



Creusabro® M

a wear resistant steel with high Manganese content

Creusabro® M is a high Manganese, fully austenitic, quench annealed, non magnetic, work-hardening steel with an exceptionally high level of wear resistance when subjected to work-hardening by shock or high impact pressure in service.

The main characteristics is a superior wear resistance : Severe wear on the surface has a work-hardening effect on the austenitic structure of this steel. This, when combined with the level of carbon in accordance with the international standards, leads to an increase in hardness from 200BHN (in as delivered plates) up to an in-service hardness of at least 600BHN.

This work-hardening capability renews itself through out in-service life. The underlayers not work-hardened maintain an excellent resistance to shock and a very high ductility

Standards

EURONORM 1.3401 – X120Mn13
AFNOR X120Mn13

DIN W1.3401
ASTM A 128 Gr B2

Chemical analysis - Weight %

C	Si	Mn	S	P
1.13	.40	13	.003	≤ .020

Typical values

Mechanical properties

	Hardness HB	Y.S. MPa	UTS MPa	El%	KCV 20 °C (68 °F) - J
Typical values	220	380 (55 KSI)	940 (136 KSI)	40	≥ 112 J (≥ 83 ft.lbs)
Guaranteed values*	180/245	350 (51 KSI)	800 (116 KSI)	30	64 J (47 ft.lbs)

* after water quenching 980 °C (1800 °F)

Physical properties

Metric	Density *	Expansion Coeff. O-600°C	Specific heat	Electrical * resistivity	Thermal * conductivity	Magnetic * permability
	7.88	10 ⁻⁶ °C ⁻¹	J/Kg.°C	μΩ.m	W/m.°C	≈ 1.002
		21.5	502	75	13	
US		10 ⁻⁶ °F ⁻¹	BTU/lb°F	μΩ.m	BTU/hr.ft°F	
		11.9	.12	75	7.3	

* Physical characteristics at 20°C (68°F)

Processing

The majority of normal processing can be performed on Creusabro® M plates. However, due to its particular properties (aptitude to work-hardening, high coefficient of expansion, low thermal conductivity) specific precautions have to be taken, especially for the machining and the welding operations.

Cutting

① Thermal cutting

The aspect after cutting can be improved through :

- an increase of the heating power of the flame.
- a speed reduction of nozzle displacement of about 30% as compared to the parameters adapted to classical low alloyed steels.

The thermal cutting by plasma or laser is particularly adapted to Creusabro M. When possible, we do advise selection of these processes which produce cuts of the greatest precision.

② Mechanical cutting

Guillotine cutting can be easily achieved with sufficiently powerful machines and freshly sharpened blades. When crossed cutting are necessary, intermediate local grinding is required on edge.

Machining

Classical methods are satisfactory as long as inter-pass depth is deeper than the work hardened zone of the preceding pass. Therefore sufficiently powerful equipment, without excessive play is required.

① Drilling

Drilling should be executed with bit in supercarburized Cobalt high speed steel type HSSCO (e.g. AISI grade M42) :

- reinforced shape
- long twist
- point angle at 130°

Dry drilling leads to good results. The depth of the hole to be drilled, should not exceed 3 times the bit diameter.

Drilling operation must be performed continuously, without any stop.

Typical cutting characteristics

	Ø drill < 10 mm	Ø drill ≥ 20 mm
Cutting speed m/min (")	2 to 3 mm 80 to 120"/min	2 to 3 mm 80 to 120"/min
Rotation speed rev/min	70	35
Feed (mm/rev)	0.08	0.15

Other possible solutions : drilling with bits at 3 lips with carbide-tipped or drilling with bits for concrete when small series or hot drilling are considered.

② Milling

Milling with tools in supercarburized Cobalt type HSSCO is possible (e.g. AISI grade M42) but tools with carbide tip (e.g. ISO type P25) are recommended whenever possible.

With these tools, the recommended parameter are :

- cutting-speed : 50 m/min (160ft/min)
- feed : 0.2mm/tooth for example (0.008"/tooth)

③ Punching

Punching can be achieved with sufficiently powerful equipment. But the operation should be kept as regular as possible.

Forming

Forming with Creusabro® M is very easy at room temperature. $R = 2 \times e$

Pre-heating is not necessary.

Hardened edges resulting from previous mechanical shearing should be grinded before forming. Also a light bevelling of edges should be made. Forming has to be performed slowly.

