



# DILLIMAX 500 ML

## FINE GRAINED HIGH STRENGTH TMCP STEEL PLATES

**Specification DH-E77-D**  
**Edition: November 2009**

DILLIMAX 500 ML is a thermomechanically rolled, fine-grained structural steel. It is characterized by high toughness and strength combined with a lean chemistry. Due to its chemical composition, this material has a low carbon equivalent and hence excellent fabrication properties, particularly weldability. The steel is preferentially used by the customers for sophisticated design in constructional steelwork, hydraulic steelwork, mechanical engineering, offshore constructions, storage tanks or spheres.

### Product description

#### Designation and range of application

DILLIMAX 500 ML is usually delivered with minimum tested impacted values at -50 °C. Other testing temperatures can be agreed upon request.

DILLIMAX 500 ML can be delivered in thickness from 10 to 75 mm in accordance with our dimensional programme for TMCP rolled steel. Other thicknesses are possible on request.

#### Chemical composition

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

C	Si	Mn	P	S	Al	Ni	Cu	Mo	Cr	V	Nb	Ti
≤ 0,09	0.15- 0.55	1.00- 1.75	≤ 0.020	≤ 0.005	≥ 0.02	≤ 0.70	≤ 0.35	≤ 0.35	≤ 0.35	≤ 0.08	≤ 0.05	≤ 0.025

Maximum carbon equivalent:

Plate Thickness t [mm]	CEV <sub>1</sub> <sup>1)</sup>	CEV <sub>2</sub> <sup>2)</sup>	CET <sup>3)</sup>	Pcm <sup>4)</sup>
t ≤ 50	0.45	0.47	0.30	0.24
50 < t ≤ 75	0.47	0.49	0.31	0.24

Auxiliary data:

	20 mm	60 mm
C	0.08	0.08
CEV <sub>1</sub>	0.43	0.44
CEV <sub>2</sub>	0.44	0.45
CET	0.28	0.28
Pcm	0.21	0.21

#### Delivery Condition

Thermomechanically rolled (short designation M)<sup>5)</sup>

1)  $CEV_1 = C + Mn/6 + Si/24 + Ni/40 + Cr/5 + Mo/4 + V/14$

2)  $CEV_2 = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$

3)  $CET = C + (Mn + Mo)/10 + (Cr + Cu)/20 + Ni/40$

4)  $Pcm = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$

5) Thermomechanical rolling leading to the delivery condition M can include processes with an increasing cooling rate with or without tempering including self-tempering but excluding direct quenching and quenching and tempering.



## Mechanical and technological properties in the delivery condition

Tensile test at ambient temperature - transverse test specimens in accordance with EN 10025 -

Plate Thickness t [mm]	Minimum Yield Strength <sup>1)</sup> R <sub>eH</sub> [MPa]	Tensile Strength R <sub>m</sub> [MPa]	Minimum Elongation A <sub>5</sub> [%]
t ≤ 16	500	610 - 750	17
16 < t ≤ 50	490	610 - 750	17
50 < t ≤ 75	480	600 - 750	17

Impact test on Charpy-V-specimens - longitudinal test specimens -

	Test Temperature [°C]	Impact Values A <sub>v</sub> [J]
DILLIMAX 500 ML	-50	30

Other testing temperatures can be agreed upon request.

The specified minimum value is the average of 3 tests. Not more than one individual value is permitted to be below this minimum value; it has to be at least 70 % of this minimum average value. Subsize specimens are admitted for plate thickness ≤ 12 mm, the minimum specimen width is 5 mm. The minimum impact energy will be decreased proportionally.

### Option:

As an option, the mechanical values can be adapted to the values standardised for S500Q in EN 10025-6 such as for the yield strength R<sub>eH</sub> ≥ 500 MPa for t ≤ 50 mm and R<sub>eH</sub> ≥ 480 MPa for 50 < t ≤ 75 mm and for the tensile strength R<sub>m</sub> = 590 - 770 MPa.

## Testing

Tensile test and impact tests are carried out once per heat, 40 t and thickness range as specified for the yield strength according to above table. Tests on every plate-as-rolled may be possible on request.

The specimens for the tensile test are prepared according to EN 10025-4. Testing is carried out in accordance with EN 10002-1 on specimens of gauge length L<sub>0</sub> = 5.65 √S<sub>0</sub> or L<sub>0</sub> = 5d<sub>0</sub>.

