# Industeel

## Creusabro® 4800



## Creusabro® 4800 : advanced technology in wear

**Creusabro® 4800** is a high performance wear resistant steel, exhibiting a wear resistance 50% higher than that of conventional 400HB water quenched steel.
Rather than relying exclusively on a high hardness level, properties of **Creusabro® 4800** are improved as a result of the combination of an enriched alloying content (chromium, nickel, molybdenum and titanium) and specific heat treatment procedures. **Creusabro® 4800** is designed to offer the best possible optimization of an exceptional wear resistance and very acceptable workability.
The moderate hardness of **Creusabro® 4800** in the as delivered condition makes processing operations like cutting, machining and forming easier and far better than ordinary water quenched steels.
When in service, **Creusabro® 4800** strongly improves its wear resistance by a surface hardening effect of about +70 HB under the action of local plastic deformations caused by impact with rocks or pressure by the abrasive particles.
**Creusabro® 4800** is ideal for applications in mines and quarries, cement and steelmaking industries, public works and agricultural machinery. The grade is suitable for all types of abrasion, sliding or impact, dry or wet environments, including operating temperatures up to 450°C.

# Properties

## Standards

Creusabro® 4800 is a proprietary and exclusive grade developed by Industeel. There exists no engineering standard for plates intended for wear resistant applications.

## Chemical Analysis - % Weight (Max. values).

| C | S | P | Mn | Ni | Cr | Mo |
|---|---|---|---|---|---|---|
| ≤ 0.20 | ≤ 0.005 | ≤ .018 | ≤ 1.6 | ≤ 1.0 | ≤ 1.9 | ≤ 0.40 |

## Mechanical Properties (Indicative values).

| Hardness (HB) | Y S MPa (ksi) | UTS MPa (ksi) | Elongation 5.65 % | KCVL - 40°C/°F J (ft.lb) | Elasticity modulus GPa |
|---|---|---|---|---|---|
| 370 | 900 ( 130 ) | 1200 ( 174 ) | 12 | 50 (1) ( 37 ) | 205 |

Guaranteed values (as supplied) Hardness 350 - 420 HB
*(1) typical value Thickness 30 to 120 mm*

# Physical Properties

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

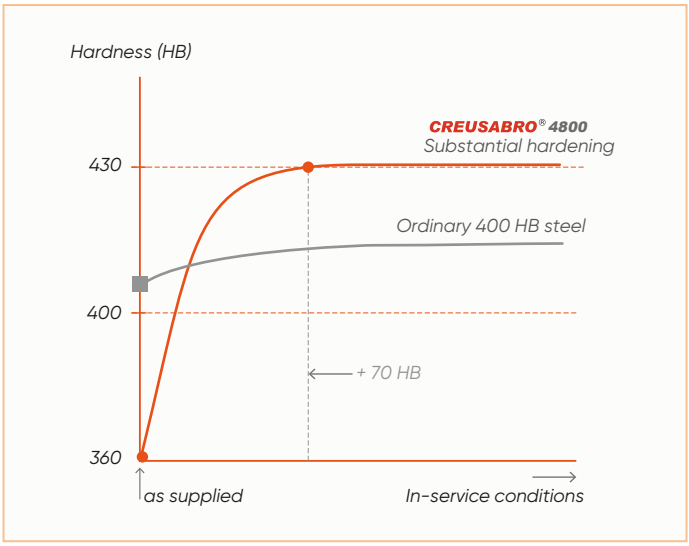
| 20/100°C (68/212°F) | 20/200°C (68/392°F) | 20/300°C (68/572°F) | 20/400°C (68/752°F) | 20/500°C (68/932°F) | 20/600°C (68/1112°F) |
|---|---|---|---|---|---|
| 12.4 | 13.1 | 13.9 | 14.4 | 14.7 | 15.0 |

# Metallurgical Concept

Abrasion resistance is not exclusively associated with the hardness of the steel in the supplied condition. Also the chemical composition and metallurgical structure strongly influence the actual performance in service. The balanced 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:

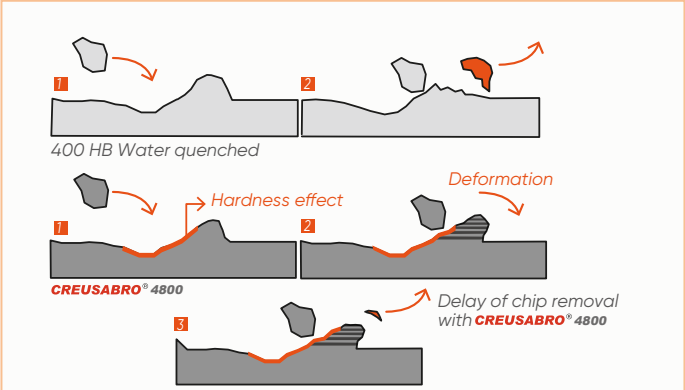
## Work hardening in service

When entering in service, **Creusabro® 4800** exhibits 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 improved ductility contributes to a delay in the chip removal from the steel by abrasive particles, thus ensuring a slower wear rate (weight loss) than on ordinary water quenched steels.




