

FORA 500

A 500 HB wear resistant steel

FORA 500 is a water quenched martensitic steel, with a 500HB (51.5 HRC), typical hardness, resistant to very severe abrasion wear. Thanks to its mechanical properties, good toughness, high hardness and strength, **FORA 500** steel can be used wherever a sliding wear resistance is required and where 400 HB steels do not provide sufficiently long service life.

Compared to conventional steels, such as S355, **FORA 500** offers a real improvement on the life time of equipment, up to 5 times longer and consequently allows a significant reduction in the design thickness.

FORA 500 steel is particularly suitable for applications such as quarries, construction equipment, mines, cement plants, the iron and steel industry, etc...

STANDARD

FORA 500 – INDUSTEEL SPECIFICATION

CHEMICAL ANALYSIS

Guaranteed Maximum values (% Weight)

C	Mn	P	S	Cr	Ni	Mo	B
0.30	1.5	0.02	0.003	2.0	0.6	0.3	0.003

max. thickness 50mm
 $C_{Eq} \leq 0.89\%$

$$C_{Eq} = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

MECHANICAL PROPERTIES

Typical values

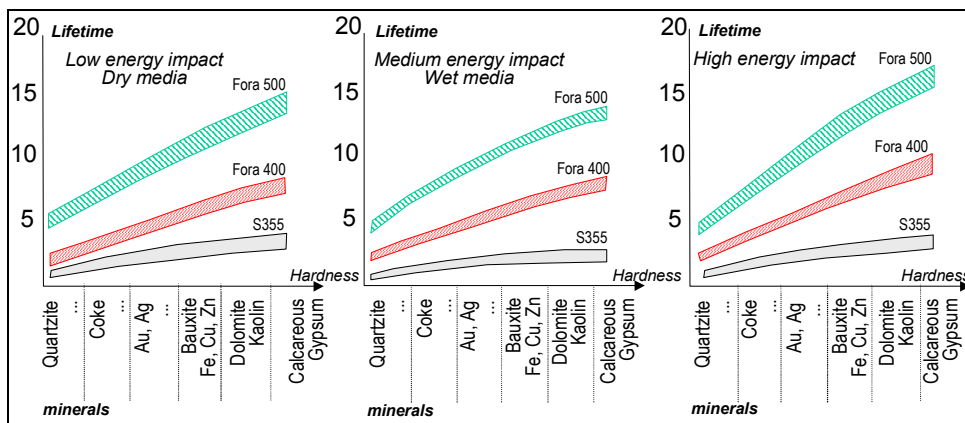
Hardness	Yield Strength ¹ 0.2 %	UTS ¹	E 5.65√S ⁽¹⁾ (%)	KCV long. -20°C (-4°F)
500 HB	1350 N/mm ²	1700 N/mm ²	10 %	30 J/cm ²
51.5 HRC	195 KSI	245 KSI	10 %	18 ft.lb

Guaranteed hardness in delivery condition : 460 / 540 HB (49/54 HRC)

¹ Prismatic tensile probes.

ABRASION RESISTANCE PROPERTIES

Wear tests data :



PROCESSING

Cutting

All the classical processes in thermal cutting are compatible with **FORA 500** (gas, plasma, laser).

Plates between 8 to 10 mm (0.3" to 0.4") thick need not be preheated if thermal cutting is performed at a temperature higher than 10°C (50°F). Where this is not the case or where plates have a thickness higher than 10 mm (0.4"), preheating at 100-150°C (200-300°F) is recommended.

Thickness →	8-10 mm (0.3"-0.4")	> 10 mm (> 0.4")
Cutting Temperature ↓		
≥ 10°C (50°F)	No preheating	Preheating at 100-150°C (212-302°F)
< 10°C (50°F)	Preheating at 100-150°C (212-302°F)	

Cutting by water jet can also be performed.

Machining

Drilling and milling should be performed with supercarburized cobalt high-speed steel type HSSCO, wherever possible using an oil lubricant. However, classical high-speed steels can be used. Typical cutting parameters are :

Drilling		Ø = 10 mm (0.4")	Ø = 20 mm (0.8")	Ø = 30 mm (1.2")
Cutting Speed	(m/min)	4-6	4-6	4-6
	(ft/min)	13-20	13-20	13-20
Rotation speed	(rev/min)	130	65	40
Feed	(mm/rev)	0.1	0.2	0.3

Tapping		Ø = 10 mm (0.4")	Ø = 20 mm (0.8")	Ø = 30 mm (1.2")
Cutting Speed	(m/min)	1-3	1-3	1-3
	(ft/min)	3.3-10	3.3-10	3.3-10
Rotation speed	(rev/min)	50	30	20

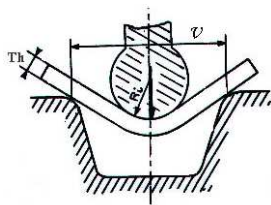
Milling		Depth mm (inch)	Cutting speed m/min	Feed (mm/tooth)
HSSCO AR 12.0.5.5 (T15)		1 (0.04")	10 - 12	0.08
		4 (0.16")	8 - 10	0.12
		8 (0.31")	5 - 8	0.12

Bending

Thanks to the quality of the steel making process (low sulphur and phosphorous contents), **FORA 500** can be bent, provided that the following conditions are respected :

- Dressing (or grinding) of the ridges caused by gas-cutting to limit the hardened zones
- Sufficiently powerful equipment
- Respect of the minimum forming radius

For plate below to 20 mm (0.8") thick, forming conditions are summarized in the following table ; beyond 20 mm (0.8"), consult us.

