



Creusabro® 8000[®]

A high performance wear resistant steel

Creusabro® 8000[®] is an advanced abrasion-resistant steel with a better compromise, in extreme applications, between abrasion resistance and toughness (crack resistance). More than 50 % of wear life higher than 500 HB conventional water quenched steels.

Creusabro® 8000[®] capitalizes upon an innovative metallurgical concept, based on a specific chemical analysis. This chemical analysis is combined with a dedicated heat treatment conducted by Oil Quenching.

Standard

Creusabro® 8000[®]

Chemical analysis

C	Mn	Ni	Cr	Mo	S
≤ .28	≤ 1.6	≈ .40	≤ 1.6	≥ .20	≤ .002

Mechanical properties

	Hardness HB	YS 0.2 MPa (KSI)	UTS MPa (KSI)
Indicative values	470	1250 (181)	1630 (236)
Guaranteed values (as supplied)	430/500	1250 (181)	1630 (236)
	El. %	KCVL -20°/-4°F J (ft.lbs)	E GPa
Indicative values	12	44 (32 ft.lbs)	205
Guaranteed values (as supplied)	12	32 (24 ft.lbs)	205
Yield Strength	200°C (392°F)	400°C (752°F)	500°C (932°F)
	1080 (156)	880 (127)	520 (75)
UTS	200°C (392°F)	400°C (752°F)	500°C (932°F)
	1650 (236)	1250 (181)	900 (130)

The successful use of Creusabro® 8000[®] for wear parts in different areas of industries is a result of :

- a superficial hardening following a very efficient work hardening capability in service, governed by a metallurgical phenomenon called TRIP effect (Transformation Induced by Plasticity).
- a very fine and homogeneous dispersion of hard particles in the steel (mainly chromium, molybdenum and titanium microcarbides) giving to the material its extremely high abrasion resistance.

In addition to its high wear resistance, Creusabro® 8000[®] provides a very good ability of processing (forming, machining...) much better than the existing 500 HB resistant steels.

Creusabro® 8000[®] is known as the best compromise for severe applications where exceptional abrasion, impact, heat and moderate corrosion are requested in service.

Creusabro® 8000[®] is currently used in typical industries such as : Mining, Quarries, Cement and Concrete industries, Iron making and Steel processing Recycling, Earthmoving (public works), Dredging...

Physical properties

Density at +20°C (68°F) = 7.85 kg/dm³

Expansion coefficient - average (x 10⁻⁶.°C⁻¹)

20/100°C 68/212°F	20/200°C 68/392°F	20/300°C 68/572°F
11.2	12.0	12.5
20/400°C 68/752°F	20/500°C 68/932°F	
13.2	13.8	

Metallurgical concept

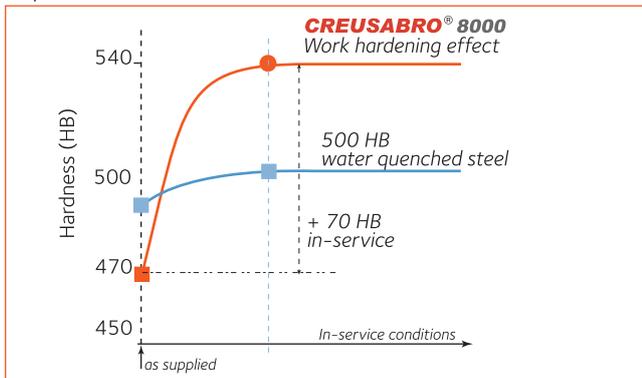
Wear resistance depends not only on the hardness of the steel in the as delivered state, but also on the other properties, such as crack resistance, work hardening, strength, ductility, softening resistance, etc.

The performance in service of given wear resistant steel is strongly influenced by the microstructure obtained after thermal processing.

In the case of Creusabro® 8000[®], a significant improvement of the wear resistance in service is mainly due to the following properties :

"TRIP effect" : TRansformation Induced by Plasticity.

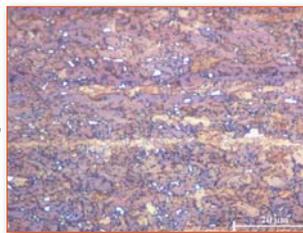
Due to its initial structure not fully martensite (a mix of martensite, bainite and retained austenite), Creusabro® 8000[®] has the ability to work-harden when submitted to local plastic deformation in service. Plastic deformation induces a surface hardening phenomenon by transformation of retained austenite into fresh and very hard martensite while the material remains ductile underneath, makes it a most effective to withstand both abrasion and heavy impact in service.



