

# DIFENDER 500

## High strength armoured steel

### Material data sheet, edition May 2021<sup>1</sup>

**DIFENDER 500** is an alloyed, high strength quenched and tempered steel with a resistance against bullet and fragments impacts and the effects of blast. It is preferably used for light weight armoured vehicles. Due to its performance the steel is used by the customers for civil and military protection systems.

## Product description

### Definition and range of application

DIFENDER 500 is an alloyed, high strength quenched and tempered steel, with a hardness range of 480 – 530 HBW in the delivery condition.

DIFENDER 500 can be delivered in two grades as follows:

- Basic with minimum impact values of 24 J at -40°C: **DIFENDER 500**
- Extra tough with minimum impact values of 32 J at -40°C: **DIFENDER 500 PLUS**

DIFENDER 500 can be supplied in the following dimensions:

Thickness	≥ 6 mm ≤ 80 mm
Width	≤ 2,500 mm
Length	≤ 8,000 mm

On request, other dimensions can be agreed.

### Chemical composition

For the ladle analysis, the following max. values in % are applicable:

C	Si	Mn	P	S	Cr	Ni	Mo
0.32	0.50	1.20	0.015	0.005	2.00	3.70	0.70

Typical values for carbon equivalent (CEV) can be submitted up on request.

### Delivery condition

The plates are delivered in the quenched and tempered condition.

<sup>1</sup>) The current version of this material data sheet can also be found on [www.dillinger.de/downloads](http://www.dillinger.de/downloads).

## Mechanical and ballistic properties

### Hardness

Brinell surface hardness at room temperature: 480 – 530 HBW

### Tensile testing on transverse specimens at room temperature

Plate thickness [mm]	Minimum tensile strength R <sub>m</sub> [MPa]	Minimum yield strength R <sub>p0,2</sub> [MPa]	Minimum elongation A <sub>5</sub> [%]
6 to 40	1,500	1,300	8
> 40 to 80	1,450	1,250	8

### Charpy-V impact test

Grade	Specimen direction	Impact energy KV <sub>2</sub> [J] at -40°C
DIFENDER 500	longitudinal/transverse	24
DIFENDER 500 PLUS <sup>1)</sup>	longitudinal/transverse	32

<sup>1)</sup> The requirement DIFENDER PLUS can be agreed upon request.

The specified minimum value is the average of 3 tests. Only one individual value may be below the minimum average value specified, provided that it is not less than 80 % of that value.

For plate thickness below 12 mm the Charpy-V-notch test can be carried out on Charpy-V-test pieces with reduced width, the minimum size of the sample shall not be less than 5 mm. The minimum specified value decreases proportional to the reduction of the section.

### Properties under ballistic impacts

The requirements have to be agreed upon request.

## Testing and documentation

Determination of the chemical composition (ladle analysis) for the above mentioned elements; the following additional elements can be determined upon request: Al, Cu, V, Nb, Ti, B, W.

Determination of the mechanical properties in the delivery condition per heat in ¼ plate width in accordance with EN 10021.

The hardness test is carried out in accordance with ISO 6506-1. The tensile test is carried out on flat rectangular, transverse specimens in accordance with ISO 6892-1. The impact test will be carried out on Charpy-V-longitudinal and transverse specimens in accordance with ISO 148-1.

The bullet resistance test can be carried out optional upon agreement of the requirements.

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 via perforated steel stamps with at least the following information:

- steel grade (DIFENDER 500 or DIFENDER 500 PLUS)
- 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, 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 should be observed. The much higher tensile properties of the armoured steel comparing to other steels covered by the standard can lead to a higher crack probability while processing.

## Welding and thermal cutting

The heat input during welding and thermal cutting can lead to a decrease in hardness in a small area adjacent to or in the weld seam. This can have an impact on the bullet resistance properties of DIFENDER 500. The manufacturer is advised to take this into account in his design.

## Forming

The material can be formed by cold bending, in spite of its high hardness. It is recommended that the thermal cutting or shearing edges in the area of the bend should be grinded. The bending speed must be adjusted by the fabricator to the geometry of the processed parts.

Due to the high strength values of DIFENDER 500 in the quenched and tempered condition the spring-back phenomenon has to be taken into account while cold forming. During the processing, the necessary safety measures have to be taken, so that nobody will be exposed to a danger by a possible fracture of the work piece during the forming process.

## Heat treatment

DIFENDER 500 is delivered in a heat treatment condition which is ready for assembly. Subsequent heat treatment above 200 °C impairs its ballistic properties and is therefore not permissible.

## Machining

DIFENDER 500 is suitable for machining. In view of its high delivery hardness a lower cutting speed must be anticipated.

## General technical delivery requirements

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

## Tolerances

Unless otherwise agreed the following tolerances apply:

For width and length tolerances EN 10029 table 2 and 3 will apply.

Thickness [mm]	$6 \leq t \leq 16$	$16 < t \leq 20$	$20 < t \leq 24$	$24 < t \leq 40$	$40 < t \leq 80$
Tolerance [mm]	-0 / +0.8	-0 / +0.9	-0 / +1.0	-0 / +1.2	-0 / +2.0

Unless otherwise agreed, the flatness tolerances will be in accordance with EN 10029, table 4, steel group H. Smaller flatness tolerances may be agreed upon request.

## Surface quality

Unless otherwise agreed, the indications in accordance with EN 10163-2, class B3, apply.

## Surface protection

Upon request the plates can be shot blasted and / or primer coated with a product at the manufacturer's choice. In case you wish the application of a shop primer, but you do not specify the shop primer in detail, Dillinger offers shop primers as standard: you will find more information in our brochure „Shot blasted and primer coated heavy plates“ (<http://www.dillinger.de/downloads>).

## Ultrasonic testing

Unless otherwise agreed, indications be in accordance with EN 10160, class S2/E2 apply.

## General note

If particular requirements, which are not covered 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 technical data sheet is a product description. This material data sheet is updated at irregular intervals. The current version is available from the mill or as download at [www.dillinger.de/downloads](http://www.dillinger.de/downloads).

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