Industeel

ArcelorMittal

Creusabro® 4800℗

Advanced technology in wear

Creusabro® 4800℗ is a wear resistant steel offering up to 50% extra in service life compared with a 400 HB water quenched steel.
The steel combines several modern metallurgical concepts which, depending on thickness, use different combinations of an enriched chemical analysis (Cr, Mo, Ti...) and controlled quenching rate.

Creusabro® 4800℗ is designed to provide the optimum combination of wear resistance controlled hardness and ease of processing.

Rather then using just a high hardness level, it achieves this aim by using proven and controlled metallurgical mechanisms, which are more complex but more efficient than the simple effect of hardness alone :

- Work-hardening and Cr Mo micro-carbides, the basic Creusabro® concept ,
- TRIP(*) effect originally developed with Creusabro® 8000℗,
- Reinforcement of the structure with Titanium carbides.

The limited as delivered hardness of Creusabro® 4800℗ makes processing operations like cutting, machining and forming no more difficult then processing 400HB water quenched steel.

Creusabro® 4800℗ is ideal for applications in mines and quarries, cement and the steelmaking industries, publics works and agricultural machinery. It is suitable for all types of abrasion, sliding or impact, dry or wet media including high temperature abrasion up to 350°C (*660°F*).

(1) **TR**ansformation **I**nduced by **P**lasticity

Standard

Creusabro® 4800℗

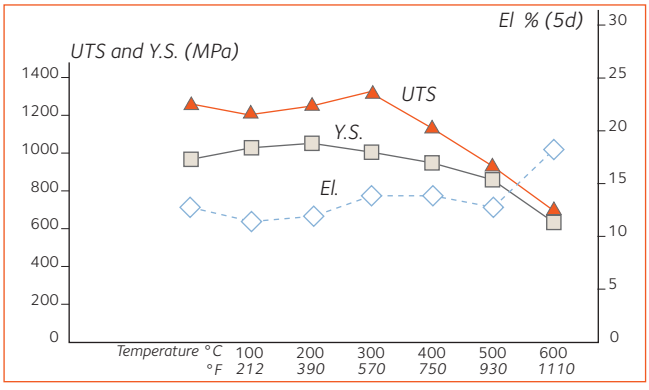
Chemical analysis - % weight

C	S	P	Mn	Ni	Cr	Mo	Other element
≤ .20	≤ .005	≤.018	≤ 1.60	≈ .20	≤ 1.90	≤ .40	≤ .200

Mechanical properties - Typical values

Hardness (HB)	Y.S. 0.2 MPa (KSI)	UTS MPa (KSI)
370	900 *(130)*	1200 *(174)*
El 5.65 %	**KCVL-20°C (-4°F) J (ft.lb)**	**Elasticity modulus GPa**
12	36 *(27)*	205

Guaranteed values (as supplied)
Hardness 340/400 HB



Mechanical properties at high temperature (typical values)

Physical properties

Expansion coefficient - average (x 10^{-6}.°C^{-1})

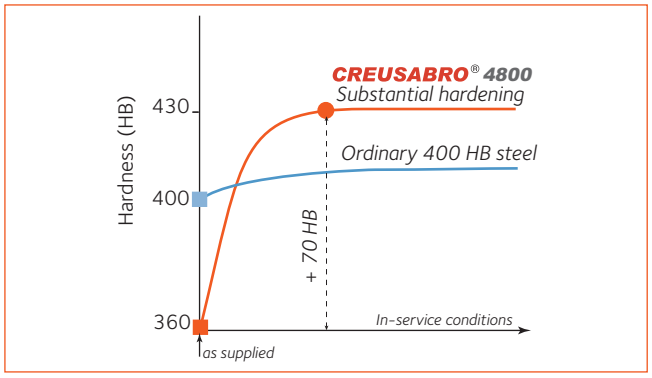
20/100°C *68/212°F*	20/200°C *68/392°F*	20/300°C *68/572°F*
12.4	13.1	13.9
20/400°C *68/752°F*	**20/500°C *68/932°F***	**20/600°C *68/1112°F***
14.4	14.7	15.0

Metallurgical concept

Abrasion resistance is not exclusively associated with the hardness of the steel in the supplied condition. Its composition and structure strongly influence the actual performance in service. The chemical composition and the manufacturing processes applied to Creusabro® 4800© develop a metallurgical structure, which contributes strongly to the improvement of its wear resistance through effects described here after :

