

CREUSABRO® 8000^(P)

A high performance wear resistant steel

CREUSABRO® 8000^(P) is a high performance wear resistant steel, exhibiting a wear resistance 50% higher than that of conventional 500 HB water quenched steel.

CREUSABRO® 8000^(P) uses an innovative concept, based on a unique combination of chemical analysis and heat treatment procedures (oil quenching). This confers to the steel an improved wear resistance by the contribution of:

- a very fine distribution of chromium and molybdenum microcarbides reinforcing the microstructure with the same principal as composite materials.
- a very efficient work hardening capability in service, coming from a metallurgic effect called **TRIP** effect (**TR**ansformation **I**nduced by **P**lasticity).

In addition to its high wear resistance, CREUSABRO® 8000^(P) still maintains a very good aptitude to processing, far better than that of other 500 HB water quenched steels. CREUSABRO® 8000^(P) offers the best possible optimization of an exceptional wear resistance and a very acceptable workability.

STANDARD CREUSABRO® 8000^(P)

CHEMICAL ANALYSIS

Guaranteed values (Weight %)

| C | Mn | Ni | Cr | Mo | S |
|--------|--------|-----------|--------|--------|---------|
| ≤ 0.28 | ≤ 1.60 | ≈ 0.40(*) | ≤ 1.60 | ≥ 0.20 | ≤ 0.002 |

(*) for widths over 2500mm, Ni ≈ 1.25%

MECHANICAL PROPERTIES

Indicative values (As delivered)

| Hardness HB | YS 0.2 MPa | UTS MPa | EI. % | KCVL-20°C J/Cm ² | E GPa |
|----------------|---------------|------------|----------|--------------------------------|----------|
| 470 | 1250 | 1630 | 12 | 55 | 205 |

Guaranteed values (As delivered)

Hardness: 430/500 HB

Toughness: KCVL -20°C ≥ 40 J/cm²

KCVL -40°C ≥ 30 J/cm²

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(P) Grade patented by USINOR INDUSTRIEL

Hot mechanical properties (indicative values)

| YS Mpa | | | UTS Mpa | | |
|--------|-------|-------|---------|-------|-------|
| 200°C | 400°C | 500°C | 200°C | 400°C | 500°C |
| 1080 | 880 | 520 | 1650 | 1250 | 900 |

PHYSICAL PROPERTIES

Density at +20°C: 7,85kg/dm³

Expansion coefficient (x 10⁻⁶.°C⁻¹)

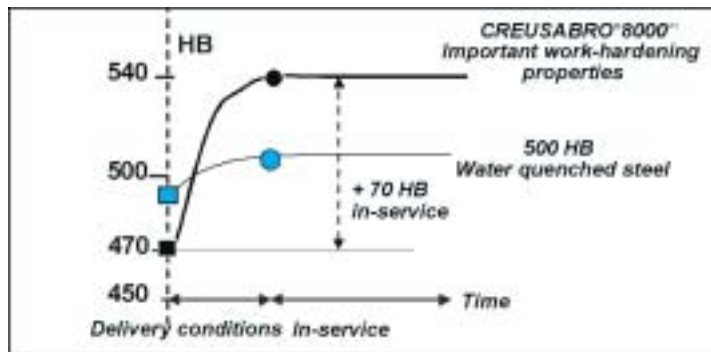
| 20/100°C | 20/200°C | 20/300°C | 20/400°C | 20/500°C |
|----------|----------|----------|----------|----------|
| 11.2 | 12.0 | 12.5 | 13.2 | 13.8 |

METALLURGICAL CONCEPT

Abrasion resistance is not exclusively connected to the hardness of the steel in the as delivered condition. Its components and its structure strongly influence its performance. Chemical balance and manufacturing processes of CREUSABRO® 8000^(P) impart a metallurgical structure to the steel which strongly improves its wear resistance through the following properties.

When entering into service, CREUSABRO® 8000^(P) takes advantage of a surface hardening effect of about 70 HB, whatever the applied strain level is (impact, pressure...)

