ABRASERVICE
UK

CREUSABRO® DUAL®

HIGH PERFORMANCE WEAR RESISTANCE STEEL

— **CREUSABRO® DUAL** is an advanced abrasion-resistant steel additionally alloyed with high titanium content (0.6 %). This innovative grade is mainly dedicated to severe sliding wear conditions in service for applications where conventional water quenched steels (500 HB, 550 HB), hardfacing plates or hard-casting parts are traditionally implemented.

— By analogy with **CREUSABRO® 8000®**, **CREUSABRO® DUAL** capitalizes upon innovative metallurgical concept, based on a specific chemical analysis. In addition, it is also produced by Oil Quenching, which reduces the level of the residual stresses that is encountered, within the plate after heat treatment, with more drastic quenching methods (water quenching).

— The outstanding extra wear resistance, severe abrasion combined with high impact cycle load, is mainly due to the contribution of the following hardening phenomena :

– an homogeneous precipitation of extra hard primary titanium carbides in the steel matrix leads to a significant improvement of the sliding wear resistance in extreme service conditions.

– a superficial hardening following a very efficient work hardening capability in service, governed by a metallurgic phenomenon called TRIP effect (Transformation Induced by Plasticity).

– in addition to a high stress grinding abrasion resistance, an ability of forming also remains within reasonable limits and allows the processing of curved parts (Fig 1, fig 2 : **CREUSABRO® DUAL**, 2000x300x10mm, Rint=1000mm)

— No other competitor offers wear resistant steel at this level of hardness 500HB, with such high abrasion resistance combined with high resistance to cracking in service!

Chemical composition

C	Mn	Ni	Cr	Mo	S	Ti
≤ 0.40	≤ 1.30	~ 0.45	≤ 0.70	≤ 0.340	≤ 0.002	≤ 0.60

Mechanical properties in delivery condition (indicative values)

Hardness (HB)	UTS (MPa)	YS (MPa)	E (%)	KCVL - 20 °C (J/cm²)	Elasticity modulus (GPa)
480	1200	1630	10	168	205

— **Hardness:**
450-520 HB (at delivery condition).

Physical properties in delivery condition (indicative values)

20/100 °C (68/212 °F)	20/200 °C (68/392 °F)	20/300 °C (68/572 °F)	20/400 °C (68/732 °F)	20/500 °C (68/932 °F)
11.2	12.0	12.5	13.2	13.8

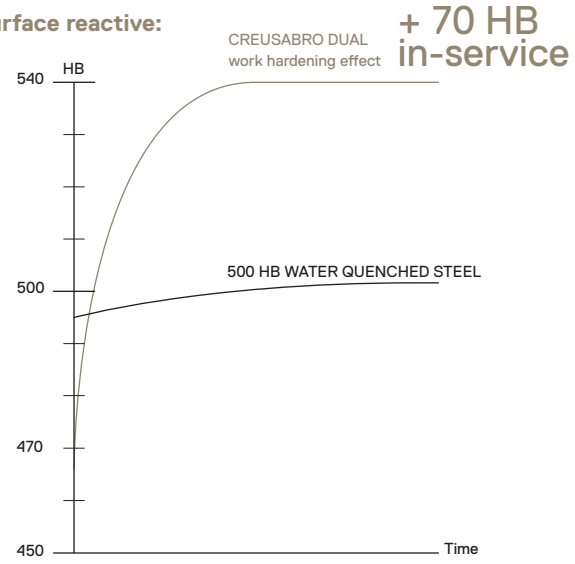
Metallurgical concept

— Wear resistance depends not only on the hardness of the steel at delivered state, but also on the other properties, such as crack resistance, work hardening effect, 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® DUAL**, 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® DUAL** 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.

