

**ThyssenKrupp Steel Europe**

Security steel	Steel grade		Material No.	Material Specification
	TKSE-Short name	EN-Short name		
Heavy plate	<b>SECURE 600</b>	-	-	1933  June 2011

**Scope**

This Material Specification applies to the alloyed, liquid-quenched and tempered high-strength special steel SECURE 600 for civil use, that is usually produced from 4 up to 40 mm in thickness. This steel is delivered with defined properties of ballistic protection.

**Application**

The steel may be used at the discretion of the purchaser for purposes of ballistic protection mainly for applications like armoured limousines and valuable transporters. The entire processing technique is of fundamental importance for the good performance of the products made of this steel. 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.

The selection of the material is up to the purchaser.

**Chemical composition** (heat analysis, %)

C	Si	Mn	P	S	Cr	Mo	Ni	B
≤ 0.40	≤ 0.80	≤ 1.50	≤ 0.025	≤ 0.010	≤ 1.50	≤ 0.50	≤ 1.50	≤ 0.005

The steel has a fine-grained microstructure. Nitrogen is absorbed to form nitrides by means of Al and if necessary Nb.

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

**Hardness at room temperature in the delivery condition:** 570 - 640 HBW

The hardness shall be determined in accordance with ISO 6506-1. The hardness is to be determined about 1 mm below plate surface.

**Typical mechanical properties** in the state of delivery condition at room temperature (transverse specimens according to ISO 6892-1, method B), Charpy-V-test acc. ISO 148-1 (transverse specimens).

yield strength $R_{eH}$ <sup>*)</sup> MPa	tensile strength $R_m$ MPa	elongation at fracture A %	Impact energy, - 40 °C J
1500	2000	8	15

<sup>\*)</sup> If continuous yielding occurs, the yield strength is determined as  $R_{p0.2}$

## Number of tests

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

Hardness testing will be determined once per 40 t of a melt.

Bullet resistance testing can be performed according to customer requirements in addition and must be agreed upon separately. If the customer doesn't take use from the bullet resistance testing at the time of the inquiry and ordering, the products are to be delivered in accordance with the base specifications of this document.

All test results are documented by inspection certificates following EN 10204-3.1.

## General processing information

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

The general information below can only cover a few important points. The information outlined in STAHL-EISEN-Werkstoffblatt 088 (weldable fine grain structural steels, processing directions 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

Because of the high hardness a cold forming of the steel SECURE 600 is not recommended.

## Heat treatment

In general this steel obtains its mechanical properties through austenitization followed by conventional quenching and tempering. The heat treatment depends on the chemical composition and the product thickness. To avoid decrease of hardness, SECURE 600 must not be heated above 200 °C.

## Thermal cutting

For plate thickness up to 15 mm the laser-cutting process is preferably used. For plates up to 40 mm in thickness plasma cutting under water is recommended. Flame cutting is also possible without any difficulties. According to the plate thickness a sufficient pre- and post-heating is required. Detailed information is given in our processing recommendation for cutting of SECURE.

## 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 should be used that lead to the lowest possible hydrogen content in the weld metal. The use of the austenitic welding consumable type 18 8 Mn (Thermanit X) is recommended. For plate thicknesses up to 25 mm preheating is generally not necessary. For high loaded welds, welded with a ferritic welding consumable, preheating should be carried out for the thicknesses specified in STAHL-EISEN-Werkstoffblatt 088. The height of the preheating temperature for welding depends on plate thickness and residual stress behavior of the construction. Interpass temperatures above 200 °C should be avoided. Detailed information is given in our processing recommendation for welding of SECURE.

**Dimensions and tolerances**

thickness	4 - 40 mm
thickness tolerances	$\leq 15.0$ mm: -0 / +0.8 mm $\leq 20.0$ mm: -0 / +1.0 mm $\leq 40.0$ mm: -0 / +1.2 mm
width	1250 - 2500 mm
length	4000 - 12000 mm

**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 10029, unless other terms have been agreed upon.

Thickness tolerances are listed in the table above (paragraph "Dimensions and tolerances").

The flatness of the plates corresponds to table 4H plus 3 mm per meter.

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

Recommendation for thermal cutting  
of SECURE steels

ThyssenKrupp Steel Europe AG, D-47161 Duisburg

Recommendation for welding  
of SECURE steels

ThyssenKrupp Steel Europe AG, D-47161 Duisburg

ThyssenKrupp Steel Europe brochure  
"Ballistic steels. Making life saver."

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