In service work hardening thanks to TRIP effect



“TRIP effect”: TRansformation Induced by Plasticity

CREUSABRO® 8000^(P), due to its initial structure containing retained austenite, has the capability to work-harden in service under the action of local plastic deformations.

These plastic deformations create hardening by the transformation of retained austenite into very hard fresh martensite.

The TRIP effect also contributes to the delay of chip removal from the steel under the action of abrasive particles.

The steel consequently becomes harder and remains very resistant to wear by chip removal.

Fine dispersion of micro carbides

The fine structure of CREUSABRO® 8000^(P) is obtained by a fine dispersion of micro-carbides.

This structure is just the opposite of the rough acicular lamellar structure typical of 500HB water quenched steels.

Cracking along lamellas leads easily to the chip removal effect under the action of abrasion.

This effect is strongly reduced in CREUSABRO® 8000^(P) which does not have this lamellar structure.

More over, this fine dispersion of carbides reinforces the steel and works in combination with the work-hardening effect to delay the chip removal effect in service.



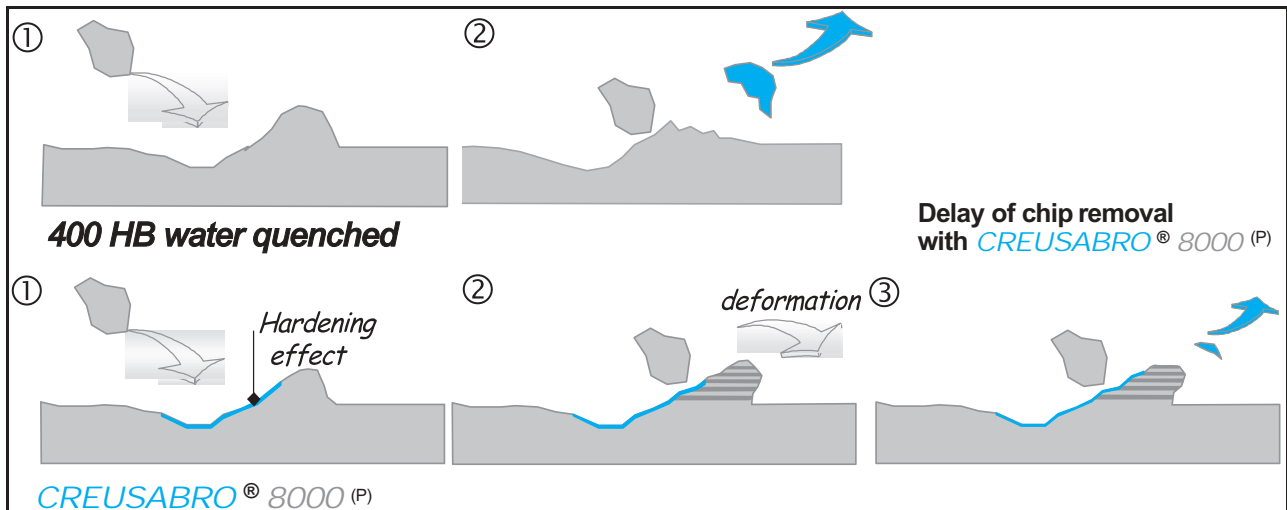
500 HB Water quenched
Microstructure



CR® 8000^(P) Microstructure

Delay of chip removal

Creusabro® 8000^(P) 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.



