

Properties

DILLIDUR

Properties

Wear resistant DILLIDUR is highly suitable for processing due to its exceptional homogeneity as well as its cleanness. The information on the properties and processing of DILLIDUR has been developed in accordance with Dillinger's best knowledge and experience. It is intended to support manufacturers in developing their own processing procedure for DILLIDUR.

Our wide product portfolio at a glance

| | Plate thickness ^t [mm] | Hardness [HBW] | Speciality |
|---------------------------------|--------------------------------------|------------------------------|---|
| DILLIDUR IMPACT | 40 ≤ t ≤ 150 | 310 - 370 | Enhanced crack resistance |
| DILLIDUR 325 L | 6 ≤ t ≤ 100 | 325 (nominal) | Air-hardened for higher working temperature |
| DILLIDUR 400^b | 6 ≤ t ≤ 150 | 370 - 430 | Through-hardened version on request |
| DILLIDUR 450 | 6 ≤ t ≤ 100 | 420 - 480 | - |
| DILLIDUR 500^b | 8 ≤ t ≤ 100 | 450 (470) ^b - 530 | Through-hardened version on request |
| DILLIDUR 550 | 10 ≤ t ≤ 100 | 550 (520) ^b - 580 | - |
| DILLIDUR 600 | 15 ≤ t ≤ 60 | 560 - 610 | - |

^a other plate thicknesses on request (also < 8 mm)

^b depending on the thickness

DILLIDUR is characterised by the optimum combination of alloy components required to achieve the highest mechanical properties with good wear resistance. They were developed to ensure that customers can work economically with maximum wear protection. This is particularly reflected in the low carbon equivalent, which allows good weldability and low preheating temperatures.

Carbon equivalent CEV (indicative values)

| | | Plate thickness [mm] | | | | |
|------------------------|------------------|----------------------|------|------|------|------|
| | | 10 | 25 | 40 | 80 | 100 |
| DILLIDUR IMPACT | CEV ^a | - | | 0.63 | | 0.70 |
| DILLIDUR 325 L | | 0.77 | 0.78 | 0.79 | 0.80 | |
| DILLIDUR 400 | | 0.45 | 0.49 | 0.56 | 0.63 | |
| DILLIDUR 450 | | 0.46 | 0.52 | 0.55 | 0.69 | |
| DILLIDUR 500 | | 0.46 | | 0.57 | 0.63 | |
| DILLIDUR 550 | | 0.56 | 0.60 | | 0.75 | |
| DILLIDUR 600 | | - | 0.63 | | - | - |

^a CEV = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15

Carbon equivalent CET (indicative values)

| | | Plate thickness [mm] | | | | |
|------------------------|------------------|----------------------|------|------|------|------|
| | | 10 | 25 | 40 | 80 | 100 |
| DILLIDUR IMPACT | CET ^a | - | | 0.40 | | 0.41 |
| DILLIDUR 325 L | | 0.44 | | 0.45 | | |
| DILLIDUR 400 | | 0.30 | 0.32 | 0.35 | 0.36 | |
| DILLIDUR 450 | | 0.34 | 0.36 | | 0.39 | |
| DILLIDUR 500 | | 0.39 | | 0.41 | 0.44 | |
| DILLIDUR 550 | | 0.46 | 0.47 | | 0.49 | |
| DILLIDUR 600 | | - | 0.51 | | - | - |

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

The growing size of machines such as earthmovers, crushers in the recycling sector, construction machinery in the mining sector and many more are placing increasing demands on the dimensions of the plate as well as on its inner values. With DILLIDUR, Dillinger also has a solution for every extreme case: DILLIDUR IMPACT with guaranteed notch toughness, the first choice for impact-type stresses such as impact wear. DILLIDUR 325 L is designed for hot applications. DILLIDUR 600 is available for extremely high hardness requirements.

