



DILLINGER HÜTTE GTS

DILLIMAX 700 M

HIGH STRENGTH FINE GRAINED STRUCTURAL STEEL
THERMOMECHANICALLY ROLLED

Specification DH-E66-C
Edition May 2006

DILLIMAX 700 M is a high strength thermomechanically rolled, fine grained structural steel with a minimum yield strength of 700 MPa in its delivery condition ex works.

DILLIMAX 700 M is preferentially used by the customers for welded steel structures within mechanical constructions, plant constructions and structural steel works.

Product description

Designation and range of application

DILLIMAX 700 M can be delivered in two qualities:

- **Basic quality (M)** with minimum impact values down to -20 °C (-4 °F): **DILLIMAX 700 M**
- **Tough quality (ML)** with minimum impact values down to -40 °C (-40 °F): **DILLIMAX 700 ML**

DILLIMAX 700 M plates can be delivered in the following dimensions:

- thickness: 10 to 40 mm (0.4 to 1.6 in.)
- width: 1,500 to 2,800 mm (59 to 110 in.)¹⁾
- length: $\leq 12,000$ mm (472 in.)

¹⁾ other dimensions may be possible on request

Chemical composition

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

| DILLIMAX 700 | C | Si | Mn | P | S | Ni | Cu | Mo | Cr | Nb+V+Ti |
|--------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|
| M, ML | ≤ 0.10 | ≤ 0.60 | ≤ 2.10 | ≤ 0.020 | ≤ 0.003 | ≤ 1.50 | ≤ 0.50 | ≤ 0.50 | ≤ 1.50 | ≤ 0.15 |

The steel is fully killed and fine grain treated, and may contain in addition up to 0.005 % boron.

Auxiliary data for CET and Pcm :

| Plate thickness in mm | CET ¹⁾ | Pcm ²⁾ |
|-----------------------|-------------------|-------------------|
| 12 | 0.30 | 0.22 |
| 25 | 0.29 | 0.21 |

¹⁾ CET = $C + (Mn + Mo) / 10 + (Cr + Cu) / 20 + Ni / 40$

²⁾ Pcm = $C + Si / 30 + (Mn + Cu + Cr) / 20 + Mo / 15 + Ni / 60 + V / 10 + 5.B$

Delivery condition

Thermomechanically rolled and, if necessary, accelerated cooled (M).

Mechanical and technological properties in the delivery condition

Tensile test at ambient temperature - transverse test specimens -

| Tensile strength R_m in MPa (ksi) | Minimum yield strength R_{eH} ¹⁾ in MPa (ksi) | Minimum elongation | |
|--|---|--------------------|-------------------------------|
| | | A_5 in % | $A_{2in.}$ in % ²⁾ |
| 750 - 950 (109 - 138) | 700 (101) | 12 | 15 |

¹⁾ If R_{eH} is not apparent, the yield strength $R_{p0.2}$ is measured instead.

²⁾ This value applies if tested according to ASTM A370.

The values in brackets are for information only.

Impact test on Charpy-V-specimens

| DILLIMAX 700 | Specimen direction | Impact energy A_V in J (ft.-lb.) at test temperature | |
|--------------------|---------------------------|--|-------------------|
| | | -20 °C (-4 °F) | -40 °C (-40 °F) |
| Basic quality (M) | longitudinal / transverse | 30 / 27 (22 / 20) | - |
| Tough quality (ML) | longitudinal / transverse | 40 / 30 (30 / 22) | 30 / 27 (22 / 20) |

The specified values are minimum values; they are the average of 3 specimens, whereby the lowest individual value is not to be less than 70% of the specified minimum. The values in brackets are for information only.

Bend test

Formability of the transverse test specimen subjected to the bend test:

bending angle 180 °; mandrel diameter $\geq 3 \times$ specimen thickness

A smaller mandrel diameter can be agreed on request.

Testing

Tensile and impact tests, and on request bend tests, will be performed once per heat and 40 t.

The tensile test is carried out on specimens of gauge length $L_0 = 5.65 \cdot \sqrt{S_0}$ or $L_0 = 5 \cdot d_0$, 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 specimens taken close to the surface.

The bending test will be carried out according to EN ISO 7438.

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

Identification of plates

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

- steel grade (DILLIMAX 700 M or ML)
- heat number
- number of mother plate and individual plate
- the manufacturer's symbol
- 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. The recommendations in accordance with EN 1011-2 should be observed.

Cold forming

DILLIMAX 700 M can be cold formed at temperatures below 580° C taking into account its high yield strength. Irregularities in the bend area of the flame cut (cratering, blow-out, deep drag lines) should be ground smooth before cold forming, in order to avoid stress concentration.

Cold forming is always related to a hardening of the steel and to a decrease in toughness. If a heat treatment of unwelded cold formed parts becomes necessary, please contact us prior to the ordering.

Hot forming

Hot forming is not allowed for thermomechanically rolled steel, because the particular microstructure would be altered. Consequently the forming of DILLIMAX 700 M at temperatures above 580 °C without a significant deterioration of its mechanical properties is not possible and so shall not be applied.

Flame cutting and welding

Due to its high yield strength, the processing of DILLIMAX 700 M requires special care.

DILLIMAX 700 M needs no preheating for flame cutting.

For general welding instructions, please follow the recommendations of EN 1011.

DILLIMAX 700 M has a low carbon content and a low carbon equivalent, which leads to a low hardness increase and a decreased susceptibility to cold cracking. Nevertheless preheating may be necessary to avoid cracks in the weld metal, due to the sensitivity of high strength filler materials. Thus only welding consumables adding a very little hydrogen to the weld shall be used. Shielded arc welding should be preferred. For manual arc welding, electrodes with basic coating (type HD < 5 mL/100g in accordance with ISO 3690) should be used after drying according to the manufacturer's instructions. Heat treatment for hydrogen effusion (soaking) immediately after welding is recommended in case of increasing plate thicknesses and high restraint welds.

The high yield strength of the base material must also be taken into account while selecting the filler materials. In order to ensure that the tensile strength of the weld metal fulfils the requirements of the base material, the heat input and interpass temperature must be limited during welding. This is applicable when using suitable filler materials of a corresponding yield strength class. The post-weld stress relieving of the welded joints leads to a deterioration of the toughness properties in the heat affected zone. **DILLIMAX 700 M is consequently not suitable for a post-weld stress relieving of structural components.**

Heat treatment

Heat treatments are on principle not allowed for thermomechanically rolled steels.

If a stress relieving of the unwelded base material has to be considered because of design codes, constructive reasons or because it is necessary during the fabrication, please consult us. The properties of structural components can be altered by a stress relief heat treatment.

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.

Surface quality

Unless otherwise agreed, the specifications will be in accordance with EN 10163, class A2. Higher requirements may be agreed on request.

General Note

If particular requirements are demanded and not covered in this specification, please contact us with these requirements for our review and agreement prior to ordering.

The information in this specification is a product description. This specification is updated if necessary. The latest version is available from the mill.

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