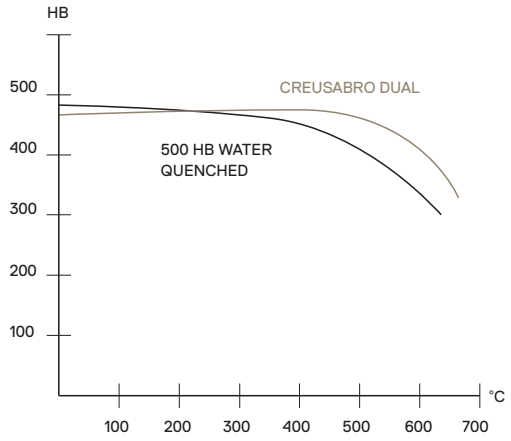
– **Titanium carbides**
The extreme abrasion resistance versus the conventional wear resistant steels (500 HB, 550 HB...) is gained by the presence of the primary titanium carbides which are precipitated during the first stage of the solidification (already presence within the semi-products, slab or ingot, before rolling and heat treatment). These titanium carbides exhibit an average hardness of 3000 HV (Vickers hardness) and therefore create numerous hard spots in the steel matrix like crushed gravels in concrete.

— **Surface reactive:**



Properties at high temperature

— Chemical composition of **CREUSABRO® DUAL**, and specially chromium, molybdenum and huge titanium contents, confer a high softening resistance to the material. Such a quality allows using **CREUSABRO® DUAL** 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).



Service life

Whatever service conditions are, the original metallurgical concept of **CREUSABRO® DUAL** confers to the material an improvement of its performances in terms of wear resistance and process ability, 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.

Processing informations

— 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).

— Forming and Machining:

Refer to the **CREUSABRO® DUAL** guideline.

— Welding:

CREUSABRO® DUAL can be welded with all classical processes : manual (SMAW), semi-automatic under gas protection (GMAW), automatic under flux (FCAW). Welded areas shall be clean, free of grease, water, oxides... Electrodes and flux shall be dried according to supplier's recommendations. For welds without preheating, an austenitic welding wire shall be used. Following welding conditons have been used in our weld tests).

	Solid Wire	Gas
Trademark	LNM 307	ATAL 5A
Standard name	ER307 / G18-8-Mn	M21
Supplier	Lincoln	Air Liquide
Diameter / Composition	Ø 1.2 mm	82% Ar+18% CO_2
Automatic / Manual	automatic	
Welding position	PB	
Heat input (Kj / cm)	12-26	
Voltage (V)	26-28	
Amperage (A)	220-270	
Travel speed (cm / min)	25-35	
Polarity	DC+	
Wire feed rate (m / min)	10-12	
Gas flow rate (l / mm)	18-24	
Stick-out (mm)	10-20	
Preheating (°C)	20 °C	
Interpass temp. (°C)	40 °C	

— If you are using a ferritic welding product, preheating is strongly recommended in order to avoid cold cracking defects... Following welding conditions have been used in our weld tests:

	Solid Wire	Gas
Trademark	Nertalic 70A	ARCAL 12
Standard name	A5.18 / G3Si1	M21
Supplier	SAF	Air Liquide
Diameter / Composition	Ø 1.2 mm	98% Ar+2% CO_2
Automatic / Manual	automatic	
Welding position	PB	
Heat input (Kj / cm)	12-18	
Voltage (V)	26-28	
Amperage (A)	220-270	
Travel speed (cm / min)	25-30	
Polarity	DC+	
Wire feed rate (m / min)	7.5	
Gas flow rate (l / mm)	18-24	
Stick-out (mm)	10-20	
Preheating (°C)	160 °C	
Interpass temp. (°C)	180 °C	

Applications

The properties of **CREUSABRO® DUAL** clearly indicate that this steel has many potential applications where an extreme abrasion resistance combined with high resistance to cracking is required in service, such as:

- 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
- Deflectors
- Grinder liners (SAG Mill)
- Demolition tools (recycling)
- Pipes for dredging
- Blade liners for heavy duty fans...
- Hopper liners

In general, for complex applications where the wear phenomenon is combined with high temperature or corrosion, the service conditions should be carefully investigated in order to provide adequate solution...

Dimensional programme

Sizes (mm (inch))	Thickness (mm (inch))
2000 x 6000 (78.740 x 236.220)	6-50 (0.236-1.968)
2500 x 8000 98.425 x 314.960)	6-50 (0.236-1.968)

Indicative dimensional programme, others dimensions available on request.

Contact

A. Arley Road, Saltley, Birmingham B8 1BB, United Kingdom
T. +44 121 326 3100
F. +44 121 326 3105
E. a.uk@abraservice.com
W. www.abraservice.com/uk/