Despite their high hardness, DILLIDUR steels have very good toughness properties for their typical field of application. The impact toughness is highest for the low-carbon DILLIDUR steels with a martensitic microstructure, whereby the toughness level slowly decreases as the carbon content increases. The impact energy is therefore lower for DILLIDUR 325 L with a bainitic microstructure.

Impact test on Charpy-V-specimen

Impact energy on Charpy-V-specimens in longitudinal direction (indicative values)

| | Plate thickness t [mm] | Test temperature [°C] | KV ₂ [J] |
|-----------------------|------------------------|-----------------------|---------------------|
| DILLIDUR 325 L | 10 | -20 | 20 |
| DILLIDUR 400 | t ≤ 30 | -40 | 40 |
| DILLIDUR 450 | | | 35 |
| DILLIDUR 500 | | | 30 |
| DILLIDUR 550 | | | 25 |
| DILLIDUR 600 | | | 15 |

Minimum mean values of the impact energy on Charpy-V-specimens in longitudinal direction

| | Sample position | Plate thickness t [mm] | Test temperature [°C] | KV ₂ [J] |
|------------------------|-----------------|------------------------|-----------------------|---------------------|
| DILLIDUR IMPACT | t/4 | 40 ≤ t ≤ 150 | -40 | 30 |

The specified minimum value is the average of 3 tests. One individual value may be below the minimum average value specified, provided that it is not less than 70 % of that value.

Tensile test at room temperature (indicative values)

| | Plate thickness [mm] | Tensile strength R _m [MPa] | Minimum yield strength R _{eH} [MPa] | Minimum elongation A ₅ [%] ^a |
|------------------------|----------------------|---------------------------------------|--|--|
| DILLIDUR IMPACT | 90 | 1000 | 950 | 15 |
| DILLIDUR 325 L | 10 | 1000 | 650 | 13 |
| DILLIDUR 400 | 20 | 1200 | 800 | 12 |
| DILLIDUR 450 | 20 | 1400 | 950 | 11 |
| DILLIDUR 500 | 20 | 1600 | 1100 | 9 |
| DILLIDUR 550 | 20 | 1800 | 1350 | 8 |

^a L₀ = 5,65·√S₀, transverse test pieces

The overview shows that the tensile strength increases with increasing hardness of our martensitic DILLIDUR steels. Despite their high strength properties, DILLIDUR steels are not intended for safety-relevant components. The high-strength quenched and tempered DILLIMAX steels are available for this purpose.

Heat resistance

Despite its high hardness, DILLIDUR only has limited heat resistance. Use at higher temperatures affects the mechanical properties, especially the hardness.

The DILLIDUR 325 L air hardener can be used at temperatures of 400 °C in permanent operation. Depending on the application, up to 500 °C for short periods.

DILLIDUR IMPACT is hardened by controlled cooling in water and then tempered. For this reason, DILLIDUR IMPACT can be used up to 500 °C without significant impairment of the mechanical properties.

DILLIDUR 400 to DILLIDUR 600 obtain their hardness through accelerated cooling from the austenitising temperature. These grades are only suitable to a very limited extent or not at all for wear processes that take place at temperatures of more than 200 °C (250 °C for DILLIDUR 400 and briefly for DILLIDUR 450).

In the case of such applications, we recommend early consultation with Dillinger.

