Quenched and tempered special structural steels	Steel grade		Material No.	Material Specification
	TKSE-Short name	EN-Short name		
	XABO® 890	**S890QL**	**1.8983**	245
	XABO® 960	**S960QL**	**1.8933**	
Haevy plate				November 2015

Scope

This Material Specification applies to liquid-quenched and tempered heavy plates from 3 up to 100 mm [1)] in thickness, made of the high-strength special structural steels XABO® 890 and XABO® 960.

Application

The steels are used for welded constructions of all kinds such as transport vehicles, mobile cranes, hoistings and mining equipment, pressure vessels and penstocks.

The entire processing technique 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 steel XABO® 890 has been approved under the terms of the provisions in force in the Federal Republic of Germany for the construction of pressure vessels (see VdTÜV-Werkstoffblatt 417).

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

Chemical composition (heat analysis, %)

C	Si	Mn	P	S	Cr	Mo	Ni	V
≤ 0.18	≤ 0.5	≤ 1.6	≤ 0.020	≤ 0.010	≤ 0.8	≤ 0.7	≤ 2.0	≤ 0.1

The steel has a fine-grained microstructure. Nitrogen is absorbed to form nitrides.

Delivery condition: quenched and tempered (see paragraph "Heat treatment")

Mechanical properties in the state of delivery condition at room temperature (transverse test specimens according to ISO 6892-1, method B).

Steel grade	Minimum yield strength R_{eH} *) MPa [2)]				Tensile strength R_m MPa				Minimum elongation at fracture A
plate thickness mm	≤50	>50 ≤60	>60 ≤80	>80 ≤100	≤50	>50 ≤60	>60 ≤80	>80 ≤100	%
XABO® 890	890	830			940-1100	880-1100			12
XABO® 960	960	920	870	850	980-1150	970-1100	920-1070	900-1050	12

*) if continuous yielding occurs, the yield strength is determined as $R_{p0,2}$

Preparation of the tensile test specimens according to EN 10025 - part 1 and part 6.

The delivery of steel XABO® 960 in thicknesses ≤ 100mm, with improved forming properties perpendicular to the product surface in quality Z25 according to EN 10164, may be agreed separately at the time of order.

ThyssenKrupp high strength XABO® 890

ThyssenKrupp high strength XABO® 960

1) S960QL: t ≤ 50 mm acc. to EN 10025-6

3) 1 MPa = 1 N/mm²

Impact energy in the state of delivery condition (Charpy V-impact test according to ISO 148-1).

Steel grade	Specimen direction	Impact energy KV in J at a test temperature of		
		0 °C	- 20 °C	- 40 °C
XABO® 890	longitudinal	50	40	30
XABO® 960	transverse	35	30	27

For the steel XABO® 890 impact energy values at -60 °C may be agreed upon.

The values stated for the impact energy are minimum values obtained as the average of 3 specimens, no single value being less than 70 % of the values stated in the table. For plate thicknesses < 40 mm the specimens are taken near the surface and ≥ 40 mm they are taken at a distance of ¼ of the plate thickness. For thicknesses < 10 mm the impact energy value is reduced proportionally to the specimen width (product thickness).

According to EN 10025 -1 impact tests are not required for nominal thickness < 6 mm.

Number of tests

Unless otherwise agreed upon in the order, the tests listed below performed during inspection:

1 tensile test	1 test specimen per 40 t from each heat*
1 notched-bar impact test (3 specimens)	1 set specimens per 40 t from each heat* at a specified test temperature and specimen direction. If no mention is made in the order, the impact energy will be determined at the lowest temperature in the table above on longitudinal specimens respectively to the steel grade ordered.

* as referenced in EN 10025 - 6.

General processing information

For those who process these steels for the first time, it is recommended to consult the steel supplier to take advantage of the experiences gathered so far.

The general information stated below can only cover a few of the important points. The information outlined in STAHL-EISEN-Werkstoffblatt 088 (weldable fine grain structural steels, processing directives especially for welding) applies equally to these steels.

Recommendations for welding are also given in EN 1011 part 1 and part 2 - Welding, Recommendation for welding of metallic materials -.

Cold forming

The steels are generally processed cold, i. e. at temperatures below the highest permissible stress-relieving temperature.

