



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.

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

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.

Standard

FORA 500 – INDUSTRIEL Specification

Chemical analysis - % weight

C	Mn	P	S	Cr	Ni	Mo	B
.30	1.5	.02	.003	1.0	.7	.3	.003

Guaranteed maximum values

C. Equivalent

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

Thickness range - mm ("")	C.Eq Typ
8/50 (.31"/1.97")	≤ .67

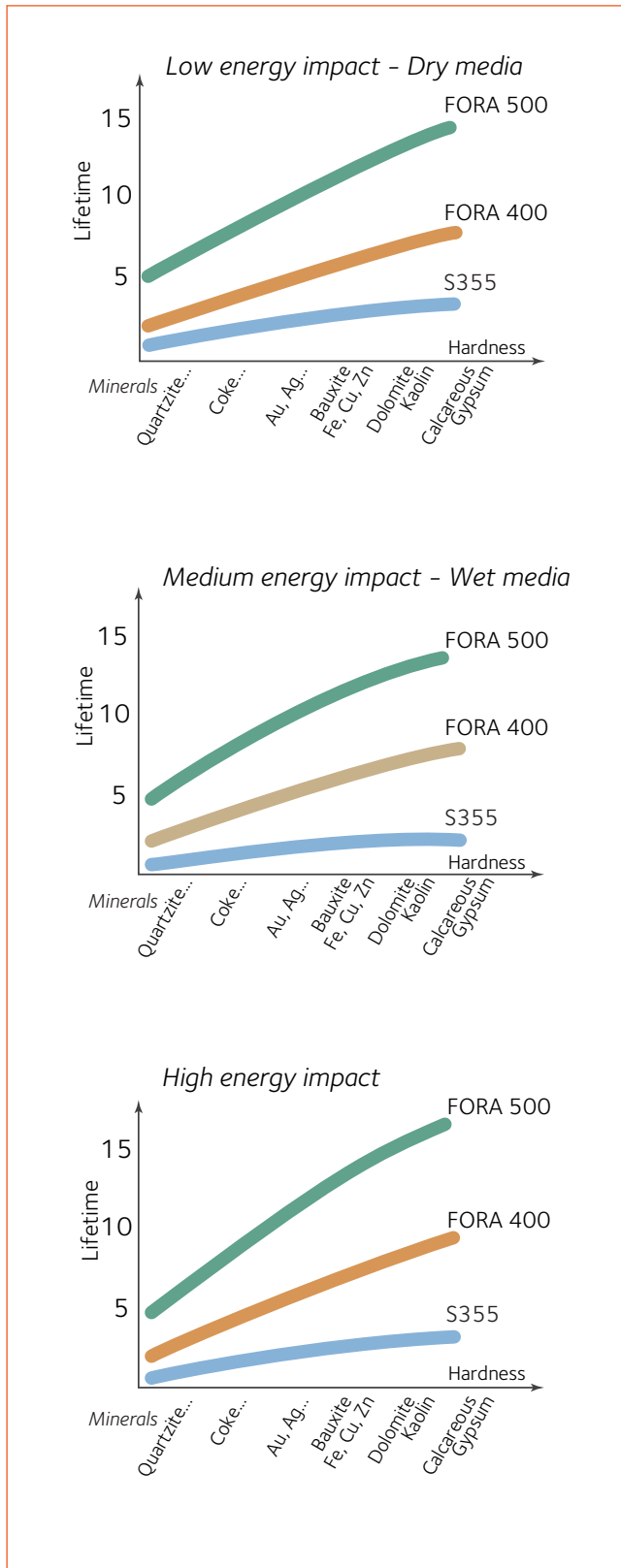
Mechanical properties

Hardness	Y.S. 0.2	UTS	El 5.65 ^{√s} %	KCVL -40°C (-40°F)
500 HB	1400 MPa	1600 MPa	10	30 J
51.5 HRC	195 KSI	245 KSI	10	22 ft.lbs

Typical values

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

Wear resistant properties



Wear test data

Processing

Cutting

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

Plates 8 to 10 mm (.3" to .4") thick do not require pre-heating if thermal cutting is performed at a temperature higher than 10°C (50°F). Where this is not the case or where the plates are thicker than 40mm (1.6"), pre-heating at 100-150°C (200-300°F) is recommended.