Work hardening in service

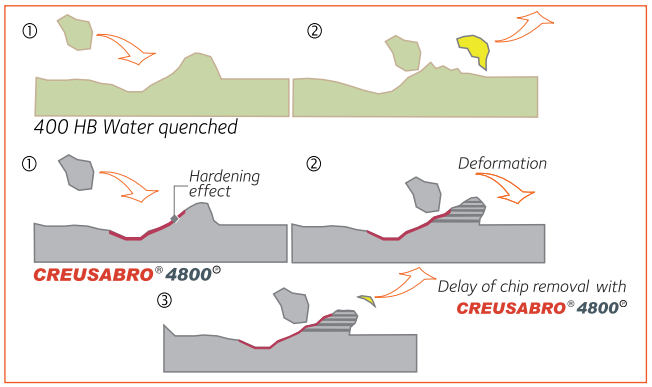
When entering in service, Creusabro® 4800© takes profit of a surface hardening of about 70 HB whatever the applied strain level is (impact, pressure....)



Delay of chip removal

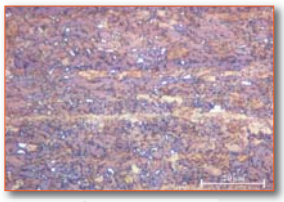
Creusabro® 4800© has the advantage of a higher capacity for plastic deformation caused by impacts.

This extra-ductility induces a delay in the chip removal ensuring a slower wear rate (weight loss) than on 400HB water quenched steels.



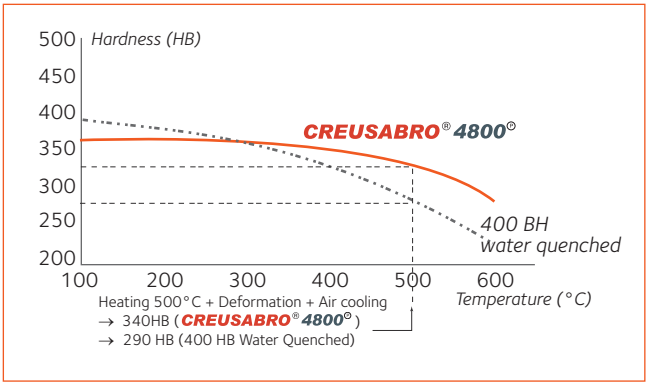
Titanium carbides

In addition to the fine and homogeneous distribution of chromium and molybdenum carbides (respectively 1500 HV and 1800 HV) common to Creusabro® steels, Creusabro® 4800© is a new generation steel in the field of wear resistance steels with a significant addition of Titanium resulting in the formation of a structure with very hard and fine particules of titanium carbide, TiC reaching a hardness level of 3200 Hv. These carbides give to the steel an increased wear resistance..

	400 HB water quenched Conventional route Passive material	**Creusabro® 4800** Innovative route Active material
Wear resistance	Just connected to supplied hardness ↓ **PASSIVE STEEL**	Combining : ▪ in service hardening ▪ TRIP effect ▪ Microcarbides + Titanium effect ↓ **REACTIVE STEEL**
Process	▪ Low alloyed steel (C. Mn. B) ▪ Water quenching	▪ Specific addition of alloying elements (Cr, Mo B, Ti...) ▪ Controlled cooling rate
Structure	▪ 100 % martensitic structure  *Retained austenite*	▪ Structure : bainite/martensite + retained austenite + micro-carbides →Transformation of retained austenite into fresh martensite under abrasive effect → Fine micro-carbides homogeneously dispersed + very hard Titanium carbides

Properties at high temperature

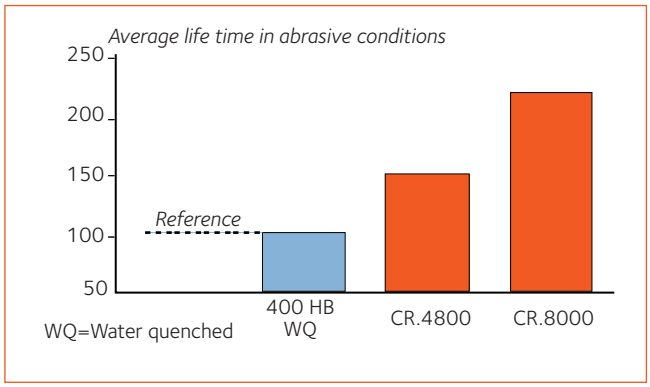
Creusabro® 4800© chemical composition, Chromium and Molybdenum contents principally give a high resistance to softening in hot conditions, much better than that of 400 HB water quenched steel.



