Industeel

ArcelorMittal

SuperElso® 500

SuperElso® 500: Quenched and Tempered High Strength Steel for Pressure Equipment

SuperElso® 500 (SE 500) is a 500 MPa (72 ksi) yield strength quenched and tempered steel adapted for pressure equipment. SE 500 is manufactured via the electric furnace with dephosphorisation, ladle refining and vacuum degassing to provide a reproducible, clean and homogeneous steel.
The chemistry of **SuperElso® 500** has been carefully adapted to combine high strength and excellent weldability. This steel also displays excellent toughness, with transition temperatures typically below -50°C/-58°F. This steel is particularly suitable for pressure equipment in the offshore oil and gas industry, where its high strength allows significant weight and cost reductions. It can be supplied with stainless steel or alloy cladding where necessary.

PROPERTIES

STANDARD

> EN10028 part 6	P500Q-QH-QL1-QL2
> ASTM	A 533 Type C Cl. 2
> ASME II Part A	SA-533 Type C Cl. 2

CHEMICAL ANALYSIS - WEIGHT %

Heat analysis in weight % (typical values)

C	Mn	Si	P	S	Ni	Mo
≤ 0.13	≤ 1.6	≤ 0.40	≤ 0.010	≤ 0.004	≤ 1.0	≤ 0.50

Ni ≤ 1.5% for thick plate (> 80 mm). Vanadium microalloying (≤ 0.08%) may be used for plates thickness ≤ 80 mm

DELIVERY CONDITION

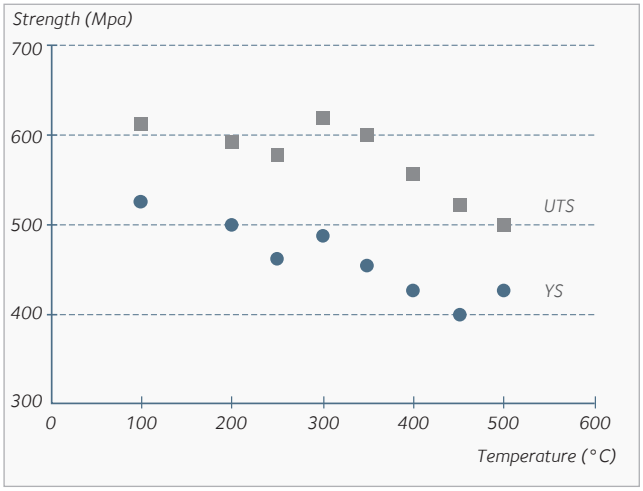
Water quenched and tempered.

MECHANICAL PROPERTIES

Guaranteed transverse tensile values at room temperature

	YS		UTS				Elongation
	Mini		Mini		Max		Mini
	MPa	ksi	MPa	ksi	MPa	ksi	%
t ≤ 150 mm	500	72	600	87	720	104	18
150 < t ≤ 250 mm	480	70	580	84	720	104	18

High temperature tensile properties are available on demand.
The 50J Charpy toughness level can be guaranteed down to -50°C (-58°F) for t ≤ 150 mm and down to -20°C (-4°F) for 150 < t ≤ 250 mm.



Typical high temperature tensile data for SuperElso® 500, 50 mm thick plate.

PLATE PROCESSING

FORMING

As the properties of SuperElso® 500 are obtained by water quenching and tempering, cold forming (+ stress relief for high strains), warm forming or hot forming can be applied:

> **cold forming (< 150°C): to be followed by Post-Weld Heat Treatment (PWHT)**

> **warm forming (< 550°C): to be followed by PWHT**

> **hot forming (900-1100°C): to be followed by complete heat treatment (water quench and temper) followed by PWHT**

Please contact us for full heat treatment details.

HEAT TREATMENT

> **Austenitizing and tempering:** austenitizing at 900° C - 950° C, water quenching. Tempering after water quenching according to the manufacturer's recommendations.

> **Stress relieving (Post Weld Heat Treatment)** at 600°C - 635°C

WELDING

Filler materials

A non-exclusive list of suitable filler materials is given hereafter:

Supplier	SMAW	FCAW	SAW
OERLIKON	TENACITO 70	FLUXOFIL M141	UP OE-SD3Mo / OP42TT FLUXOCORD 41 /OP121TT (*/**)
ESAB / PHILARC	-	OK 15.24/ PZ 61 45 / PZ 61 38	OK 13.24 -OK 15.28 OK Flux 10.62

The following list of filler materials has been determined according to suppliers' data, please confirm this choice with your supplier.
* successfully tested by Industeel.
** Ni content is greater than 1%

Welding conditions

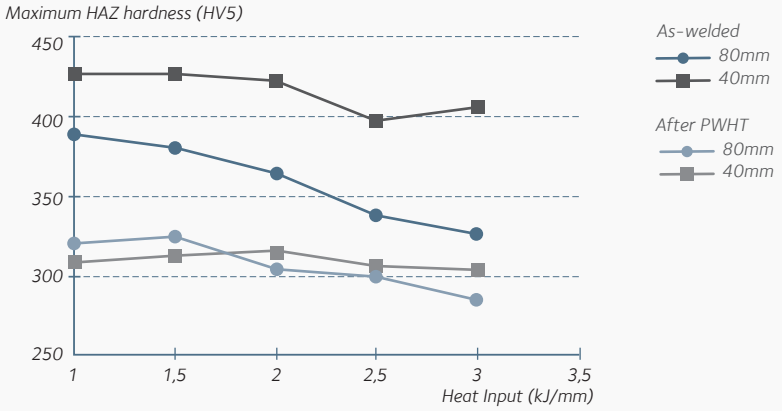
The reduced carbon content of SE 500 allows the use of low preheating temperatures.

Heat Input	Hydrogen content	Preheating temperature	Post-heating
1.0 - 2.0 kJ/mm	3 ≤ H_2 < 5 ml/100g (SAW, SMAW)	100°C	Yes *
1.0-1.5 kJ/mm	H_2 ≤ 3 ml/100g (FCAW, GMAW)	100°C	Yes *

** to be determined according to the plate thickness (min 150°C/2h). These welding conditions have been determined for highly clamped welds (Implant tests, NFA 89100).*

HAZ properties

The controlled carbon content of SuperElso® 500 limits the maximum HAZ hardness after PWHT (4h at 580°C/1076°F, no preheat). Typical HAZ hardness values are shown below:



The following CVN toughness values (J) have been measured in the HAZ (Fusion Line + 1 mm) at a test temperature of -20°C.

Welding conditions		As welded				After PWHT 580°C / 2h			
Process	Heat input	Skin		1/3 thickness		Skin		1/3 thickness	
	kJ/mm	Av.	Min.	Av.	Min.	Av.	Min.	Av.	Min.
SMAW	4.2	197	127	188	74	217	208	224	220
	1.4	241	216	191	162	206	194	162	149
FCAW	1.6	203	149	184	58	139	94	198	157
GMAW	1.1	194	166	191	170	137	110	167	143
SAW	2.7	181	165	115	43	154	62	197	157

APPLICATIONS

SuperElso® 500 is suitable for thick wall pressure vessels such as processing equipment (separators, scrubbers etc) in the oil and gas industry. It is particularly aimed at offshore applications where its high mechanical properties allow significant wall thickness reduction.

SuperElso® 500 can be supplied as plates, shells and heads, with or without stainless or alloy cladding such as 304L, 316L, 904L, 825. Ingots can also be supplied for the forging of nozzles.

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