In addition, the super ductility of the retained austenite contributes to improve the lifetime in service by allowing larger micro shearing and thus delays the ultimate tearing of metal particles from the surface of the material exposed to the abrasive.

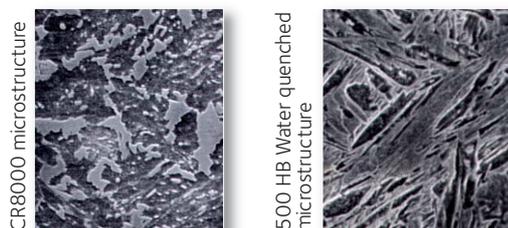
On this typical microstructure of Creusabro® grades, the retained austenite grains revealed by means of Klemm reactive etching appear in white.

When subjected to plastic deformation in service (impact or high pressure), Creusabro® 8000[®] takes advantage of a surface hardening about 70 HB, whatever the applied strain level.



Fine dispersion of micro carbides

The fine microstructure of Creusabro® 8000[®] is a result of a specific chemical composition combined with a controlled cooling rate performed by oil quenching.



Such a microstructure differs from the rough acicular lamellar structure which is typical of the fully martensite steels (conventional 500 HB water quenched steels).

Moreover, the fine and homogeneous dispersion of micro carbides significantly contributes to improve the reinforcement of the matrix by improving the sliding wear resistance in service.

Summarize

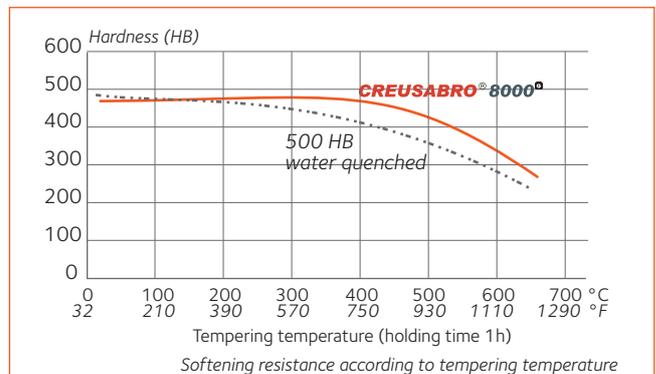
500 HB water quenched steel Conventional route Passive steel	Creusabro® 8000 [®] Alternative route Active steel
» Restricted alloy elements (mainly C, Mn, B)	» Specific chemical composition
» Drastic water quenching	» Controlled cooling (oil quenching)
↓	↓
» Fully martensitic structure	» Mix macro-structure : martensite + bainite + retained austenite
	» Perfect balance : high wear resistance + improvement workability
	» Wear resistance in service is a combination of : → work-hardening effect (TRIP phenomenon) → Presence of micro-carbides (chromium, molybdenum, titanium) → Delayed tearing of metal particles (super-ductility of the retained austenite).

Wear resistance in service is a result of the hardness in the as delivered state. It is an answer for common applications

Creusabro® 8000[®] is an answer for specific applications.

Properties at high temperature

Chemical composition of Creusabro®8000[®], and specially chromium, molybdenum and titanium contents, confer a high softening resistance to the material. Such a quality allows using Creusabro®8000[®] in hot service conditions, at a maximum of 450°C (840°F) while conventional 500 HB water quenched steels are limited to 250°C (480°F).



It is also possible to process the steel at high temperature 500-550°C (930-1020°F) (hot forming : bending, rolling) followed by a slow air cooling without inducing any significant drop of hardness (about 30-50 HB).

Service life

Whatever service conditions are, the original metallurgical concept of Creusabro® 8000® confers to the material an improvement of its performances in terms of wear resistance and workability, compared to other conventional 500 HB water quenched steels. This, especially for extreme applications, when severe abrasion conditions are combined with huge impact, heat or moderate corrosion.

Field tests

Many tests were performed in different areas of industries which confirm the high performance of Creusabro® 8000® compared to 500 HB water quenched steels.

