

SuperElso[®] 533 High Strength MnMoNi Steel

High Strength Steel for Pressure Vessels for low-temperature or wet H₂S service

SuperElso[®] 533 is a quenched and tempered high strength steel dedicated to pressure equipment, including those operating under wet H₂S service condition. Its high strength allows a significant weight reduction versus equipment in carbon steel.

SuperElso[®] 533 is produced via the low-CO₂ emission steelmaking process of electric arc furnace (EAF). It can also be delivered on request under XCarb[®] brand that guarantees a further reduction in CO₂ emissions (certificate with product carbon footprint certified by an independent third-party).

Properties

Standards

SuperElso[®] 533 can be ordered according to following standards (multiple certifications upon request):

- ASTM A/ ASME A/SA-533 Type C Class 2
- ASTM A/ ASME A/SA-533 Type E Class 2
- EN 10028-6 P500Q - QH -QL1 - QL2

Chemical composition

Heat analysis (maximum values in mass weight %)

C	Mn	S	P	Ni	Cr *	Mo	CE _{low}
0.10	1.50	0.002	0.007	1.00	0.60	0.60	0.60

(*) Cr 0.30% max for Type C

Mechanical properties

Tensile properties as per ASTM/ASME at room temperature

Tensile Strength		Yield Strength		Elongation
MPa	Ksi	MPa	Ksi	%
620-795	90-115	≥ 485	≥ 70	≥ 16

Tensile properties at elevated temperatures are available on request.

Charpy-V notch impact toughness properties

Impact toughness properties are guaranteed on base material both in as-delivered condition and following post weld heat treatment (PWHT).

Thickness	Test temperature	Average energy
≤ 120 mm	-60°C (-76°F)	≥ 60 J
> 120 mm	-51°C (-60°F)	≥ 60 J

Test location: quarter-thickness (T/4) and/or mid-thickness (T/2).

Sour service

SuperElso® 533 has been designed to meet following requirements:

- Hardness requirement as per NACE MR0175 / ISO 15156-2 assuming appropriate welding procedure (filler material, welding parameters and PWHT) is carried out.
- HIC criteria (testing per NACE TM0284 latest edition)

	CLR	CSR	CTR
Per sample	< 5%	< 1.5%	< 0.5%
Per specimen (average of 3 sections)	< 7%	< 2.0%	< 0.7%

Welding

Filler materials

A non-exclusive list of suitable filler materials is provided in table below:

Supplier	SMAW	SAW	
		Wire	Flux
BOEHLER	FOX EV 65	Union S 3 NiMo 1	UV 420 TTR-C
	EN ISO 18275-A : E 55 6 1NiMo B 4 2 H5	EN ISO 26304-A: S 62 4 FB S3Ni1Mo H5	
	AWS A5.5: E8018-G H4R	AWS A5.23 : F9P6-EF3-F3-H4	
ESAB	FILARC 98S	Autrod 13.40	OK Flux 10.62
	EN ISO 18275-A : E 55 6 Mn1NiMo B T 32 H5	EN ISO 14171-A : S3Ni1Mo	
	AWS A5.5 : E9018-G	SFA/AWS A5.23: EF3	
LINCOLN	Conarc 60G	LNS 168	P230
	EN ISO 18275-A : E 55 4 Z B 32 H5	EN ISO 26304-A : S3Ni2.5CrMo	
	AWS A5.5 : E9018M-H4	AWS A5.23 : EG	

Post-weld heat treatment (PWHT)

SuperElso® 533 is P-No.3 Group No.3 material as per ASME BPVC Section IX. Minimum PWHT temperature is 595°C (1103°F).

SuperElso® 533 mechanical properties are usually guaranteed for maximum PWHT 625°C – 12 hours. Thanks to its lower carbon content (compared to other MnMoNi alloyed steels), **SuperElso® 533** can meet HAZ hardness requirements of NACE MR0175 / ISO 15156-2 for PWHT temperature at or above 620°C.

Delivery conditions

Heat treatment

SuperElso® 533 is delivered in quenched and tempered condition. Tempering is performed in accordance with API RP 582 latest edition (Table 7, footnote a).

Plates and formed pieces

SuperElso® 533 plates can be produced in thicknesses from 5 mm up to 180 mm (3/16" up to 7"). Formed pieces such as elliptical or hemispherical heads in single- or multi-pieces can also be supplied (thicknesses 40 mm and above).

XCarb®

On request, **SuperElso® 533** plates can be delivered with **XCarb®** certificate that guarantees steels with a low carbon footprint, made through the electric arc furnace using recycled scrap and renewable electricity. Product carbon footprint is third-party verified.

Technical literature

A non-exhaustive list of publications is provided below. These papers can be provided on request, only within the framework of discussions linked to projects that may consider the use of **SuperElso® 533** for the fabrication of pressure equipment.

- Development of New High Strength Steel SuperElso® 533 for Sour Service (ESOPE, 2016)
- Alternative Metallurgies Reduce the Cost of Amine Gas Treating Units (GPA Midstream, 2018)
- Consideration of Tempering and PWHT Temperatures of C-Mn and Low Alloy Steels Used for the Fabrication of Pressure Vessels (ASME PVP Conference, 2018)
- Substitution of Carbon Steels for ASME SA-533 Type E for Lightweight Equipment (NACE Corrosion Conference, 2019)
- Low-alloy SA-533 Steels as Alternative to ASME SA-516 Carbon Steel for Fabrication of Lightweight FPSO Vessels (ASME PVP, 2022)

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Technical data and information are to the best of our knowledge at the time of editing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.