ThyssenKrupp Steel Europe

Thermomechanically rolled special structural steels	Steel grade		Material No.	Material Specification
	TKSE-Short name	EN-Short name		
	XABO® 460	-	-	1210
	XABO® 460 T	-	-	
Heavy plate				May 2017

Scope

This material Specification applies to plates, made from thermomechanical rolled special structural steels XABO® 460 and XABO® 460 T. The steels differ in the lowest test temperature for the notch-bar impact test. By default, the plates are delivered in thicknesses up to 35 mm. Higher plate thicknesses up to 60 mm are to be agreed on the base of special inquiry.

Application

These steels are applied in welded constructions such as supporting structures, vessels etc., where a secured prevention against cold cracking in the welded joints is required. Due to the low carbon equivalent, these steels are highly resistant against cold cracking.

The entire processing is of fundamental importance for the good performance of the products made of these steels. The processor must assure himself, that his methods of calculation, designing and working conform with the material to be used, meet the latest requirements of technical progress, and are suited to the proposed application. Due consideration must be given to relevant construction specifications.

The selection of the material is left up to the purchaser.

Chemical composition (heat analysis, %)

Steel grade	C	Si	Mn	P	S	Cu	Nb	Ni	CE [1]
XABO® 460	≤ 0.14	≤ 0.50	≤ 1.70	≤ 0.025	≤ 0.015	≤ 0.30	≤ 0.05	≤ 0.40	≤ 0.45
XABO® 460 T					≤ 0.010				

[1] $$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

Delivery condition

Thermomechanically rolled, if necessary accelerated cooled (short symbol TM) or quenched and tempered (short symbol QT).

Typical values for the mechanical properties

Steel grade	Minimum Yield strength R_{eH} MPa [2] plate thickness mm			Tensile strength R_m MPa plate thickness mm		Minimum Elongation A_5 %	Minimum impact energy KV in J (Charpy V-specimens) Test temperature, °C			
	≤ 35	> 35 ≤ 50	> 50 ≤ 60	≤ 40	> 40		- 50	- 40	- 30	- 20
XABO® 460	460	440	430	540 - 720	530 - 710	17	longitudinal	-	-	-	40
							transverse	-	-	-	21
XABO®460 T							longitudinal	27	40	50	65
							transverse	16	25	35	45

[2] 1 MPa = 1 N/mm²

The values of strength and elongation given in the table before are valid both for transverse specimens.

If the notch-bar-impact test is required, the test temperature and the specimen direction have to be specified in the order. If no mention is made in the order, the notch-bar impact test will be carried out at the lowest test temperature given in the table on Charpy V-specimens taken in the longitudinal direction. The values stated for the impact energy are minimum values obtained as the average of 3 specimens, with no single value being less than 70 % of the specified values stated in the table.

If the thickness of the material is not sufficient for manufacturing of Charpy V-specimens with a width of 10 mm, the impact energy value is reduced proportionally to the specimen width (product thickness). No impact test is performed on products below 5 mm in thickness.

Upon special agreement is made for carrying out a bend test, it will be carried out on transverse specimens, the mandrel diameter being a minimum of 4 times the material thickness and a bending angle of 180 °.

Physical properties at room temperature (auxiliary values)

Density kg/dm^3	Modulus of elasticity (dynamic) GPa	Thermal conductivity $\frac{W}{mK}$	Mean specific heat capacity (20 °C) $\frac{J}{g\ K}$	Actual specific heat capacity $\frac{J}{g\ K}$	Thermal diffusivity cm^2/s	Specific electric resistance $\mu\Omega$ m	Magnetic properties
7.85	213	45	0.45	0.45	0.13	0.3	magnetizable

Number of tests

Unless otherwise agreed upon in the order, the tests listed below will be performed during the acceptance inspection

Inspection lot: mother plate 1 test-specimen from one end

From every test piece one tensile test on a transverse specimen at room temperature as well as one notch-bar-impact test at a temperature specified for the particular steel grade on longitudinal specimens will be carried out.

For tensile tests flat specimens are utilised. At material thicknesses ≤ 40 mm both surfaces as rolled of the specimens have to be left in their original condition. Flat specimens made of products > 40 mm in thickness shall be tested either with as rolled surfaces in the case of full-thickness specimens or with the half of the plate thickness. In this case one as rolled surface remains undisturbed.

Round tensile specimens only are allowed at plate-thicknesses > 30 mm and prior agreement. These test specimens shall be taken in such a way that their axis lies approximately to ¼ of the plate thickness measured from the surface of the plate or as close to it as possible.

Notch-bar-impact specimens are taken from an area close to the surface. At plate thicknesses above 40 mm the specimens are taken in such a way that their longitudinal axis lies approximately to ¼ of the plate thickness measured from the surface of the plate or as close to it as possible.

Upon special agreement a bend test based on ISO 7438 can be performed. At thicknesses above 25 mm the test specimen will be machined to 25 mm in thickness.

Fabrication - welding

Products made of steel grades according to this specification

- are very suitable for welding. Due to the low tendency for cold cracking, generally at lower plate thicknesses, preheating prior to welding is not necessary. More over for the fabrication the document "STAHL-EISEN-Werkstoffblatt 088" has to be applied as well.

  Recommendations for welding are also given in EN 1011 part 1 and part 2 - Welding, Recommendation for welding of metallic materials -.
- are very suitable for cold forming and machining.
- are not suitable for heat treatment above 500 °C.

General information

Unless otherwise stated in this Material Specification, the delivery will be governed by the conditions outlined in EN 10021. As per prior agreement at the time of ordering other inland and foreign delivery conditions are negotiable.

If special deformation properties vertical to product surface are required, for the steels relating to this Specification values for the reduction of area in the through-thickness direction may be agreed in the order in accordance with the three categories of EN 10164 - Steel products with improved deformation properties perpendicular to the surface of the product.

Ultrasonic examination for internal imperfections can be agreed upon according to EN 10160 - Ultrasonic testing of steel flat product of thickness equal to or greater than 6 mm (reflection method) -.

Publisher's addresses

STAHL-EISEN-Werkstoffblätter	Verlag Stahleisen GmbH, Postfach 10 51 64, D-40042 Düsseldorf
EN-, ISO Standards	Beuth Verlag GmbH, Postfach, D-10772 Berlin