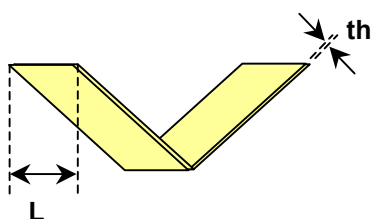


Bending 90°

	Perpendicular to the rolling direction	Parallel to the rolling direction
Bending internal radius R_i (mini)	7 x th	9 x th
Die opening V (mini)	18 x th	22 x th

Within these allowable bending parameters, the force required to form a plate is a function of the bent length, the metal thickness, die opening, die form (V or U), punch form, etc...

The following table shows the bending forces, for the minimum die opening ($V=18\ th$), required for V bending plates for different bent plate widths :



th(thickness)	Bending force required / bent plate width*	
	Tons/m	Tons/ft
5mm / 0.2"	60	17
10mm / 0.4"	115	35
15mm / 0.6"	170	52
20mm / 0.8"	230	70

*(±10%)

FORA 500 steel is unsuitable for hot forming at a temperature higher than 200°C (400°F)

FORA 500 can be welded using following parameters :

Weld preparation

Welded surface must be dry and clean and superficially ground in order to eliminate any rust, scale, grease or paint traces as well as any gas-cutting ridges.

Welding process

Any conventional fusion welding method can be used such as submerged arc welding (SAW), manual metal arc welding (SMAW), flux cored wire arc welding (FCAW), MIG, MAG (GMAW) and TIG (GTAW).

Heat input should be limited to 10-30 KJ/cm with a maximum temperature between the welding passes of 200°C (392°F).

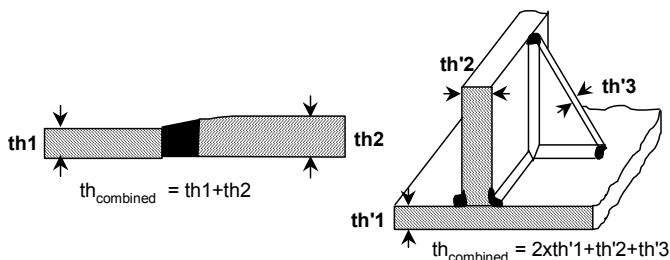
Welding products

	Stick electrodes	MIG-MAG	Flux core wire gas protected	Submerged arc welding Wire / flux
AFNOR	NFA81-340 EY50 1niMo Bxxx1xTBH			NF A81-322 FP/x xx/xx xB x SA31 47 05 04
AWS	A5-5-81 E 70xx	A5-28 ER 70 S-x	A5-29 E 7xT5-x	A5-23 F7P4-Exxx-A2
DIN	DIN 1913 E51 55 Bx			

WELDING

Pre-heating

FORA 500 can be welded without any crack risk and without preheating up to a combined plate thickness of 10mm (0.4"). For the higher thickness, following conditions are recommended.



PREHEATING			
	No	150°C (300°F)	200°C (400°F)
th_{comb} :	< 10mm (0.4")	12-20mm (0.4-0.8)	>20mm (0.8")

APPLICATIONS

- Quarries, Construction- Earth moving Screens, bunkers, bulldozers, etc...
- Cement plant Scraper, crushers, bunkers, etc...
- Mines, Coal mines Crushers, winding and discharging machines, etc...
- Iron and steel industry Bunkers, guide and shifting plates, etc...

DIMENSIONAL PROGRAMME

Thickness mm (inch)	Width mm (inch)	Tol/Thickness mm	Flatness mm/m (inch)
6/7 (0.24")	1500/2500 (59"/98")	1.2	7 (0.28")
8 (0.28")	1500/2750 (59"/108")	1.2	7 (0.28")
9 (0.35")	1500/2750 (59"/108")	1.2	7 (0.28")
8/14 (0.3/0.6)	1500/3000 (59"/118")	1.2	7 (0.28")
15/24 (0.6/1)	1500/3000 (59"/118")	1.4	6 (0.24")
25/39 (1/1.5)	1500/3000 (59"/118")	1.6	6 (0.24")
40/50 (1.57/2)	1500/3000 (59"/118")	2.4	5 (0.20")

Typical lengths: 4000 – 6000 – 8000 – 10 000 mm

Please consult us for other thicknesses and specific dimensions

NOTE :

1. This technical data and information represents our best knowledge at the time of printing. However, it may be subject to some slight variations due to our ongoing research programme on wear resistant grades. We therefore suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here is only for the purpose of description, and may only be considered as guarantees when our company has given written formal approval. Further information may be obtained from the following address.
2. FORA 500 : Application range.
FORA 500 has been developed specifically for its abrasion resistance. Customer's usage of FORA 500 for any other purposes, not directly resulting from its abrasion resistance, is his own prerogative but won't, in any way, engage INDUSTRIEL's responsibility. In addition to the recommendations given in this document, Customer will have to follow the Industry standard quality rules for any processing operation performed on this material.

INDUSTEEL IS CERTIFIED ISO 9001

Information : *INDUSTEEL Belgium*
Rue du Chatelet, 266
B-6030 CHARLEROI
Phone : +32 71 44 18 78
Fax : +32 71 44 19 59
www.industeel.info