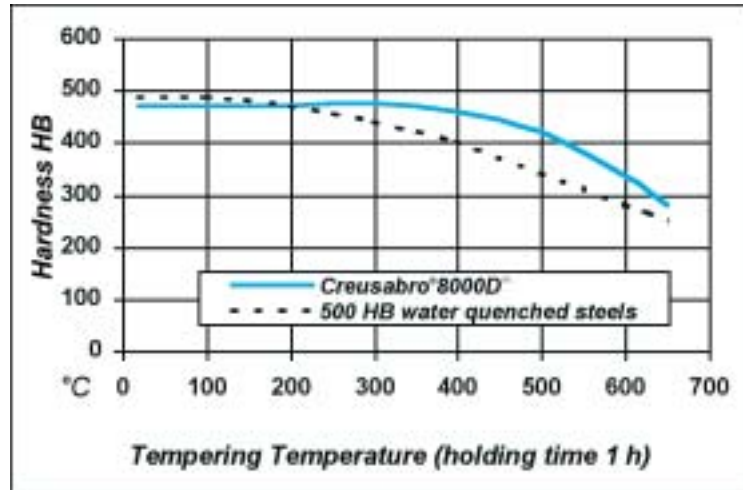
Summary

| Water quenched 500HB Conventional route Passive material | Creusabro® 8000^(P) Innovative route Active material |
|---|---|
| <ul style="list-style-type: none"> • Low alloyed steel • Water quenching <p style="text-align: center;">↓</p> <ul style="list-style-type: none"> • 100% martensitic lamellar structure | <ul style="list-style-type: none"> • Specific additions of alloying elements • Controlled cooling (heat treatment) <p style="text-align: center;">↓</p> <ul style="list-style-type: none"> • Structure: martensite + retained austenite + micro-carbides → Transformation of retained austenite into fresh martensite under abrasive effect → Fine micro-carbides, homogeneously dispersed |
| Wear resistance just connected to delivered hardness. Steel suffers from crack propagation along lamellas | Resistance to wear and chip removal effect, due to combined actions of hardness, TRIP effect, and micro-carbides. |

PROPERTIES AT HIGH TEMPERATURE

Chemical analysis of CREUSABRO® 8000^(P), specifically, its chromium and molybdenum contents, imparts to the steel an improved resistance in hot conditions, much better than that of 500HB water quenched steels.

Softening resistance according to tempering temperature

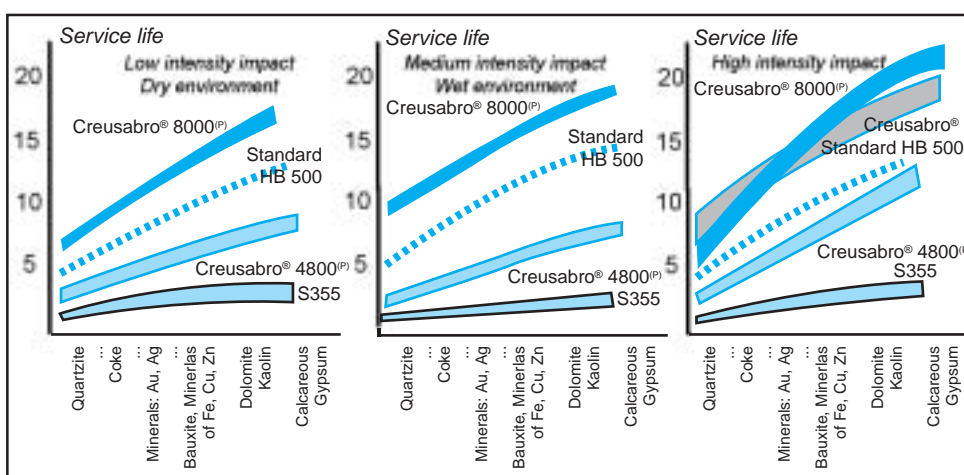


This property allows processing of the steel in hot conditions (450/500°C), hot forming for example, cooling down in air without inducing any significant drop of hardness (about 30 HB max).

The hot resistance of CREUSABRO® 8000^(P) allows its use in hot conditions where pieces are heated up to 300°C max.

SERVICE LIFE

Whatever service conditions are, the specific metallurgical concept of CREUSABRO® 8000^(P) leads to an improvement of its performance, compared with other grades available on the market.



Comparative service life; reference is the service life of S355 steel in quartz environment (\approx value 1)

PROCESSING

Cutting

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

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

| Plate temperature | Thicknesses \leq 40mm | Thicknesses $>$ 40mm |
|---------------------------|---|-----------------------------------|
| $\geq 10^{\circ}\text{C}$ | No preheating | Preheating: 150°C |
| $< 10^{\circ}\text{C}$ | All thicknesses: Preheating 150°C | |

Water jet cutting can be used.

