



DILLINGER HÜTTE GTS

# DILLIMAX 500

HIGH STRENGTH FINE GRAINED STRUCTURAL STEEL  
QUENCHED AND TEMPERED

Material Data Sheet Edition April 2003 <sup>1)</sup>

**DILLIMAX 500** is a high strength quenched and tempered, fine grained structural steel with a minimum yield strength of 500 MPa (72 ksi) in its delivery condition (referring to the lowest thickness range), which mechanical properties are achieved by water quenching followed by tempering.

DILLIMAX 500 fulfils the requirements of EN 10137 <sup>2)</sup>. It is preferentially used for welded steel structures within mechanical constructions, plant constructions and structural steel works, such as machines for structural engineering, conveying plants, hoists, cranes, flood gates, bridges and frameworks.

## Product description

### Designation and range of application

DILLIMAX 500 can be delivered in three qualities:

- **basic (B)** with minimum impact values down to -20 °C (-4 °F): **DILLIMAX 500 B**  
Steel number 1.8924 - S500Q according to EN 10137 <sup>2)</sup>
- **high toughness (T)** with minimum impact values down to -40 °C (-40 °F): **DILLIMAX 500 T**  
Steel number 1.8909 - S500QL according to EN 10137 <sup>2)</sup>
- **extra tough (E)** with minimum impact values down to -60 °C (-76 °F): **DILLIMAX 500 E**  
Steel number 1.8984 - S500QL1 according to EN 10137 <sup>2)</sup>

DILLIMAX 500 can be delivered in thickness from 6 to 150 mm (1/4 to 6 in.), according to the dimensional program. Dimensions which deviate from the usual dimensional program may be possible on request.

### Chemical composition

For the ladle analysis, the following limiting values in % are applicable:

DILLIMAX 500	C	Si	Mn	P	S	Cr	Ni	Mo	V+Nb
<b>B,T,E</b>	≤ 0.16	≤ 0.50	≤ 1.60	≤ 0.020	≤ 0.010	≤ 0.70	≤ 1.00	≤ 0.60	≤ 0.08

The steel is fine grained through sufficient aluminium content.

Furthermore, the limiting CEV <sup>3)</sup> values indicated by prEN 10025-6 are respected. Lower carbon equivalent values can be guaranteed on request.

### Delivery condition

Water quenched and tempered according to EN 10137 <sup>2)</sup>.

<sup>1)</sup> The latest version of this data sheet is available at [www.dillinger.de](http://www.dillinger.de)

<sup>2)</sup> In future: EN 10025 Part 6

<sup>3)</sup>  $CEV = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15$

## Mechanical and technological properties in the delivery condition

### Tensile test at ambient temperature - transverse test specimens -

Plate thickness t [mm] (in.)	Tensile strength	Minimum yield strength	Minimum elongation	
	$R_m$ [MPa] (ksi)	$R_{eH}^{1)}$ [MPa] (ksi)	$A_5$ [%]	$A_{2in.}^{2)}$ [%]
$\leq 50$ (2)	590 - 770 (86 - 112)	500 (72)	17	18
$> 50$ (2) $\leq 100$ (4)	590 - 770 (86 - 112)	480 (70)	17	18
$> 100$ (4) $\leq 150$ (6)	540 - 720 (78 - 104)	440 (64)	17	18

The values in brackets are only for information.

### Impact test on Charpy-V-specimens

DILLIMAX 500	Specimen direction	Impact energy $A_v$ [J] (ft.-lb.) at test temperature			
		0 °C (32 °F)	-20 °C (-4 °F)	-40 °C (-40 °F)	-60 °C (-76 °F)
Basic (B)	longitudinal / transverse	40/30 (30/22)	30/27 (22/20)	–	–
High toughness (T)	longitudinal / transverse	50/35 (37/26)	40/30 (30/22)	30/27 (22/20)	–
Extra tough (E)	longitudinal / transverse	60/40 (44/30)	50/35 (37/26)	40/30 (30/22)	30/27 (22/20)

The specified minimum value is the average of 3 tests. Not more than one individual value is permitted to be below this minimum value, and no more than 30%. For plate thickness below 10 mm, the test will be carried out on Charpy-V test specimens with reduced width. The minimum impact value will be reduced proportionally. The values in brackets are only for information.

## Testing

Tensile and impact tests will be performed according to EN 10137<sup>3)</sup> once per heat and 40 t. Tests on every heat treated plate may be possible on request.

The specimens for the tensile test are prepared according to EN 10137<sup>3)</sup>. Testing is carried out on specimens of gauge length  $l_0 = 5.65\sqrt{S_0}$  or  $l_0 = 5d_0$ , in accordance with EN 10002-1. Tensile tests according to ASTM A370 may be agreed.