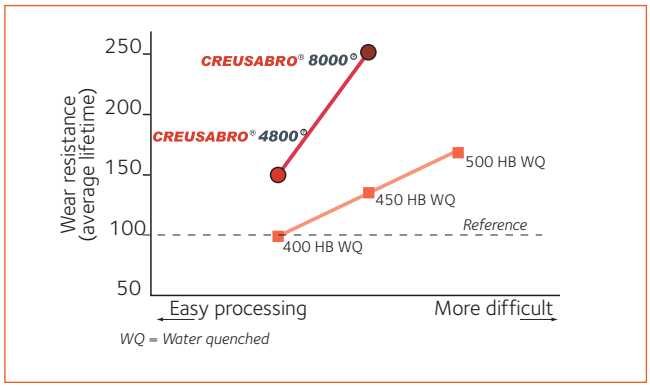
These properties enable the steel to be processed in the hot condition (450/500°C- *840/930°F*) : Forming of thick plates, for example, followed by a slow cooling without inducing any significant drop of hardness.
Hot resistance of Creusabro® 4800© allows its use in hot environments where pieces are heated up to 350°C (*660°F*).

Service life

Creusabro® 4800® metallurgical concept improves its wear resistance compared to other anti-abrasion grades available in the market, and in all service conditions.



Creusabro® 4800® benefits from the optimum compromise between wear resistance and ease of processing.



Processing

Cutting

All classical thermal processes (oxygen-plasma-laser) can be used. Plasma/Laser processes are specially recommended, they provide a better precision and cutting aspects and produce a narrower Heat Affected Zone (HAZ).

Whatever process (thermal) is used, following conditions are sufficient to avoid any cold cracking :

Plate temperature	Thickness ≤ 60 mm (2.4")	Thickness > 60mm (2.4")
≥ 10°C *(50°F)*	No preheating	Preaheating 150°C *(302°F)*
< 10°C *(50°F)*	All thicknesses : preheating 150°C *(302°F)*	

Water jet cutting also can by used.

Machining

Drilling could be done with high speed tools, HSSCO type. (ex. AR 2.9.1.8 according to AFNOR, M42 according to AISI)

Lubrication with soluble oil diluted to 20%.

Tool	Ø mm	Cutting speed (m/min)	Revolution Speed (rev/min)	Feed mm/rev
HSSCO AR.2.9.1.8 (M42)	5	15 -20	950 - 1250	.07
	10	13 17	415 - 540	.09
	15	12 -15	255 -320	.10
	20	11 -14	175 - 220	.12
	25	9 -12	115 - 150	.15
	30	8 -10	85 - 105	.20

Indicative parameters

Milling could be done with cutting tool with insert F40M.

Lubrication with soluble oil.

Tool	Depth (mm)	Cutting speed (m/min)	Feed tooth
F40M Ø 12mm	1-5	70-200	.12-.35

Forming

Cold forming of Creusabro® 4800® can be done without any problem when the following conditions are met

→ No marks or scratches in shaped zones, mainly on external face,

→ Bevelling by grinding of edge angle specially on extended skin – Eventually grinding to remove cutting heterogeneities,

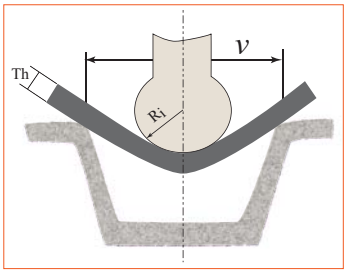
→ Minimum internal bending radius (table below),

→ Plate temperature > 10°C (*50°F*).

Bending

Internal bending radius (min.)
th= thickness

⊥ to rolling Direction	$r_i \geq 3th$
// to rolling Direction	$r_i \geq 4th$
Die opening V (mini)	V ≥ 12 th



▪ The strength necessary to bend depends on UTS and plate thickness as well as bended length and die opening V.

Indicative values, for die opening V = 12th (V bending)

Th plates (mm)	Bending strength L = 1m (ton/m)
5	70
10	130
20	250

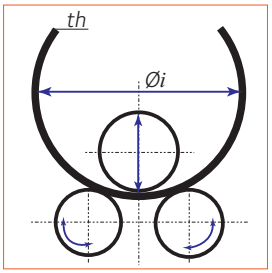
▪ Spring back : allows for a tight bending angle to compensate spring back effect.

