduced during the completion and the operation of the well such as completion fluids and acidizing fluids.
Corrosion resistant materials are therefore required, owing their capacity to resist the more corrosive gases being produced, along with adequate mechanical properties to withstand both the higher pressure encountered and the heavier weight of the longer production strings.

These materials are also often used in oilfields where high level of reliability and safety are required: failures and repairs (if practically feasible) may have very severe consequences in term of cost and environment.

MST answer to the all these severe requirements can be classified into three groups of materials as per the below table.

MST has developed specific manufacturing routes to produce CRA tubular products in plain end condition for OCTG applications to achieve the complex corrosion resistance and mechanical property requirements needed for these alloys.

This is especially valid in case of cold hardened grades (CH), where high level of mechanical properties are achieved by applying a well defined cold working, by cold drawing or cold pilgering processes.

The amount of cold work hardening depends on the specific strength level required and the material hardening behaviour.

MST Material	UNS Number	Material identity ISO 13680		
		Group	Structure	Category
DMV 22.5	S31803		Duplex	22-5-3
DMV 25.7	S31260	2	Duplex	25-7-3
DMV 25.7 N	S32760		SuperDuplex	25-7-4
DMV 928	N08028	3	Austenitic Fe base	27-31-4
DMV 825	N08825			21-42-3
DMV G3	N06985			22-50-7
DMV G2	N06975	4	Austenitic Ni base	25-50-6
DMV 50	N06950			20-54-9
DMV C276	N10276			15-60-16

Duplex and Super Duplex

These materials are characterised by excellent mechanical properties, combined with high stress corrosion cracking (SCC) resistance.

MST duplex and superduplex availability for OCTG application is resumed in the following table.

MST Material	UNS Number	Material identity ISO 13680			Grade	Delivery condition
		Group	Structure	Category		
DMV 22.5	S31803		Duplex	22-5-3	65	SA
					110	CH
					125	CH
					140	CH
DMV 25.7	S31260	2	Duplex	25-7-3	75	SA
					110	CH
					125	CH
					140	CH
DMV 25.7 N	S32760		SuperDuplex	25-7-4	80	SA
					125	CH
					140	CH

SA = Solution annealed
CH = Cold hardened

Austenitic Stainless steels

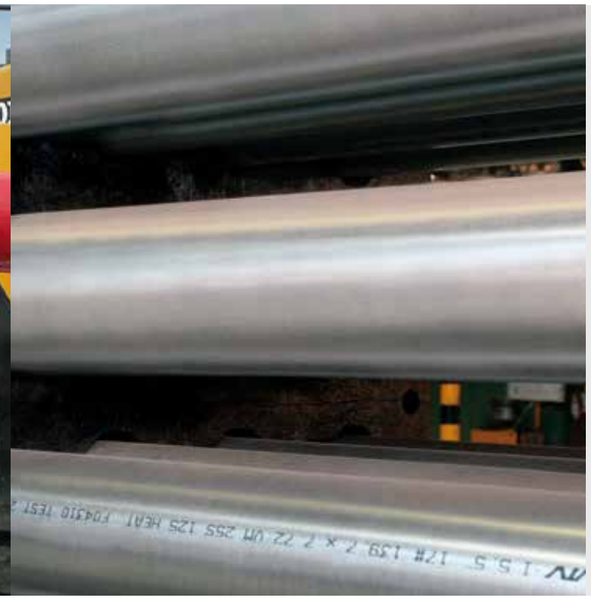
They are Iron-base alloys, where the major alloying element is Ni instead of Cr.
The typical MST material in this group is DMV 928.

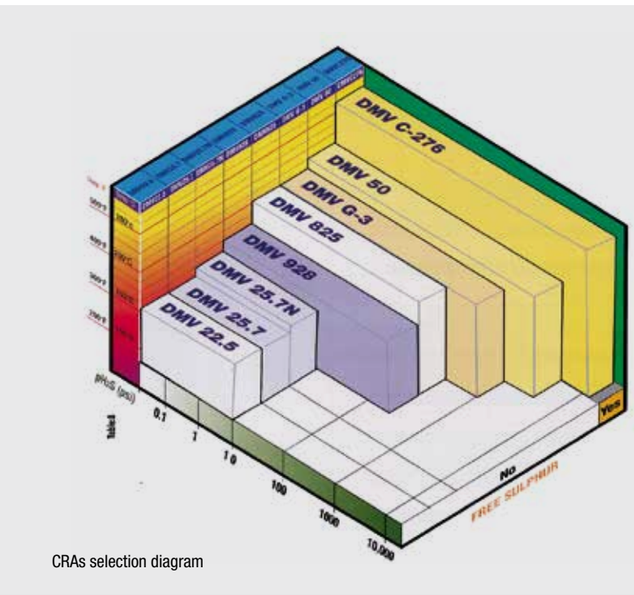
Nickel Alloys

Nickel Alloys have Ni as predominant element, exploiting the high degree of corrosion resistance of this metal, usually present in minimum 38% in weight.
The addition of Cr, Mo, W, Cu and other elements increase the resistance to corrosion and make these alloys suitable to be used in the most severe environments.

MST Material	UNS Number	Material identity ISO 13680			Grade	Delivery condition
		Group	Structure	Category		
DMV 928	N08028	3	Austenitic Fe base	27-31-4	110	CH
					125	
DMV 825	N08825			21-42-3	110	CH
					120	
DMV G3	N06985			22-50-7	110	CH
					125	
DMV G2	N06975	4	Austenitic Ni base	25-50-6	110	CH
					125	
DMV 50	N06950			20-54-9	110	CH
					125	
DMV C276	N10276			15-60-16	125	CH
					140	

CH = Cold hardened





CRAs selection diagram

In the following table, the chemical compositions of the available MST materials are shown.