The impact test will be carried out on Charpy-V-specimens in accordance with EN 10045-1. Unless otherwise agreed, the test will be performed at the lowest temperature of the corresponding quality on transverse test specimens taken as follows:

- for plate thickness  $\leq 40$  mm: close to the surface
- for plate thickness  $> 40$  mm:  $\frac{1}{4}$  of the plate thickness

Unless otherwise agreed, the test results are documented in a certificate 3.1 B in accordance with EN 10204.

## Identification

The marking of plates is carried out via steel stamps with at least the following information:

- the manufacturer's brand
- steel designation (DILLIMAX 500 B, T or E)
- heat number
- rolled plate number

In addition, the plates are stencilled with DILLIMAX 500 B, T or E.

## Plate processing

The processing and application techniques are of fundamental importance to the reliability of products made from these steel qualities. The fabricator should ensure that his calculation, design and processing methods are aligned with the material, correspond to the state of the art and suitable for the intended application. The customer is responsible for the selection of the material. The recommendations of the EN 1011 should be observed.

## Cold forming

Cold forming means forming below the maximum allowable stress relief temperature (560 °C / 1040 °F). DILLIMAX 500 can be cold formed with regard to its high yield strength. Flame cut or sheared edges in the bending area should be grinded before cold forming.

<sup>1)</sup> If not apparent, the yield strength  $R_{p0.2}$  is measured instead.

<sup>2)</sup> These values apply if tested according to ASTM A370.

<sup>3)</sup> In future EN 10025 Part 6

Cold forming is related to a hardening of the steel and to a decrease in toughness. These changes in the mechanical properties can, as a rule, be partially neutralized through a subsequent stress relief heat treatment.

For large cold forming amounts or if prescribed by regulations, a new quenching and tempering treatment may be necessary to restore the original mechanical properties. In this case we recommend you to consult us prior to ordering.

Cold forming of DILLIMAX 500 should be carried out according to the following recommendations (where t is the plate thickness):

	Minimum bending radius	Minimum die width
Transverse direction	1 t	6 t
Longitudinal direction	1.5 t	7 t

### Hot forming

Hot forming means forming at temperatures above the maximum allowable stress relief temperature (560 °C / 1040 °F). The original quenched and tempered condition will thereby be altered. As a result, a new quenching and tempering treatment is always necessary after hot forming. It should be noted that when applying a new quenching and tempering treatment, it is not always possible to obtain the same properties as with the original hot forming at the mill, because of different hot forming equipment, for instance. In this respect we recommend you to contact us prior to ordering, in all cases where hot forming is required. However, it is the fabricator's responsibility to obtain the required values of the steel through an appropriate heat treatment.

### Welding and flame cutting

DILLIMAX 500 is characterized by a low carbon content and a low carbon equivalent. This means for the heat affected zone low hardness, low sensitivity to hydrogen induced cold cracking and good toughness. Experience has shown that good properties can be reached in the weld area if the welding parameters are chosen so that the cooling time  $t_{8/5}$  lies between 10 and 30 seconds.

The high yield strength of the base material must be taken into account when choosing the filler materials. A stress relief heat treatment after welding can change the properties of the weld metal, especially in case of elevated heat treatment temperature and duration. As a rule, the yield strength is reduced. Therefore, if a post-weld heat treatment is planned during or after plate processing, this must be already considered when selecting the filler materials.

For general welding instructions, please consult the EN 1011.

### Heat treatment

If a stress relieving has to be considered because of constructional regulations, constructive reasons or because it is necessary for plate processing, please consult us. The properties of structural components can be altered by a stress relief heat treatment.

Detailed instructions for flame cutting, welding, machining and, about the structural properties of the DILLIMAX are provided in the brochure "DILLIMAX - HIGH STRENGTH STEEL".

### General technical delivery requirements

Unless otherwise agreed, the general technical delivery requirements in accordance with EN 10021 apply.

### Tolerances

Unless otherwise agreed, the tolerances will be in accordance with EN 10029, with class A for thickness and table 4, steel group H, for the maximum flatness deviation. Smaller flatness deviations may be possible on request prior to order.

### Surface quality

Unless otherwise agreed, the specifications will be in accordance with EN 10163, class A2.

### General Note

If particular requirements are demanded and not covered in this data sheet, please contact us with the specifications for our review and agreement prior to ordering.

The indications in this data sheet are product descriptions. This data sheet is updated at irregular intervals. The latest version is available from the mill or as download at [www.dillinger.de](http://www.dillinger.de).

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