Unless otherwise agreed, the impact test will be performed according to EN 10045-1 at a temperature of -50 °C on Charpy-V longitudinal test specimens taken as follows:

- for plate thickness < 40 mm: close to the surface
- for plate thickness ≥ 40 mm: 1/4 of the plate thickness

An optional bend test on transverse specimens with a bending angle of 180° at a diameter of mandrel ≥ 3.0 x specimen thickness can be ordered.

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

## Identification of plates

Unless otherwise agreed, the marking is carried out with low stress steel stamps with at least the following information:

- steel grade (DILLIMAX 500 ML)
- heat number
- number of mother plate and individual plate
- the manufacturer's symbol
- authorized inspection representative's sign

## Processing

The entire processing and application techniques are of fundamental importance to the reliability of the products made from this steel. The user should ensure that his design, construction and processing methods are aligned with the material, correspond to the state-of-the-art that the fabricator has to comply with and are suitable for the intended use. The customer is responsible for the selection of the material.

1) If not apparent R<sub>p0.2</sub> is measured



The recommendations in accordance with EN 1011 as well as recommendations regarding job safety in accordance with national rules should be observed. You find detailed information on processing in the brochure "DI-MC Technical Information" of Dillinger Hütte GTS or in our internet platform

<http://www.heavyplate.com/>

### **Cold forming**

DILLIMAX 500 ML can generally be well cold formed with regard to its high toughness, i.e. formed at temperatures below 580 °C. Cold forming is always related to a hardening of the steel and to a decrease in toughness. This change in the mechanical properties can, as a rule, be partially recovered through a subsequent stress relief heat treatment (see also paragraph "Heat treatment"). Flame cut or sheared edges in the bending area should be ground before cold forming. For larger cold forming amounts we recommend you to consult us prior to ordering.

### **Hot forming**

Hot forming, i.e. forming at temperatures above 580 °C, leads to changes in the original material condition. It is impossible to re-establish the same material properties that had been achieved during the original manufacture through a further treatment. Therefore hot forming is not permitted.

### **Flame cutting and welding**

DILLIMAX 500 ML can be flame cut in all thickness ranges without preheating due to its low hardenability. Plasma and laser cutting processes are also suitable.

DILLIMAX 500 ML has an excellent weldability if the general technical rules are observed (EN 1011 has to be applied analogously). The risk of cold cracking is low but it must be considered that the choice of the appropriate preheating temperature depends not only on the base material, but also on the level of constraint of the construction, the plate thickness, chosen welding process, welding filler materials and heat input. From experience, an appropriate choice of these parameters allows dispensing with preheating for DILLIMAX 500 ML up to a plate thickness of 50 mm. If the filler material is chosen, the increased yield strength of the base material has to be taken into account. For manual arc welding we recommend to weld with re-dried basic electrodes with very low hydrogen input (up to 5 ml/100 g DM according to ISO 6390). The low content of carbon and other alloy elements leads to favourable toughness properties in the heat-affected-zone, even with high heat inputs leading to cooling times  $t_{8/5}$  up to 40 sec. For calculation of preheating temperatures and welding parameters also refer to the welding tools at

<http://www.heavyplate.com/>

### **Heat treatment**

Welded joints of DILLIMAX 500 ML are usually used in welded condition. If a stress relief heat treatment is necessary, it is carried out in the temperature range between 530 and 560 °C with cooling in still air. The holding time should not exceed 150 minutes (even if multiple operations are carried out). For a holding time of more than 90 minutes the lower limit of the temperature range should be aimed at. Other PWHT conditions can be agreed upon inquiry.

For flame straightening, special working recommendations have to be taken into account (see DI-MC Technical Information of Dillinger Hütte GTS).

### **Tolerances**

Unless otherwise agreed, tolerances are in accordance with EN 10029, with class A for the thickness.

### **Surface quality**

Unless otherwise agreed, the specifications will be in accordance with EN 10163-2, class A2.

### **General note**

If special requirements, which are not covered in this specification, are to be met by the steel due to its intended use or processing, these requirements are to be agreed before placing the order.

The information in this specification is a product description. This specification is updated at irregular intervals. The current version is relevant. The latest version is available from the mill or as download at

<http://www.dillinger.de/>



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## Distribution

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