A.J. Marshall
Abrasion Resistant, High Strength, COR-TEN ® & Manganese Steel Plates

technical data

12/14% Manganese/Creusabro® M

Wear Resistant Steel with High Manganese Content

Creusabro® M is 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 are 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 throughout in-service life. The under layers not work-hardened maintain an excellent resistance to shock and a very high ductility.

Typical Applications:

- Quarries and Construction: Earth moving crusher jaw, grizzly, screen, stone chute, chain guide and spreader plates, shovel buckets.
- Mines, Coal mines: Bucket blade of loader (underground mining), parts of chain conveyor, sprocket wheel, various armouring elements.
- Iron industry, Foundry: Guiding and shifting plates, scraps container, liner of shot blasting unit, pedestal liner, flanged bolster cup, wear liners.
- Parpen concrete factories, Brickworks: Core and dividing wall of parpen mould, grinding mill scraper, mixer paddle, shake-out table etc.
- 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.

Standards:

EURONORM	**1.3401 – X120Mn13**	**DIN**	**W1.3401**
AFNOR	**X120Mn13**	**ASTM**	**A128 Gr B2**

Chemical Analysis - Weight % Typical values

C	Si	Mn	S	P
1.13	0.40	13	0.003	≤0.020

Mechanical Properties – Typical values

	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)

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Physical Properties

	Density *	Expansion Coeff. 0-600°C	Specific Heat	Electrical * Resistivity	Thermal * Conductivity	Magnetic * Permability
Metric	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

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.

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.

Drilling:

Drilling should be executed with bit in super carburized 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 < 10mm	ø Drill ≥ 20mm
Cutting Speed m/min (“)	2 to 3mm 80 to 120”/min	2 to 3mm 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 is considered.

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Milling:

Milling with tools in super carburized 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 is:

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

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 x 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 $P = 760 \times w \times th^2/1000 \times L$ 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< 20KJ/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 AWSA5.4E308Mo

For semi-automatic welding under gas the same type of deposit is used in:
- Solid wire - class A5.2 ER 307 or A5.9 ER 308 Mo per AWS
- Flux cored wire - class A5.22E 307 T or A5.22E 308 Mo T per AWS

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.

Full specification and details are available on request.
The above information is provided for guidance purposes only.
For specific design requirements please contact our technical sales staff.

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