Shearing of thin plates is not recommended.

Machining

Drilling and milling operations can be done by utilising Sandvik Coromant drills and inserts.

Drilling recommendations for solid carbide, brazed carbide and indexable inserts are included in the table below.

For additional machining data please contact your local Sandvik Coromant representative.

Drilling recommendations

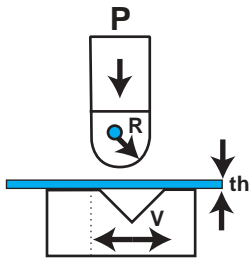
| Creusabro [®] 8000 ^(P) | Cutting Speed m/min. | Drill Dia. (mm) | Feed per Rev. |
|--|-------------------------|--------------------|---------------|
| Solid Carbide | 30-50 | Ø 3-6 | 0.05-0.09 |
| | | Ø 6.01-10 | 0.08-0.12 |
| | | Ø 10.01-14 | 0.08-0.14 |
| | | Ø 14.01-20 | 0.1-0.18 |
| Brazed Carbide | 30-50 | Ø 10-14 | 0.1-0.15 |
| | | Ø 14.01-17 | 0.12-0.18 |
| | | Ø 17.01-30 | 0.15-0.25 |
| Indexable Carbide | 80-120 | Ø 12.7-20 | 0.04-0.08 |
| | | Ø 21-30 | 0.05-0.12 |
| | | Ø 31-58 | 0.06-0.14 |

PROCESSING

Forming

Cold forming can be done as long as the following procedure is respected:

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

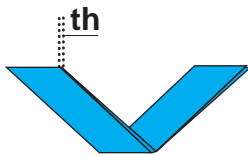


Internal bending radius (min.)

- Bend \perp to longitudinal rolling direction $R \geq 5 t$
- Bend $//$ to longitudinal rolling direction $R \geq 6 t$

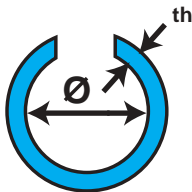
Die opening V (min) $V \geq 14 t$

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



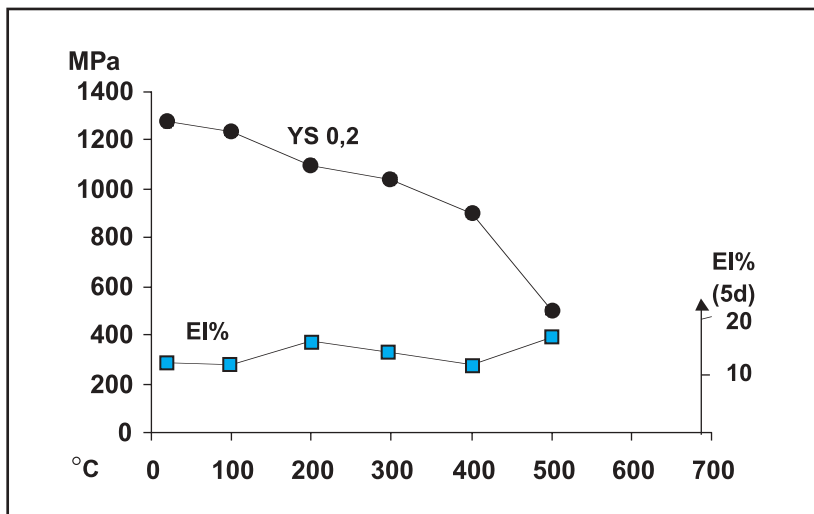
| Thickness mm | Bending strength per meter (Tons/m) |
|--------------|-------------------------------------|
| 10 | 200 |
| 20 | 430 |

Above table gives indicative power needed to bend for a die opening of 14 times the thickness.



Rolling shall be performed in following conditions.
 $\varnothing i \geq 40 th$ (temperature of the piece $\geq 10^\circ\text{C}$)

CREUSABRO® 8000^(P) can be formed at a temperature of 450/500°C without any further heat treatment. At this temperature, forming requires lower power than at room temperature, proportionally to the reduction of its yield strength (YS 0,2).