Material	C %	Si %	Mn %	Ni %	P %	S %	Cr %	Mo %	W %	N %	Fe %	Ti %	Cu %	Others	PREN
DMV 22.5	≤0,03	≤1	≤2	4,5÷6,5	≤0,03	≤0,02	21÷23	2,5÷3,5		0,08÷0,2	Bal				35 min
DMV 25.7	≤0,03	≤0,75	≤1	5,5÷7,5	≤0,03	≤0,03	24÷26	2,5÷3,5	0,10÷0,50	0,1÷0,3	Bal		0,2÷0,8		38 min
DMV 25.7 N	≤0,03	≤1	≤1	6÷8	≤0,03	≤0,01	24÷26	3÷4	0,5÷1	0,2÷0,3	Bal		0,5÷1		42 min
DMV 928	≤0,03	≤1	≤2,5	29,5÷32,5	≤0,03	≤0,03	26÷28	3÷4			Bal		0,6÷1,4		
DMV 825	≤0,05	≤0,5	≤1	38÷46	≤0,03	≤0,03	19.5÷23.5	2,5÷3,5			Bal	0,6÷1,2	1,5÷3,0	Al≤0,2	
DMV G3	≤0,015	≤1	≤1	Bal	≤0,04	≤0,03	21÷23,5	6÷8	1,5		18-21		1,5÷2,5	Co≤5 Nb+Ta≤0,5	
DMV G2	≤0,03	≤1	≤1	47÷52	≤0,03	≤0,03	23÷26	5÷7			bal	0,7÷1,5	0,7÷1,2		
DMV G50	≤0,015	≤1	≤1	≤50	≤0,04	≤0,015	19÷21	8÷10	≤1		15÷20		≤0,50	V≤0,04 Co≤2,5 Nb+Ta≤0,5	
DMV C276	≤0,02	≤0,08	≤1	Bal	≤0,03	≤0,03	14,5÷16.5	15÷17	3÷4,5		4÷7			Co≤2,5 V≤0,35 Ni+Co≤52	

(*) PREN = % Cr + 3,3 x (% Mo + 0,5 x % W) + 16 x % N as defined in ISO 15156-3
Note: Chemical composition from ISO 13680 and ISO 15156-3

The MST manufacturing range covers the ISO 13680 requirement as follows.

Duplex and Super Duplex grades in solution annealed conditions (SA)

- From 2 3/8" till 8 5/8" Tubing and Casing, including relevant Coupling Stock 9 5/8" on request.

Austenitic stainless steel and nickel alloys in cold hardened condition (CH)

- From 2 3/8" till 7 5/8" Tubing and Casing, including relevant Coupling Stock.

Tubing and Casing are available in Range 2 and Range 3 lengths, depending on the specified dimension. Coupling Stock length by agreement.

Tubes can be manufactured according to ISO 13680 PSL1 or PSL2, or according to customer technical specification by agreement.

Besides, any specific dimension can be produced for accessories, by agreement (High Yield Mechanical Tubes).

Corrosion Resistant Material Selection

MST materials chemical composition has been designed to provide optimum performance under a certain set of conditions. A correct material selection combines the best performance with lower costs. The CRAs selection diagram may help the completion engineer in making the proper selection.

The first step is to determine the most critical temperature and concentration of certain corrosive media in the production fluid. If the temperature or any of the concentrations exceeds any of the critical conditions shown below, then the need for a CRA is indicated

- pCO_2 concentration > 1500 psi
- Cl^- concentration > 250 g/l
- pH_2S concentration > 10 psi
- Temperature > 390°F

However, the final material selection is left to the final user, depending also on his experience and global evaluation.

Our know-how at your service

Reliable process control & traceability

At Mannesmann Stainless Tubes, quality management begins well before any production step.

Our manufacturing processes are under continuous control, thereby minimising industrial risks and optimising performance. From the raw material up to the final quality tests in our own laboratories on the finished product, we thoroughly evaluate, test and control our pipes and tubes, validating full compliance to the customer requirements.

Our quality departments perform checks both during the production cycle and on the finished product, using state-of-the-art equipment, ensuring efficient and reliable completion of quality control operations.

We also have extensive in-house facilities for non-destructive testing, such as ultrasonic, eddy current, hydrostatic and dye penetrant testing, which can be used to verify the soundness of the product. Furthermore, all our pipes are subject to positive material identification prior to marking and particular care is taken to ensure that traceability is maintained from raw material to finished product.

Advanced Project Management Capabilities

In every case, we apply our knowledge acquired over a series of contracts with a tailored approach which our customers expects from a professional supplier. MST encourages contacts with our clients in order to have a first hand illustration of their priorities and concerns on any given project, as we believe this is critical to best address those aspects. Our technical teams in tandem with our commercial teams, will endeavour to provide cost effective and accurate proposals subsequently honoured by our production, quality and logistics team during the execution of your contracts.

This extent of interface in between our organisation and yours, helps to foster long term mutually beneficial partnerships.

Proven Quality according to the following standards

- API 5LC
- DNV OS F101
- API 5CT
- ISO 13680
- ASTM / ASME
- NACE MR01 75 – ISO 15156
- NORSOK STANDARD M-650

And in compliance to major operators and EOMs specific material specifications.

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