

# Abrasion Resistant steel

# Quard 400



**Quard**<sup>®</sup>  
ABRASION RESISTANT STEEL

## 1 Steel description and applications

Quard 400 is a martensitic abrasion resistant steel with an average hardness of 400 HBW. Due to its versatility in terms of high toughness, good cold formability and excellent weldability, Quard 400 combines an outstanding work shop performance and a long lasting wear resistance.

Quard 400 is recommended for the following applications:

- mining and earthmoving machinery
- crushing and pulverizing equipment
- buckets, knives, crushers, feeders
- presses
- skips
- excavators
- slurry pipe systems
- screw conveyors

## 2 Technical characteristics

### Hardness guarantee

Hardness	Brinell hardness test, HBW according to EN ISO 6506-1, is performed 1 - 2 mm below the plate surface once per heat and 40 tonnes.
HBW = 370 - 430	

### Other mechanical properties (typical values)

Charpy-V notch impact test	Yield Strength (MPa)	Tensile Strength - Transverse - (MPa)	Elongation A5 (%)
40J (longitudinal at -40 °C)	1160	1300	10

### Chemical composition

The steel is grain refined.

Thickness	Max ladle analysis, %								
	C	Si	Mn	P	S	Cr	Ni	Mo	B
4 - 25,4 mm	0,16	0,60	1,40	0,025	0,010	0,50	0,10	0,25	0,005
25,41 - 40 mm	0,17	0,60	1,60	0,025	0,010	1,15	0,10	0,30	0,005
40,01 - 50 mm	0,17	0,60	1,60	0,025	0,010	1,30	0,50	0,50	0,005

Carbon equivalent, typical values, %		
Plate thickness	CEV <sup>(1)</sup>	CET <sup>(2)</sup>
4 - 8 mm	0,36	0,25
8,01 - 20 mm	0,40	0,28
20,01 - 25,4 mm	0,45	0,29
25,41 - 40 mm	0,57	0,33
40,01 - 50 mm	0,64	0,36

(1) CEV = C+Mn/6+ (Ni+Cu)/15+ (Cr+Mo+V)/5  
(2) CET = C+(Mn+Mo)/10+Ni/40 +(Cr+Cu)/20

## 3 Dimensions

Quard 400 at present is supplied in the following range:

- thickness: 4 - 50 mm (5/32" - 2")
- width: 1500 - 3100 mm (60" - 122")

NLMK Clabecq carries on the extension of its dimensional program in order to propose as soon as possible a thickness range from 3 to 60 mm. For more information, please check our website or contact your local representative.

## 4 Flatness, tolerances & surface properties

Quard 400 is delivered with a unique combination of excellent flatness, tight thickness tolerances and superior surface finish.

Feature	Norm	
FLATNESS	- EN 10029: . Class N (standard) & . Class S	<b>PLUS</b>
THICKNESS tolerance	- meets and exceeds EN 10029 Class A - tighter tolerances upon request	<b>PLUS</b>
Shape, length, width tolerances	meets EN 10029	
SURFACE properties	exceeds the usual market standards, EN 10163-2 Class B3	<b>PLUS</b>

## 5 Delivery conditions

Our Quard plates are supplied as standard in the **shotblasted and primed** condition. In order to maintain a good weldability and laser cutting performance, a low zinc silicate primer is applied. Plates can also be delivered unpainted.

## 6 Heat treatment

Quard 400 receives its properties by quenching and when applicable by subsequent tempering. The properties of the delivery condition can not be retained after exposure at service or preheating temperatures above 250 °C. Quard 400 is not intended for any further heat treatment.



## 7 Ultrasonic testing

Ultrasonic testing (UT), is applied to secure the plate from discontinuities like inclusions, cracks and porosity. In thickness from 8 mm and up, all plates are UT tested and controlled against class S2, E2, according to EN 10160.

## 8 General processing recommendations

To obtain optimal work shop productivity when processing Quard 400, it is essential to use the recommended procedures and tools given below.

### Thermal cutting

Plasma and flame cutting can be performed without the need for preheating in thicknesses up to 40 mm, provided the ambient temperature is above 0 °C.

Subsequent to cutting, let the cut parts slowly cool down to room temperature. A slow cooling rate will reduce the risk of cut edge cracking (never accelerate the cooling of the parts).

### Cold forming

Quard 400 is very well suited for cold forming operations. The minimum recommended R/t ratio when bending of Quard 400 is given in the table below:

Thickness (mm)	Transverse to rolling (R/t)	Longitudinal to rolling (R/t)	Trans. Width (W/t)	Long-Width (W/t)
t < 8.0	2.5	3.0	8	10
8 ≤ t < 20	3.0	4.0	10	10
t ≥ 20.0	4.5	5.0	12	12

R = Recommended punch radius (mm), t = Plate thickness (mm), W – Die opening width (mm) (bending angle ≤ 90°)

Due to the homogeneous properties and narrow thickness tolerances of Quard 400, variations in springback is kept at a low level. Grinding of flame cut or a sheared edge in the bending area is recommended to further prevent cracking during bending.

### Welding

Quard 400 has a very good weldability, granted by the low carbon equivalent of the steel. It can be welded using any of the conventional welding methods, both as manual or automatic.

Welding of Quard 400 is recommended to be performed at ambient temperature not lower than +5°C. Subsequent to welding, let the welded parts slowly cool down to room temperature (never accelerate the cooling process of the weld).

If welding using a heat input of 1.7 kJ/mm, preheating is not required in single plate thickness up to 20 mm. The interpass temperature used should not exceed 225 °C.

Soft weld consumables, giving low hydrogen weld deposits (<= 5 ml/100g), are recommended. The consumable strength should be as soft as the design and wear mode allows.

In general, the welding recommendation of Quard 400 should be in the accordance to EN-1011.

### Machining

Quard 400 offers good machinability with HSS and HSS-Co alloyed drills. The feed rate and cutting speed have to be adjusted to the high hardness of the material.

Face milling, counter boring and countersinking are best performed using tools with replaceable cemented carbide inserts.

For more information regarding welding, cold forming and machining, please consult the respective manuals with technical recommendations on [www.quard.me](http://www.quard.me)