ThyssenKrupp Steel Europe

Wear-resistant special structural steel	Steel grade		Material No.	Material Specification
	TKSE-Short name	EN-Short name		
Heavy plate	**XAR® 400**	-	**1.8714**	703 June 2013

Scope

This Material Specification applies to 3 to 100 mm (0.118 to 3.937 in.) thick plates of the wear-resistant special structural steel XAR® 400.

Application

The steel may be used at the discretion of the purchaser for wear-exposed structures, e.g. excavating, mining and earth-moving machinery, truck dump bodies, conveying, crushing and pulverizing equipment, scrap presses, paving moulds and in switch manufacturing.

The processing and application techniques as a whole are of fundamental importance for the successful use of the products fabricated of this steel. The processor/fabricator must assure himself, that his design and work methods are appropriate for the material, are state-of-the-art and are suitable for the envisaged purpose.

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

Chemical composition (heat analysis, mass.-%)

C	Si	Mn	P	S	Cr	Mo	B
≤ 0.20	≤ 0.80	≤ 1.50	≤ 0.025	≤ 0.010	≤ 1.00	≤ 0.50	≤ 0.005

The steel has a fine-grained microstructure. Nitrogen is absorbed to form nitrides by means of Al and, where applicable, Nb or Ti.

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

Mechanical properties

Hardness at room temperature in the delivery condition: 370 - 430 HBW

The Brinell hardness shall be determined in accordance with ISO 6506. The hardness shall be measured roughly 1 mm below the surface of the plate.

Typical carbon equivalent and strength values, typical of 15 mm (0.591 in.) plate thickness

Carbon equivalent CET in % [CET = C + (Mn + Mo) / 10 + (Cr + Cu) / 20 + Ni / 40]	: 0.32
Carbon equivalent CE in % [CE = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15]	: 0.51
Yield strength in MPa (ksi) *)	: 1000 (145.0)
Tensile strength in MPa (ksi) *)	: 1250 (181.3)
Elongation at fracture A in %	: 10

*) 1 MPa = 1 N/mm² (1 ksi = 10^3 lbf/in²)

Impact energy for plates up to 40 mm (1 ½ in.) thickness at - 20 °C (- 4 °F) in the state of delivery condition: min. 27J (20 ft·lbf) (transverse)

The typical Impact energy at - 40 °C (- 40 °F) in the state of delivery condition is 50 J (37 ft·lbf) (transverse) for 15 mm (0.591 in.) plate thickness. The testing is performed according to ISO 148-1.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 minimum value. The specimens are taken near the surface. For thicknesses < 10 mm (< 0.394 in.) the impact energy value is reduced proportionally to the specimen width (product thickness).

Impact tests are not performed for nominal thickness < 6 mm (0.236 in.).

Number of tests

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

Up to 40 mm (1 ½ in.) thickness:

1 notched-bar impact test (1 set = 3 specimens) 1 determination Brinell hardness	per 40 t per heat

Over 40 mm (1 ½ in.) thickness:

1 determination Brinell hardness	per heat

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 recommendations given in STAHL-EISEN-Werkstoffblatt 088 (Weldable fine-grained structural steels, guidelines for processing, in particular for welding) correspondingly apply to this steel as well.

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

It is left to the discretion of the processor/fabricator to decide which of the familiar precautions must be adopted to avoid cracking during thermal cutting and welding under the prevailing construction and fabrication conditions.

Cold forming

The products made of this steel are suitable for cold bending provided, that consideration is given to the high hardness. The formability of steel decreases with increasing hardness. This has to be kept in mind when forming. The forming must take place at a slow and steady rate, the cut edges must be deburred and the plates heated, if necessary, prior to the forming. A final stress-relieving is not considered for this steel.

Machinability

In spite of its high wear resistance, the steel exhibits good machinability if sufficiently heavy machine-tools and sharp carbide-tipped tools are used. The feed rate and cutting speed have to be adjusted to the high hardness of the material.

Heat treatment

Plates of the XAR® 400 grade receive the required properties as a result of austenitizing and follow-on quenching in special facilities and, where applicable, tempering below A_{c1}. Direct quenching after hot-rolling is considered equivalent to conventional quenching. The heat treatment depends on the chemical composition and the product thickness. To avoid hardness losses, the steel must not be heated above 250 °C (482 °F).

Thermal cutting

Preferably the flame-cutting process is used. For small product thicknesses, however, the plasma cutting process is used in the interest of minimum distortion.

Preheating is not normally necessary when flame-cutting thicknesses up to around 30 mm (1.181 in.). However, if the workpiece temperature is below + 5 °C (+ 41 °F), or the cut edges are to be cold-formed in the course of further processing, preheating to about 150 °C (302 °F) should be considered in the interest of cold cracking resistance.

Welding

If due consideration is given to the general rules for welding, this steel is weldable both manually and automatically. To prevent cold cracking in the welded joints only welding consumables giving welds of very low hydrogen content should be used.

Preheating is not generally necessary for welding with austenitic filler metals.

For highly stressed weld seams, welded with ferritic filler metals, preheating should in general be used for thicknesses stated in STAHL-EISEN-Werkstoffblatt 088. The preheat temperature level for welding depends on the plate thickness and the residual stress state of the structure. The working temperature should not go beyond 250 °C (482 °F).

The wear resistance of components fabricated of XAR® 400 may be increased with the aid of wear resistant layers deposited by means of welding or metal spraying.

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 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
ThyssenKrupp Steel Europe brochures	ThyssenKrupp Steel Europe AG, D-47161 Duisburg
„XAR® wear-resistant steels - Processing recommendations“	
„XAR® wear-resistant steels - Solution to your wear problems“	