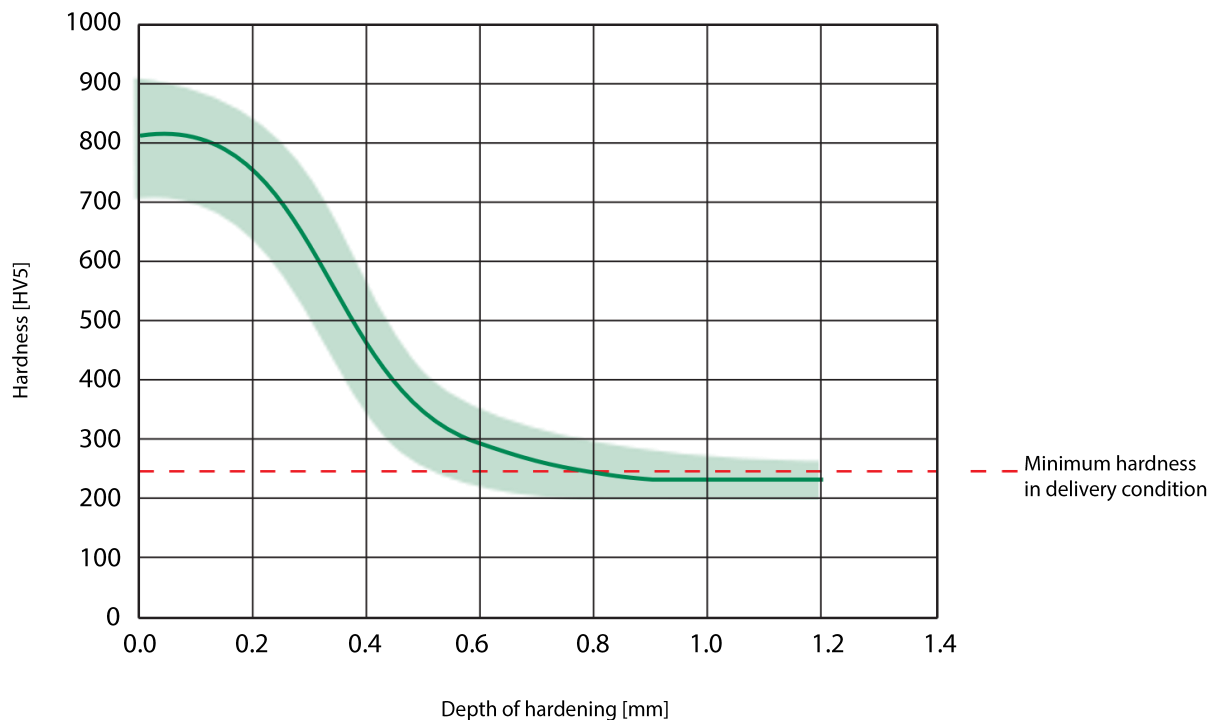
Nitriding

To increase the wear resistance near the surface, it can be useful for special applications to carry out additional nitriding of DILLIDUR, for example for moulds or for pressure rams.

During nitriding, the hardness is increased by diffusion of nitrogen into the surface of the workpiece, which leads to the formation of hard nitrides. Depending on the process, nitriding is carried out at temperatures between 500 °C and 560 °C (nitrocarburising: 570 °C to 580 °C).

Due to its content of nitride-forming elements such as aluminium, silicon, chromium, niobium, titanium and vanadium, DILLIDUR 325 L is particularly suitable for nitriding, as well as DILLIDUR Impact (up to 500 °C). When gas nitriding DILLIDUR 325 L, for example, surface harnesses of up to 920 HV and nitriding depths of up to 0.7 mm at 340 HV are achieved. Due to a tempering effect, the hardness in the core of the plate drops to a level of the minimum hardness in the delivery condition.

Typical hardening test strip for gas nitriding of DILLIDUR 325 L, Nitriding time approx. 80 h at 530 °C



DILLIDUR 400 to DILLIDUR 600 obtain their hardness through accelerated cooling. These DILLIDUR steels also form a very good hard surface layer during nitriding. However, it should be noted that the mechanical properties of the base material, especially the hardness, can be impaired below the hard nitrided layer. For the selection of suitable DILLIDUR, we recommend early consultation with Dillinger.

Further information on processing can be found in the respective modules of the DILLIDUR processing instructions at www.dillinger.de.

Disclaimer

The information and data provided concerning the quality and/or applicability of materials and/or products constitute descriptions only. Any and all promises concerning the presence of specific properties and/or suitability for a particular application shall in all cases be deemed to require separate written agreements.

This processing information is updated at irregular intervals. The current version is relevant. The latest version is available from the mill or as download at www.dillinger.de.

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Issue 02/2024