## Fine dispersion of micro carbides

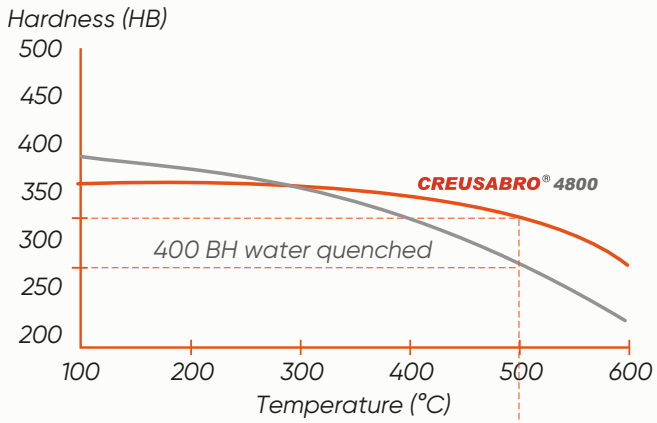
Fine and homogeneous distribution of chromium, molybdenum and titanium (for Creusabro® Dual) carbides. These carbides, respectively 1500 HV, 1800 HV and 3200 HV, provide to the steel an increased wear resistance.

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



## Properties At High Temperature

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

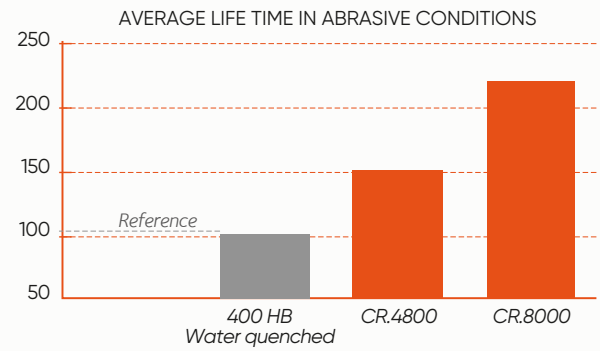



*Heating 500°C + Deformation + Air cooling*
*- 340HB (**CREUSABRO® 4800** )*
*- 290 HB (400 HB Water Quenched)*

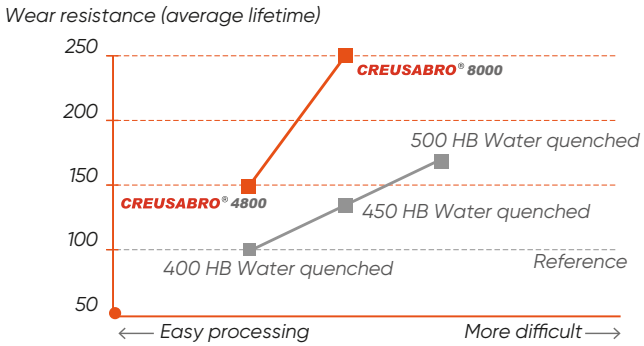
These properties enable the steel to be processed in the hot condition 450- 500°C (840 - 930°F): forming of thick plates, for example, followed by a slow cooling without inducing any significant drop of hardness. Hot resistance of **Creusabro® 4800** allows its use in hot environments where pieces are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




# Delivery conditions

## Sizes - Tolerances

| Thickness | Standard sizes (mm) | Flatness |
|---|---|---|
| 3 to 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'') | |

*Other dimensions available on request.*

# Plate processing

## Cutting

All classical thermal processes (oxygen - plasma - laser) can be used. Plasma and laser processes are especially recommended, to obtain better precision and cutting aspect and to minimize the extend of the 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 > 60 mm (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 be 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 |

