



DILLINAL 460/630

HIGH STRENGTH FINE GRAINED STEEL

Material Data Sheet Edition July 2010*

DILLINAL 460/630 is a weldable normalized fine grained steel which is characterised by a minimum yield strength of 460 MPa and a minimum tensile strength of 630 MPa.

DILLINAL 460/630 is mainly applied for the construction of tanks for the transport of liquefied gas with road and rail vehicles where the weight minimisation plays an important role.

*) The latest edition of this material data sheet is available at <http://www.dillinger.de/>

Product description

Designation and range of application

DILLINAL 460/630 can be supplied in two qualities: DILLINAL 460/630 N and DILLINAL 460/630 NL. They are both modified steels of the type P460 according to EN 10028-3. They fulfill the requirements of EN 10028-3:2009 (option 5 and footnote d, Table 4) and the VdTÜV- material data sheet 531 "Hochfester, legierter Feinkornbaustahl 460/630 für Einsatztemperaturen bis -40°C" (High Strength Alloyed Fine Grained Steel 460/630 for service temperatures down to -40 °C) and can be applied for:

- tank installations in accordance with RID/ADR as well as EN 14025
- pressure vessels in accordance with AD 2000 Merkblatt, EN13445, CODAP 2005

This material data sheet applies to heavy plates with thicknesses from 7 to 20 mm.

Production

BOF-converter process and metallurgical ladle treatment; fully killed, fine grained steel with addition of nitrogen fixing elements.

Chemical composition in %

	C max.	Si	Mn	P max.	S max.	N max.	Ni max.	V	Cr ¹⁾ max.	Cu ¹⁾ max.	Mo ¹⁾ max.
Heat	0.20	0.10- 0.60	1.00- 1.70	0.020	0.005	0.025	0.40	0.10- 0.20	0.30	0.20	0.10
Product	0.22	0.10- 0.65	0.94- 1.80	0.025	0.008	0.027	0.45	0.10- 0.21	0.35	0.25	0.13

1) Cu+Cr+Mo ≤ 0,45 % (heat)

Delivery condition

Normalized, unless otherwise agreed.

An additional tempering in accordance with EN 10028-3:2009 may be performed.

Should a PWHT be necessary the testing of the mechanical properties on the basis of simulating post weld heat treated specimens can be agreed upon. This optional testing (option 1) is to be indicated on the order and is performed instead of testing in the delivery condition.



Mechanical properties in the delivery condition

The testing of the mechanical properties is performed on specimens in the condition normalized (N) or normalized and tempered (N+T) .

Tensile test at ambient temperature – transverse test specimens

Plate thickness [mm]	Minimum Yield Strength ReH ²⁾ [MPa]	Tensile Strength Rm [MPa]	Minimum Elongation A5 %
≤ 20	460	630 - 725	17

2) If no upper yield strength is apparent, the Rp0,2 is relevant as defined per EN 10028-1 .

Impact test on Charpy-V-transverse test specimens

	Test temperature [°C]	Minimum impact values [J]
Dillinal 460/630 N	-20	27
Dillinal 460/630 NL	-40	27
Option 2 (to be indicated on the order)		
Dillinal 460/630 N	-20	45
Dillinal 460/630 NL	-40	45

The specified values are minimum values for the average of 3 tests. No individual value is to be less than 70 % of the specified minimum. For plate thickness below 11 mm the test can be carried out on Charpy-V specimens or Charpy-V-type specimens with reduced width. The minimum impact value will be reduced proportionally to the reduction of the specimen's cross section.

Testing

Sampling, testing method and tests are in accordance with EN 10028-1, unless otherwise stipulated or agreed.

The plates can be delivered with inspection certificate 3.1 or 3.2 in accordance with EN 10204. The kind of the inspection certificate has to be specified on the order.

Identification

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

- steel designation DILLINAL 460/630 N or NL
- heat number
- number of mother plate and individual plate
- the manufacturer's symbol
- inspector'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, calculation 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.



Formability

The plates can be hot or cold formed. Even in case of appropriate hot forming an additional tempering can be necessary particularly for thin plates due to the accelerated cooling within the forming tool.

Flame cutting and welding

The suitability of DILLINAL 460/630 for flame cutting and welding has been proven. The verification of the toughness properties is performed on welding specimens with basic filler metal and a cooling time $t_{8/5}$ in the range between 8 and 25 seconds. In case of high toughness requirements it may be necessary to reduce the heat input so that the $t_{8/5}$ time is below 20 seconds. In any case welding shall be performed in multi pass technique with flat welding passes and good grain refinement.

Heat treatment

If stress-relieving treatment is necessary, this is usually performed on the finished welded vessel. The stress-relieving treatment should be performed at temperatures between 530 °C to 560 °C, as higher temperatures lead to reduced toughness properties in the weld. The time-temperature-parameter P in accordance with EN 10028-3 must not exceed the value 16.7 for DILLINAL 460/630 N and 16.35 for DILLINAL 460/630 NL. The holding time should not exceed 150 minutes even for heat treatments in several cycles. For holding time above 90 minutes the lower limit of the temperature range should be aimed at. The subsequent cooling is performed in still air.

The stress-relieving treatment can be omitted if no corrosive media will be transported in the vessels and if allowed by the applicable regulations.

Tolerances

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

Surface quality

Unless otherwise agreed, the provisions in accordance with class B2 of EN 10163-2 are applicable.

General technical delivery requirements

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

General note

If special requirements, which are not listed in this material data sheet, 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 data sheet is a product description. This data sheet is updated as occasion demands. The latest version is available from the mill or as download at www.dillinger.de.



DILLINGER HÜTTE GTS

Sales

For your local representative please contact our coordination office in Dillingen:

Telephone: +49 6831 47 22 23

Telefax : +49 6831 47 33 50

or find him on the internet Internet:

<http://www.dillinger.de/dh/kontakt/weltweit/index.shtml.en>



DILLINGER HÜTTE GTS

AG der Dillinger Hüttenwerke

Postfach 1580

D-66748 Dillingen/Saar

e-mail: info@dillinger.biz

<http://www.dillinger.de>

Telephone: +49 6831 47-3612

Telefax: +49 6831 47-993450