Welding

CREUSABRO® 8000^(P) 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 | AWS |
|--------------------------|--|
| Manual Coated electrode | AWS 5-1 Class E7016 or 7018 |
| Semi-automatic Under gas | AWS A-5-18 Class ER70S4 or ER 70S6 |
| | AWS-5-20 Class ER 71T1 |

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

Welded areas should be clean, free of grease, water, oxides,...

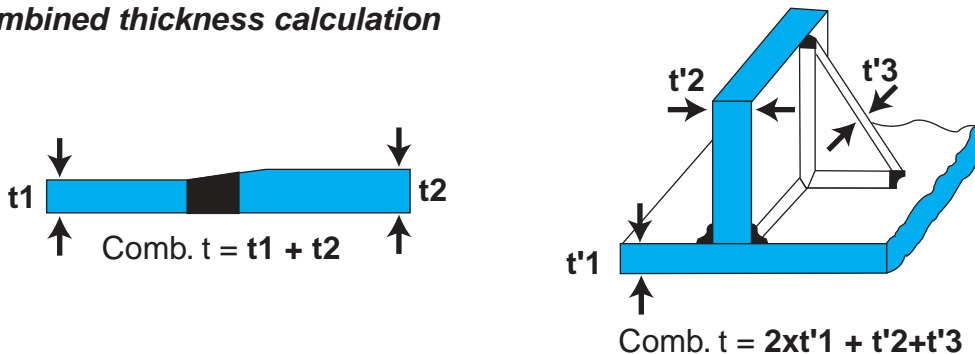
Electrodes and flux shall be stoved according to supplier's recommendations.

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

| Welding process | Heat input (kj/mm) | Pre/Postheating conditions: | | | | | | | |
|--|--------------------|-----------------------------|----|----|----|----|----|----|--|
| | | Combined thickness (mm) | | | | | | | |
| | | 30 | 40 | 50 | 60 | 70 | 80 | 90 | |
| 1 Solid wire with gas (GMAW) | 1.5 | | | | | | | | |
| | 3.0 | | | | | | | | |
| 2 Manual or flux cores wire welding (SMAW or FCAW) | 1.0 | | | | | | | | |
| | 2.0 | | | | | | | | |
| 3 Submerged arc welding (SAW) | 2.0 | | | | | | | | |
| | 3.0 | | | | | | | | |

Without pre-heating
 Pre-post heating at 75°C
 Pre-post heating at 125°C

Combined thickness calculation



APPLICATIONS

- **Quarries - Public works**
Blades, bucket liners, chute plate liners, crusher lateral armouring, screens, dumper bodies, trommels, ...
- **Mines**
Extraction equipment, conveyor bottom plates, hoppers, helical gravity and screw conveyors, skips, ventilators, discharge plates, ...
- **Cement plants**
Wheel excavator buckets, crusher lateral shields, clinker chutes, buckets, ventilators, dust separators, bagging machines...
- **Steel plants**
Guiding plates, hoppers, chutes, discharge plates, scrap containers / charging boxes ...

DIMENSIONAL PROGRAM

Thicknesses 5mm to 100 mm

| | |
|----------------|----------------|
| Standard sizes | 1500 x 3000 mm |
| | 2000 x 6000 mm |
| | 2500 x 7500 mm |

Other dimensions available on request

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 abrasion 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.

2. Creusabro® 8000^(P): Application range.

Creusabro® 8000^(P) has been developed specifically for its abrasion resistance.

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.

Further information may be obtained from the following address.

**FOR FURTHER
INFORMATION
CONTACT YOUR
LOCAL SALES
REPRESENTATIVE**

Email: sales.steelau@sandvik.com

| | |
|-------------------|---------------------|
| ADELAIDE | 08 8243 7700 |
| BRISBANE | 07 3347 0500 |
| MELBOURNE | 03 9238 7200 |
| NEWCASTLE | 02 4924 2130 |
| PERTH | 08 9351 1500 |
| SYDNEY | 02 9828 0600 |
| TOWNSVILLE | 07 4722 4100 |