Service life versus 500 HB steels

Areas of industries	Application	Thickn. Piece	Service life
Mines (gold ore)	Wear parts - External liner of bucket excavator	30 mm (1.2")	+ 100%
Foundry (handling hot agglomerate)	Extracting plates	12 mm (.47")	+ 36%
Iron making (iron ore + coal)	Wear parts - Internal chute liner	15 mm (0.6")	+ 35%
Fertilizer industry	Crushing hammers	15 mm (0.6")	+ 58%
Wood industry	Pneumatic chip handling (pipe elbows)	12 mm (.47")	+ 38%
Glass recycling (calcin)	Belt conveyor (guide plate)	15 mm (0.6")	+ 69%
Quarry (granite)	Wear parts (internal side of a jaw crusher)	40 mm (1.6")	+ 50%

Processing

Cutting

All classical thermal processes (gas-plasma-laser) can be used. Plasma/laser processes are specially recommended. They provide a better precision and cutting aspect and induce a thinner Heat Affected Zone (HAZ).

Following conditions are enough to avoid cold cracking :

Plate temperature	Thicknesses ≤ 40 mm (1.57")	Thicknesses > 40mm (1.57")
≥ 10°C (50°F)	No preheating	Preheating : 150°C (302°F)
< 10°C (50°F)	All thicknesses : Preheating 150°C (302°F)	

Water jet cutting can be used.
Shearing of thin plates is not recommended.

Machining

Drilling must be done with high speed steels HSSCO type (ex. AR 2.9.1.8. according AFNOR, M42 according to AISI) taper shank.

Carbide tip drills (K10 or K20 according to ISO) eventually coated (TiN) shall significantly improve drilling performances in case of medium to large production.

Quality	Ø mm (inch)	Drilling speed (m/min)	Revolution speed (rev./min)	Feed (mm/rev.)
HSSCO AR 2.9.1.8 (M42)	10 (.39")	4-6	125-190	0.07
	20 (.79")		65-95	0.10
	30 (1.18")		40-65	0.12
Carbide K20	10 (.39")	18-22	575-700	0.07
	20 (.79")		285-350	0.10
	30 (1.18")		190-235	0.12

Milling shall also be done with HSSCO tools (AR.6.5.2.5. according to AFNOR, M35 according to AISI or AR.12.0.5.5/T15). A better efficiency will be obtained with carbide tips P10/P30 (rough machining) or K10/K20 (finishing).

Quality	Depth mm (inch)	Cutting speed (rev/mm)	Feed (mm/tooth)
HSSCO AR 12.0.5.5 (T15)	1 (.04")	10 - 12	0.08
	4 (.16")	8 - 10	0.12
	8 (.31")	5 - 8	0.12

Forming

Cold forming can be done under the following appropriate conditions :

- edge preparation by grinding to remove flame cutting heterogeneities
- minimum internal bending radius (table below)
- plate temperature at 10°C (50°F) minimum.

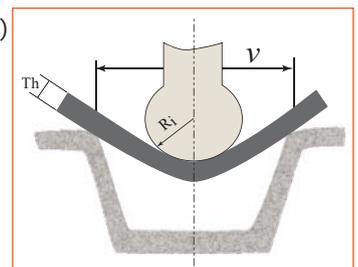
Internal bending radius (min.)

th=thickness

⊥ to rolling Direction $R_i \geq 5 \text{ th}$

// to rolling direction $R_i \geq 6 \text{ th}$

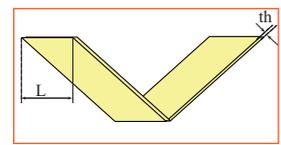
Die opening V (mini) $V \geq 14 \text{ th}$



According above parameters, bending strength depends on bending length, thickness, die opening...

Table here after gives indicative power needed to bend for a die opening of 14 times the thickness.