After severe cold forming operations it is normally sufficient if a stress relieving treatment is carried out in order to reduce the effects of cold forming and to improve the toughness which has been impaired due to the cold forming. This only is done in cases, where the inspection specifications or other regulations do not stipulate a repeated heat treatment after cold forming corresponding to the heat treatment that has been carried out at the time of delivery. It is to be noted that a stress relieving heat treatment does not completely rectify the effects of cold forming.

Hot forming

Hot forming, i. e. processing at temperatures above the maximum allowed stress relieving temperature, basically is possible. Such an operation, however, will remove the original heat treatment effect. Therefore, after hot forming it is necessary to perform a heat treatment equivalent to that of the state of delivery condition.

Heat treatment

In general the steels obtain their mechanical properties through austenitization followed by conventional quenching and tempering. Direct quenching after hot-rolling followed by tempering is considered equivalent to conventional quenching and tempering according to EN 10025-6. The heat treatment is governed by the chemical composition and the thickness of the material. Information on this can be obtained from the manufacturer.

Thermal cutting

Under suitable conditions flame cutting is possible without any difficulty. The processing conditions correspond to unalloyed or alloyed steels. The surface condition of the plates exerts a substantial influence on the flame cutting parameters and the attainable quality of the cut edge. In cases where a higher quality for the flame cut surface is required, then it is recommended to clean the upper and lower sides of the cutting edge. In that case rust, scale and other kinds of dirt must be removed.

In order to avoid cold cracking, for plate thicknesses > 20 mm it is recommended to preheat a zone of around 100 mm wide to about 150 °C before flame cutting.

For workpiece temperatures below 5 °C and also if the flame cut edges are to undergo cold forming in the course of further processing it is advisable to preheat the material to about 150 °C before flame cutting.

Welding

If due consideration is given to the general rules for welding, these steels are weldable both manually and automatically. The manual arc welding and the gas shielded arc welding procedures are preferably used. Depending on plate thickness, hydrogen content of the weld metal and heat input the welding may be carried out under preheating. The recommendations of the STAHL-EISEN-Werkstoffblatt 088 should be followed. The working temperature should not go beyond 250 °C.

A prerequisite to obtain the same mechanical properties in the weld compared to the base material is the application of suitable welding consumables and the choice of appropriate welding conditions. To prevent cold cracking in the welded joints only welding consumables giving welds of very low hydrogen content should be used. A high cooling rate in the weld region should be avoided. Detailed information is given in our recommendations for welding and our processing brochures.

To ensure, that the steel properties are not impaired to an inadmissible extent by thermal cycles during welding, an upper limit for the heat input has to be fixed. The heat input for welding is governed by the welding process, the plate thickness, the preheating temperature, the form of the welding seam and the requirements imposed on the construction.

In consideration of the desired mechanical properties at the welded joints, post weld heat treatments are not required. If stress-relieving is prescribed in construction regulations or if it is required for reasons of design, it should be performed at a temperature ranging from 530 - 560 °C.

General information

Unless otherwise agreed upon in the order, the delivery will be governed by the conditions outlined in EN 10021.

The admissible tolerances are based on EN 10051 for plates cut from hot strip and EN 10029 for four-high mill plates, unless other terms have been agreed upon.

The plates will be supplied with a maximum flatness tolerance according to EN 10029, table 4, steel type H. Smaller flatness tolerances can be agreed upon at the time of ordering.

For surface quality requirements EN 10163 is applicable.

As per prior agreement at the time of ordering other testing conditions are also possible.

As per special agreement it is possible to supply plates descaled or descaled and primed.

Publisher`s addresses

EN-, ISO Standards	Beuth Verlag GmbH, Postfach, D-10772 Berlin
STAHL-EISEN-Werkstoffblätter	Verlag Stahleisen GmbH, Postfach 10 51 64, D-40042 Düsseldorf
VdTÜV-Werkstoffblätter	Verlag TÜV Rheinland, Postfach 90 30 60, D-51123 Köln
ThyssenKrupp Steel Europe brochures „Processing of Quenched and Tempered Special Structural Steels“ “Recommendations for thermal cutting of XABO® 890/960” “Recommendations for welding of XABO® 890 and XABO® 960” “Quenched and tempered N-A-XTRA® and XABO® steels - for lighter living”	ThyssenKrupp Steel Europe AG , D-47161 Duisburg