



S355 / 420 / 460 MLO toughcore

Fracture mechanic – heat affected zone qualification up to 135 mm plate thickness to assure highest safety for offshore application

Putting the focus on the entire supply chain from installation, exploration, transportation to storage, voestalpine Grobblech GmbH gives the answer to an upcoming market with a TMCP-based plate design, satisfying this demanding world.

The new generation of thermomechanically rolled (TMCP) steel is manufactured in a completely new and patented process that enables unique combinations of properties with respect to thickness, strength, excellent toughness even at lowest temperatures as well as best weldability.

toughcore® heavy plates are pre-qualified as per EN 10225 (2019) Annex B (Option 17) in the delivery condition as well as after simulated post weld heat treatment for heat inputs of 3.5 kJ/mm and 5 kJ/mm.

With its outstanding toughness over the entire cross-section, even at very high plates thickness, it creates higher safety standards and enhance the potential for the use of heavy plates for offshore construction, especially when used for arctic applications.

Convincing advantages

- » The answer for exploration of arctic regions and fulfilling requirements acc. to Arctic Class III up to 100 mm in particular
- » Superior toughness to the core assuring highest safety levels
- » Enhanced weldability
- » Welding pre-qualification acc. EN 10225



Premium quality
with reduced carbon footprint

toughcore®
greentec steel

Chemical composition

Heat analysis in mass %

Steel grade	C max.	Si max.	Mn max.	P max.	S max.	Cr max.	Mo max.	B max.	Ti max.	Ni max.	Cu max.	Nb max.	N max.
S355 MLO toughcore	0.07	0.35	1.60	0.01	0.002	0.25	0.2 ¹⁾	0.0005	0.02	0.5	0.25	0.03	0.008
S420 MLO toughcore	0.08	0.35	1.60	0.01	0.002	0.25	0.3	0.0005	0.02	0.7	0.25	0.04	0.008
S460 MLO toughcore	0.08	0.35	1.70	0.01	0.002	0.25	0.3	0.0005	0.02	0.7	0.25	0.04	0.008

¹⁾ max. 0.08% up to incl. 75 mm

Carbon equivalent

Steel grade	Plate thickness [mm]	CEV max.	Mass [%]	Pcm max.
S355 MLO toughcore	40 – 135	0.40 ²⁾		0.2
S420 MLO toughcore	40 – 135	0.42		0.2
S460 MLO toughcore	40 – 135	0.43		0.2

²⁾ max. 0.39% up to incl. 75 mm

Mechanical properties: Notch impact energy

Notch impact energy in as-delivered condition

Steel grade	Plate thickness [mm]	Notch impact energy ³⁾ A, min / A min. [J] (1/4 t) Test temperature		Notch impact energy ³⁾ A, min / A min. [J] (1/2 t) Test temperature	
		-80 °C	-65 °C	-60 °C	-45 °C
S355 MLO toughcore	40 ≤ 100	150 / 105	150 / 105	100 / 60	100 / 60
	> 100 ≤ 135	-	150 / 105	-	100 / 60
S420 MLO toughcore	40 ≤ 100	150 / 105	150 / 105	100 / 60	100 / 60
	> 100 ≤ 135	-	150 / 105	-	100 / 60
S460 MLO toughcore	40 ≤ 100	150 / 105	150 / 105	100 / 60	100 / 60
	> 100 ≤ 135	-	150 / 105	-	100 / 60

³⁾ Notched impact bending test in accordance with EN ISO 148-1 on Charpy-V transversal samples
Normative requirements acc. to EN 10225 at -40 °C min. 60/42J in 1/2t

Mechanical properties: Tensile test

Standard values for as-delivered condition

Steel grade	Plate thickness [mm]	Yield strength $R_{p0.2}$ ⁴⁾ [MPa] min.		Tensile strength R_m ⁴⁾ [MPa]	
		¼ t	½ t	¼ t	½ t
S355 MLO toughcore	40 ≤ 100	355	355	470 – 600	470 – 600
	> 100 ≤ 135	355	355	470 – 600	470 – 600
S420 MLO toughcore	40 ≤ 100	420 – 540	390 – 510	500 – 620	490 – 610
	> 100 ≤ 135	400 – 520	370 – 490	490 – 610	470 – 590
S460 MLO toughcore	40 ≤ 100	440 – 560	400 – 520	530 – 650	510 – 630
	> 100 ≤ 135	420 – 540	390 – 510	520 – 640	490 – 610

Steel grade	Uniform elongation A_g ⁴⁾ [%]	Fracture elongation $L_0 = 5.65 \sqrt{S_0}$ A_5 ⁴⁾ [%]	$R_{p0.2}$ / UTS max.
S355 MLO toughcore	10	25	0.90
S420 MLO toughcore	10	25	0.90
S460 MLO toughcore	10	25	0.90

⁴⁾ Tensile test in accordance with EN ISO 6892-1 on transverse samples.

Available dimensions

Maximum width per thickness; minimum width 1,500 mm

Steel grade	Plate thickness [mm]	Max. width [mm]	Max. length [mm]	As-delivered condition
S355 MLO toughcore	40 – 135	3,800	18,700	toughcore®
S420 MLO toughcore	40 – 135	3,800	18,700	toughcore®
S460 MLO toughcore	40 – 135	3,800	18,700	toughcore®

Additional dimensions upon request.

OUR PATH TO A GREENER FUTURE

Premium products in the greentec steel Edition

With greentec steel, voestalpine is pursuing an ambitious step-by-step plan in the long-term decarbonization of steel production. The declared objective is to achieve carbon-neutral production by 2050, and the initial steps have already been taken. Process-optimized production operations already prevent up to 10% of the direct CO₂ emissions at the Linz site. The material and processing properties of the steel are not affected in any way in this production route. Each voestalpine heavy plate product is available in premium quality in the greentec steel Edition with a reduced carbon footprint and unique benefits.



Premium quality with reduced carbon footprint

toughcore®
greentec steel

Heavy plates (excl. heads and clad plates) – greentec steel Edition

Max. carbon footprint 2.21 kg CO₂e per kg of steel ¹⁾

¹⁾ per EN 15804+A2 (EPD methodology) cradle to gate

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