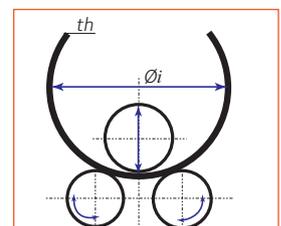
Thickness mm (inch)	Bending strength per meter (Tons/m)
10 (.39")	200
20 (.78")	430



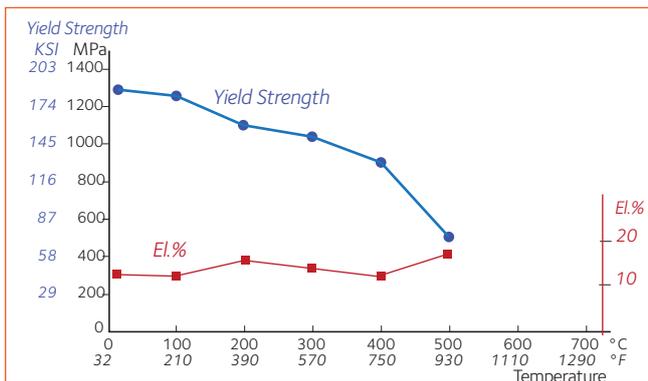
Rolling shall be performed in following conditions :

$\varnothing_1 \geq 40 \text{ th}$

(temperature of the piece $\geq 10^\circ\text{C} - 50^\circ\text{F}$)



Creusabro® 8000® can be *hot formed* at a temperature of 500–550 °C (930–1020 °F) without any further heat treatment. At this temperature, forming requires lower power (according the reduction of the yield strength YS 0.2) than the expected value at room temperature.



Welding

Creusabro® 8000® can be welded with all classical processes : manual, semi-automatic under gas protection, automatic under flux.
For welds non subjected to wear, following welding products can be used :

Processes	AFNOR	DIN	AWS
Manual coated electrode	A81309 E514/3B	DIN 1913 Class E514/3B10	AWS 5-1 Class E7016 or 7018
Semi-automatic under gas	A81311 GS2	DIN 8559 SG2	AWS A5-18 Class ER70S4 or ER 70S6
	A81350 TGS 51BH TGS 47BH	DIN 8559 SGB1 CY 4255	AWS-5-20 Class ER 71T5

For welds subjected to wear, ask us for the best choice of welding consumables.

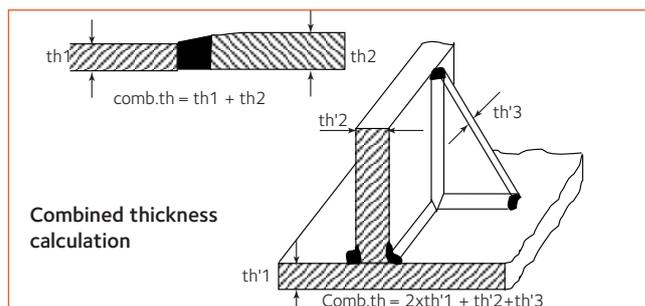
Surfaces to be welded must be clean and free of rust, heat scale, dirt, grease and water.

Electrodes and flux shall be stoved according to supplier's recommendations.

Following preheating conditions shall be respected (for welded structure without excessive stresses).

Heat input (kJ/cm)	Combined thickness								
	10	20	30	40	50	60	70	80	90
0.39	.78	1.18	1.57	1.96	2.36	2.75	3.14	3.54	
Stick manual arc welding	15/20								
Semi-auto. under gas	15								
Submerged arc welding	20	30							

without pre-heating Pre-post-heating at 100°C (212°F) Pre-post heating at 150°C (302°F)



Sizes and tolerances

Product - Thickness	Width	Length	Tolerance
COILS - 4 à 15 mm .16" - 0.6"	1500 (4.92')	Consult us	5 mm/m (.20")
PLATES - 5 to 60 mm .20" - 2.36"	2000 (6.56')	6000 (19.7')	
	2500 (8.2')	6000 (19.7')	
	2500 (8.2')	8000 (26.2')	

Other sizes - please consult

Applications

Creusabro® 8000® can be used with success in a wide range of application - as example :

- Bucket liners for excavator, shovel, loader, dozer, ...
- Cutting edges, stiffeners... for different types of buckets
- Truck tray body liners
- Wear parts for primary and secondary crushers
- Vibratory feeder liners
- Chute liners
- Hopper liners
- Screens
- Trommels
- Pipe elbows
- Cyclones
- Deflectors
- Grinder liners (SAG Mill)
- Demolition tools (recycling)
- Pipes for dredging
- Blade liners for heavy duty fans
- ...

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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.

2. This grade has been developed specifically for its abrasion resistance. Customer's usage of Creusabro® 8000 for any other purposes, not directly resulting from its abrasion resistance, is his own prerogative but won't, in any way, engage Industeel'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.