Example : for r_i / th = 5, anticipate an angular correction of about 10° .

▪ Safety : Due to high elastic energy of the steel it is adviced not to stand in front of the machine, but at the side.

Rolling has to be done using the following conditions :

$Ø_i \geq 30$ th (plate temperature > 10°C (*50°F*) : The force necessary to roll a plate will be about double that of a S355 type steel.



▪ Creusabro® 4800® can be hot formed at a temperature of 450/500°C *(840/930°F)* without any further heat treatment. At this temperature the force necessary to deform the plate will be lower than at room temperature, and the deformation capability of the steel will be higher (smaller forming radius).

It is possible to deform a Creusabro® 4800® plate thicknesses ≤ 20mm (*.78"*) within temperature range 870/1000°C (*1600/1830°F*) followed by air cooling without affecting steel properties.

This process is particularly interesting to reduce bending / rolling forces and to increase the deformation capability of the steel.

Welding

Creusabro® 4800® can be welded by all traditional welding processes : manual, semi-automatic under gas, automatic under fluxes.
For welds non exposed to wear, the following welding rods can be used.

Processes	AFNOR	DIN	AWS
Manual Stick electrode	A81-309 E51 4/3 B	DIN 1913 Class E51 43 B10	AWS 5-1 Class E7016 or 7018
Semi-automatic Under gas	A81311 GS2	DIN 8559 SG2	AWS A-5-18 Class ER70S4 or ER 70S6
	A81350 TGS 51BH TGS 47BH	DIN 8559 SGB1 CY 4255	AWS-5-20 Class ER 71T5

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For welds exposed to wear, please ask for advice on the choice of welding products and processes and parameters.

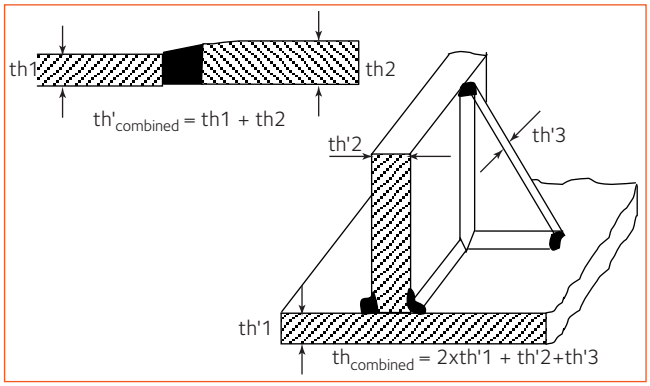
Welded area must be free of grease, water, oxides...

Electrodes and flux shall be stoved according to supplier recommendations.
Following preheating conditions shall be met (weld without excessive stresses).

Heat input (kJ/cm)		30 *1.18*	40 *1.57*	50 *1.96*	60 *2.36*	70 *2.75*	80 *3.14*	90 *3.54*
Semi-automatic under gas	15							
	30							
Manual welding Stick electrode	10							
	20							
Automatic under solid flux	20							
	30							

Without preheating
Pre-postheating at 75°C (*167°F*)
Pre-postheating at 125°C (*257°F*)

Combined thickness calculation



Sizes - Tolerances

Thicknesses	Standard sizes (mm)	Flatness
3 à 150 mm *.12" to 5.9"*	1500 x 3000 - *59" x 118"*	5 mm/m *(.2")*
	2000 x 6000 - *79" x 236"*	
	2500 x 8000 - *98" x 315"*	

Applications

▪ *Quarries - Public works*
Blades, Bucket liners, crusher lateral stiffeners, screens, dumper bodies and trommels...

▪ *Mines*
Extraction equipment, conveyor bottom plates, hoppers, helical gravity and screw conveyors, skips, ventilators, discharge plates...

▪ *Cement plants*
Wheel excavators buckets, crusher lateral shield, clinker chutes, buckets, ventilators, dust separators, bagging machines...

▪ *Steel plants*
Guiding plates, hoppers, chutes, discharge plates, scrap containers/charging boxes...

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 the product for any other purposes, not directly resulting from its abrasion resistance, is his own prerogative but won't, in any way, engage Industeel's responsability.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.