**Milling** could be done with cutting tool with insert F40 m. Lubrication with soluble oil.

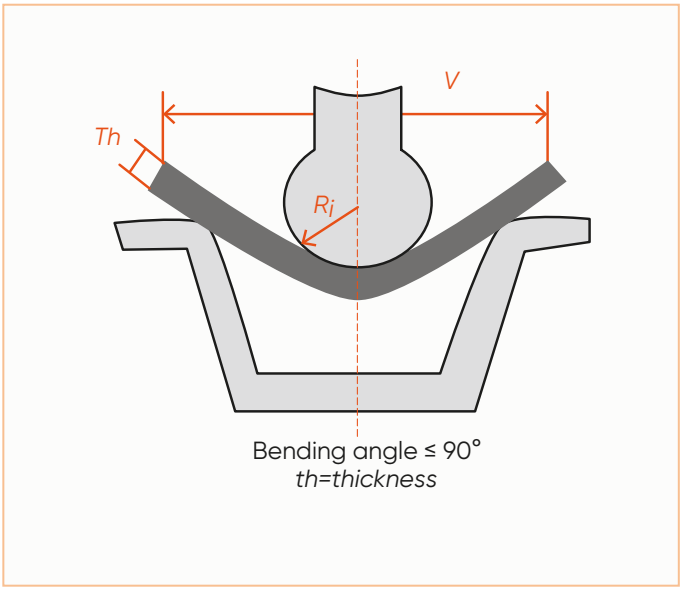
| Tool | Depth (mm) | Cutting speed (m/min) | Feed tooth |
|---|---|---|---|
| F40M Ø 12mm | 1-5 | 70-200 | .12-.35 |

*Indicative parameters*

# 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 especially on extended skin. If required grinding to remove cutting heterogeneities**
**> Minimum internal bending radius (table below),**
**> Plate temperature > 10°C (50°F).**



Bending angle ≤ 90°
*th=thickness*

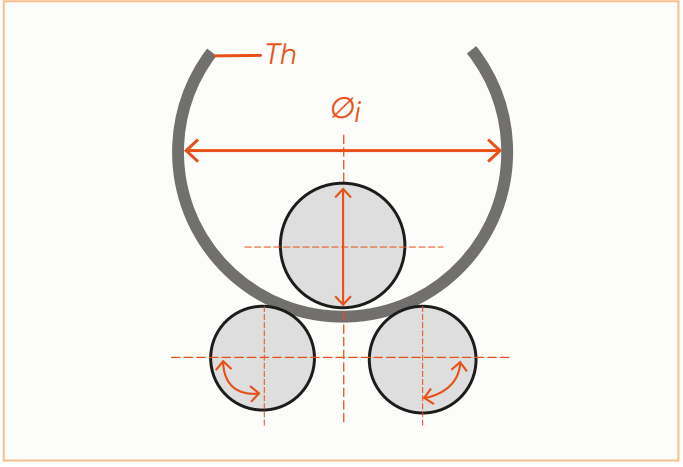
# Bending

Min internal bending radius
th=thickness

| | |
|---|---|
| ⊥ to rolling direction | ri ≥ 3 th |
| // to rolling | ri ≥ 4 th |
| Die opening V (mini) | V ≥ 12 th |

**The bending force** depends on UTS plate thickness, bended length and die opening V.
Indicative values, for die opening V = 12th (V bending)

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




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

Example: for ri / 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:**

Øi ≥ 30 th plate temperature > 10°C (50°F). The force required to roll a plate will be about double that of a S355 type steel.

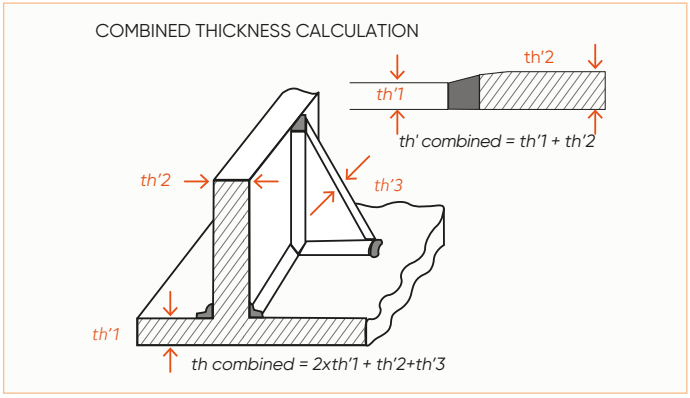
**Creusabro® 4800** can be hot formed at a temperature of 450 - 500°C (840 - 930°F) without any further heat treatment. At this temperature the force necessary to deform the plate will be lower than at room temperature, and the deformation capability of the steel will be higher (smaller forming radius).
It is possible to hot form a Creusabro® 4800 plate of thickness ≤ 20 mm (.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** (ISO/TR 15608 class 3.3) 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 products can be used.

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

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... As best practice, we recommend a minimum preheat of 120°C (250°F) to ensure the joint is dry. Electrodes and flux shall be stoved according to supplier recommendations. Following preheating conditions can be used when welding in a dry controlled environment and provided the weld joint is not subject to excessive stress.




| Heat input ( kJ/cm) | Combined thickness mm (inch) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 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 pre - heating
Pre - postheating at 75°C (167°F)
Pre - postheating at 125°C (257°F)



## Applications

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



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*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 steels.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.Further information may be obtained from the address opposite.*