DILLINGER HÜTTE GTS

DILLIMAX 890

HIGH STRENGTH FINE GRAINED STRUCTURAL STEEL
QUENCHED AND TEMPERED

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DILLIMAX 890 is a high strength quenched and tempered, fine grained structural steel with a minimum yield strength of 890 N/mm² in its delivered condition (referring to the lowest thickness range), whose mechanical properties are achieved by water quenching followed by tempering.

DILLIMAX 890 fulfils the requirements of EN 10 137. 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, penstocks, and frameworks.

Product description

Designation and range of application

The steel can be delivered in three grades:

- **basic (B)** with minimum impact values down to -20°C (-4°F): **DILLIMAX 890 B**
  Steel number 1.8940 - S890Q according to EN 10 137
- **high toughness (T)** with minimum impact values down to -40°C (-40°F): **DILLIMAX 890 T**
  Steel number 1.8983 - S890QL according to EN 10 137
- **extra tough (E)** with minimum impact values down to -60°C (-76°F): **DILLIMAX 890 E**
  Steel number 1.8925 - S890QL1 according to EN 10 137

DILLIMAX 890 plates can be delivered in thicknesses from 6 to 100 mm (1/4 to 4 inches) according to the dimensional program. Dimensions, which deviate from the usual dimensional program for this type of steel, may be possible on request.

Chemical composition

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

DILLIMAX 890	C	Si	Mn	P	S	Cr	Ni *	Mo	V+Nb	B
B,T,E	≤.20	≤.50	≤1.60	≤.020	≤.010	≤.80	≤1.20	≤.70	≤.10	≤.0040

* For greater plate thicknesses and high demands of toughness, the nickel content can be increased to max. 2%.

The steel is fine grained through sufficient aluminium content.

Delivery condition

Water quenched and tempered according to EN 10 137.

Mechanical and technological properties in the delivery condition

Tensile test at ambient temperature - transverse test specimens -

Plate thickness t mm (inches)		Tensile strength R_m N/mm² (ksi)	Minimum yield strength R_{eH} [1] N/mm² (ksi)	Minimum elongation A_5 %	$A_{2in.}$ [2] %
	≤ 50 (2)	940 - 1100 (136 - 159)	890 (129)	12	13
> 50 (2)	≤ 80 (3)	900 - 1100 (130 - 159)	850 (123)	12	13
> 80 (3)	≤ 100 (4)	880 - 1100 (128 - 159)	830 (120)	12	13

1) If not apparent, the yield strength $R_{p0.2}$ is measured.
2) These values apply if tested according to ASTM A370.
The values in brackets are only for information.

Impact test on Charpy-V-specimens

DILLIMAX 890	Specimen direction	Impact energy A_v in Joules (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 values are minimum values; they are the average of 3 specimens, whereby the lowest individual value may not be less than 70% of the specified minimum. The values in brackets are only for information. For plate thicknesses below 10 mm the test on Charpy-V-specimens will be performed with reduced width. Therefore, the minimum value of the impact energy will be reduced in proportion to the reduction of the specimen´s cross section.

Technological bend test

Formability of the transverse specimen subjected to the technological bend test:
bending angle 180°; mandrel diameter ≥ 4x specimen thickness

Testing

Tensile and impact tests, and on request bend tests, will be performed according to EN 10 137. Tests on every heat treated plate may be possible on request.

The specimens for the tensile test are prepared according to EN 10 137. 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 10 002-1. Tensile tests according to ASTM A370 may be agreed.

The impact test will be carried out on Charpy-V-specimens in accordance with EN 10 045-1. Unless otherwise agreed, the test will be performed at the lowest temperature of the corresponding grade on transverse test specimens taken as follows:

- for plate thicknesses ≤ 40 mm: close to the surface
- for plate thicknesses > 40 mm: 1/4 of the plate thickness

Unless otherwise agreed, the test results are documented in a certificate 3.1 B in accordance with EN 10 204.

Identification of plates

The plates are at least marked by stamp with the following information:

- heat number
- plate number
- steel designation (DILLIMAX 890 B, T or E)
- the manufacturer´s brand

In addition, the plates are stencilled with DILLIMAX 890 B, T or E.

Fabricating properties

The entire fabrication and application techniques are of fundamental importance for the reliability of products manufactured with these steels. The fabricator should ensure that his calculation, design and manufacturing methods are suitable for the intended application, are state of the art and, that they correspond with the properties of the material. The customer is responsible for the selection of the material. The recommendations of the Stahl-Eisen-Werkstoffblatt 088 or ECSC Information Circular No. 2 should be observed.

Cold forming

Cold forming means forming below the maximum allowable stress relief temperature (560°C / 1040°F). DILLIMAX 890 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. 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.

For larger 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.

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 example. 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

Due to its high yield strength, the fabrication of DILLIMAX 890 requires special care. For general welding instructions, please consult the SEW 088. 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. Experience has shown that the welding conditions should be chosen so that the cooling time $t_{8/5}$ does not exceed 12 seconds. This is applicable when using suitable filler materials of a corresponding yield strength class.

The raised yield strength of the base material must be taken into account when the filler materials are chosen. It should be considered that increased heat input leads to lower tensile properties in the weld metal. If either during or after the manufacturing a stress relief heat treatment is planned, this must already be considered when selecting the filler materials. To avoid hydrogen-induced cold cracking, only filler materials which add very little hydrogen to the base metal, may be used. Therefore, shielded arc welding should be prefered. For manual arc welding, electrodes with basic coating (type HD < 5 in accordance with DIN 8572), which are dried according to the manufacturer´s instructions, should be used. With increasing plate thicknesses and a high residual stress condition of the weld, low hydrogen annealing directly out of the weld heat is recommended.

For flame cutting, the following minimum preheating temperatures are recommended: 50°C (120°F) for plate thicknesses up to 25 mm, 100°C (212°F) for plate thicknesses up to 50 mm and, 150°C (300°F) for thicker plates.

Heat treatment

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

Tolerances

Unless otherwise agreed, the tolerances will be in accordance with EN 10 029, 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 10 163, 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.

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