Thickness →	8-10mm (.3"- .4")	> 10mm (> .4")
Cutting temperature ↓		
≥ 10°C (50°F)	No preheating	Pre-heating 100-150°C (212-302°F)
< 10°C (50°F)	Preheating 100-150°C (212-302°F)	

Water jet cutting or shearing can also be used

Machining

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

Drilling		Ø = 10mm (.40")	Ø 20mm (0.80")	Ø 30mm (1.18")
Cutting speed	m/min ft/min	4 - 6 13 - 20	4 - 6 13 - 20	4 - 6 13 - 20
Rotational speed	rev/min	130	65	40
Feed	mm/rev	0.1	0.2	0.3

Tapping		Ø = 10mm (.40")	Ø 20mm (0.80")	Ø 30mm (1.18")
Cutting speed	m/min ft/min	1 - 3 3.3 - 10	1 - 3 3.3 - 10	1 - 3 3.3 - 10
Rotational speed	rev/min	50	30	20

Milling		Depth mm (")	Cutting speed m/min (")	Feed (mm/tooth)
HSSCO AR 12.0.5.5 (T15)	1 (.04")	100-120(3.9-4.7)	0.08	
	4 (.16")	80-100(3.1-3.9)	0.10	
	8 (.31")	50- 80 (2-3.1)	0.15	
F40M	1 to 5 .04" to .20"	70 to 200 2.7" to 7.9"	.15 to .35	

Bending

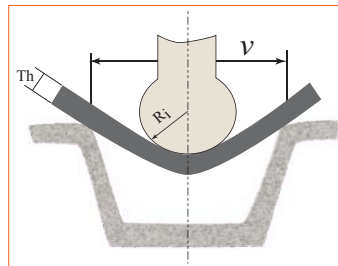
Thanks to the high refining level of the steel (low sulphur and phosphorous contents), FORA 500 is easy to bend provided that following conditions are respected :

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

For plates below 20 mm (.8") thickness, forming conditions are summarized in following table ; beyond 20 mm (0.8"), consult us.

<i>th</i> = thickness	Perpendicular to the rolling direction	Parallel to the rolling direction
Bending internal radius R_i (mini)	7 x <i>th</i>	9 x <i>th</i>
Die opening V (mini)	18 x <i>th</i>	22 x <i>th</i>

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



Bending angle = 90°

The following table shows the bending forces, for the minimum die opening ($V=18\ th$), required for V bending plates for for 1m bent.

Thickness mm (")	Bending force required per meter of bend* (tons/m)
5mm (.20")	60
10mm (.40")	115
15mm (.60")	170
20mm (.78")	230

* ± 10%

FORA 500 steel is unsuitable for hot forming at a temperature higher than 200°C (392°F).

Welding

FORA 500 can be welded using following parameters :

Weld preparation

Weld surfaces must be dry, 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 core wire arc welding (FCAW), MIG, MAG (GMAW) and TIG (GTAW). Heat input should be limited to 10-30 kJ/cm with maximum interpass temperature between preheating temperature and 200/220°C (390-430°F) maxi.

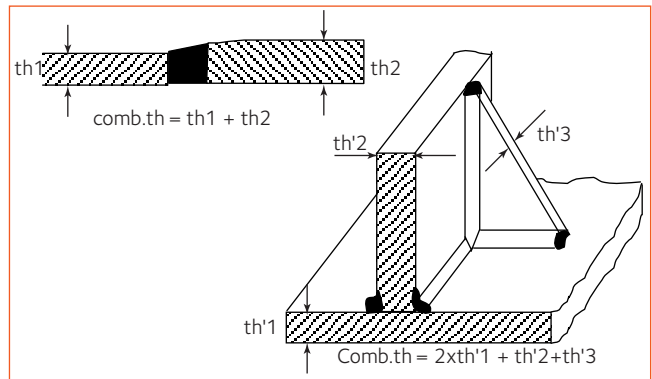
Welding consumable

All products in accordance with following standards are acceptable :

Stick Electrodes	MIG-MAG	Flux core wire gas protected	Submerged arc welding Wire-flux
AFNOR			
NF A81-340 EY50 1NiMo Bxxx1xTBH			NF A81-322 FP/x xx/xx xB xSA31 47 05 04
ASW			
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			

Pre-Post heating conditions Combined thicknesses

FORA 500 can be welded without any crack risk and without preheating up to a combined plate thickness of 10 mm (.4").



For higher thicknesses, the following conditions are recommended :

comb t_h	Preheating		
	No preheating	150°C (300°F)	200°C (400°F)
< 10mm (.4")	12-20mm (.4-.8")	> 20mm (.8")	

Sizes - Tolerances

FORA 500 is available in a large dimensional programme :

Thickness		Quarto			Flatness mm/m (*)
mm	inch "	width mm	width "	Tol./th (mm)	
8-10	.31 - .40	1200-2500	47-98.4	± 0.6	8 (.31")
10-11	.40 - .43	1200-3000	47-118	± 0.6	8 (.31")
11-60	.43- 2.36	1200-3000	47-118	± 0.7	8 (.31")

Typical lengths	
mm	ft (')
4 000	13.12
6 000	19.68
8 000	26.24
10 000	32.80

*.31" in every 40"

Plates outside this dimensional programme can be available after agreement. Please, ask us.

For any information

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Nota

1. Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on wear resistant grades. Therefore, we 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 are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company.