Necessary folding force (P) has to be $P = 760 \times \frac{w \times th^2}{1000 \times L}$ typically

Width = w ; th = thickness ; L = die opening

Hot forming

The minimum temperature for hot forming must be greater than 850°C (1560°F).

Pieces must be water quenched immediately. If the temperature is lower than 850°C (1560°F), it is necessary to reheat at a temperature higher than 980°C (1800°F) before quenching.

Welding

Creusabro® M should be welded with some precautions related to its specific properties. Because of its high coefficient of expansion and low thermal conductivity, the steel is sensitive to thermal distortions and local excessive heating. Consider also that long stages at temperatures higher than 300°C (570°F) induce carbide precipitations which strongly decrease toughness and non-magnetism property.

All standard welding procedures can be used.

General recommendations :

Welding is performed with low heat-input - $E < 20 \text{KJ/cm}$, interpass temperature limited to about 100°C (210°F) - with water cooling between each pass if necessary. Distortions should be hammered between passes if necessary.

NB : NEVER PREHEAT

Weld metal

Heterogeneous welds (main practice) :

- For manual arc welding :
 - weld deposit design 18Cr8Ni6Mn per AWS A5.4.E307
 - weld deposit design 20Cr10Ni3Mo per AWS A5.4.E308Mo
- For semi-automatic welding under gas the same type of deposit is used in :
 - solid wire - class A 5.2. ER 307 or A 5.9. ER 308 Mo per AWS
 - flux cored wire - Class A 5.22E 307 T or A5.22E 308 Mo T per AWS

Example of products

Coated electrode for manual welding	Wire for gas metal arc welding (GMAW) or flux-cored
<ul style="list-style-type: none"> . Lincoln Jungo 309 . Lincoln Arosta 309 Mo . Böhler Fox A7 . Saf Safinox B Blindage 	<ul style="list-style-type: none"> . Lincoln LMN 307 . Saf Nertalic 51 . Oerlikon Fluxinox 307L or 309 MoL

Homogeneous welds (work-hardenable deposit) :

- For manual arc welding, typical deposit 13Mn3NiMo Class A5.13 E FeMn per AWS
- For semi-automatic welding, with or without protective gas, use to flux cored wire of similar composition.

Example of products

Coated electrode for manual welding	Flux core wire for semi-automatic welding
<ul style="list-style-type: none"> . Oerlikon Cito Mangan . Saf Safmanga . Lincoln Mangrod . Stulz Manganese - XL 	<ul style="list-style-type: none"> . Böhler BM-FD

Summarized welding products

Welding type		Heterogeneous welds	Homogeneous welds
Semi automatic	Manual (main practice)	A5.4 E307 or A5.4 E308Mo	A5.13 EFeMn
	Solid wire	A5.2 ER307 or A5.9 ER308Mo	
	Flux core wires	A5.22 E307 T or A5.22 E308Mo T	A5.13 EFeMn

Applications

- *Quarries, Construction - Earth Moving*
 - . Crusher jaw, grizzly, screen, stone chute...
 - . Chain guide plate, spreader plate, shovel bucket,...

- *Mines, Coal mines*
 - . Bucket blade of loader (→ underground mining), parts of chain-conveyor, sprocket-wheel, various armoring elements,...

- *Cement plants*
 - . Chain extractor,...

- *Iron industry, Foundry*
 - . guiding and shifting plate, scraps container, biner of shot blasting unit, pedestal liner, flanged bolster cup wear liner,...

- *Parpen concrete factories, brickworks*
 - . Core and dividing wall of parpen mould, grinding mill scraper, mixer paddle, shake-out table,...

- *Scraps-recoveries*
 - . Wheel disk, striker and hammer mill...

- *Automotive industries*
 - . Shot-blasting equipment...

It is also used for :

- its low coefficient of friction in metal-to-metal applications,
- its non-magnetic properties in electrical transformer assemblies and for industrial lifting magnets.

For any information

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Sizes

Products and thicknesses (mm)	Sizes (mm) and (") - Width and Length				
	w = 1500 -	w = 1500 L = 3000	w = 2000 L = 6000	w = 2500 L = 6000	w = 2500 L = 8000
(")	w = 59 -	w = 59 L = 118	w = 78.7 L = 236.2	w = 98.4 L = 236.2	w = 98.4 L = 315
Coils .157 to .196					
Plates .196 to 4.72					

Nota

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.

The grade has been developed specifically for its abrasion resistance. Customer's usage 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.