Astralloy
a NUCOR company

Rol-Man®

Wear Resistant Steel with High Manganese Content

Chemical Composition* – % Weight				
C	Mn	P	S	Si
1.0 – 1.4	11 – 14	≤ .06	.01 – .03	.1 – .3

Physical Properties – Typical Values at 68° F				
Hardness Furnished	Work Hardened	Tensile Strength	Yield Strength	Elongation in 2”
220 BHN	600 BHN	136 ksi	55 ksi	40 %

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

The main characteristic of our Rol-Man product is its superior wear resistance. Severe wear on the surface has a work-hardening effect on the austenitic structure of this steel. This leads to an increase in hardness from 200 BHN (in as delivered plates) up to an in-service hardness of at least 600 BHN.

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

Note: The data contained in this document is accurate at time of printing, and intended for use as a general guide.
*Typical average values. Chemical composition may vary by thickness. Mill certifications are available upon request.

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PROCESSING

The majority of normal processing can be performed on Rol-Man plates. However, due to its 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 post-cutting aspect 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 alloy steels

The thermal cutting by plasma or laser is recommended for Rol-Man. When possible, we suggest selecting a process which will generate cuts with the greatest precision.

Mechanical cutting

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

MACHINING

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

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 three times the bit diameter. The drilling operation must be continuous.

Below are typical cutting characteristics for Rol-Man:

	Cutting Speed (m/min)	Rotation Speed (rev/min)	Feed (mm/rev)
Ø drill < 10 mm	2 – 3 mm	70	0.08
Ø drill ≥ 20 mm	2 – 3 mm	35	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.

Milling

Although milling with tools in supercarburized Cobalt type HSSCO is possible, (e.g. AISI grade M42) tools with carbide tip (e.g. ISO type P25) are recommended.

With these tools, the recommended parameters are:

* 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 Rol-Man is very easy at room temperature and pre-heating is not necessary.

$R = 2 \times e$

Hardened edges resulting from previous mechanical shearing should be ground before forming. Also, edges should be slightly beveled. Forming has to be performed slowly.

Necessary folding force (P) has to be

$$P = 760 \times \frac{w \times th^2}{1000 \times L}$$

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 immediately water quenched. 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.

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WELDING

Due to Rol-Man's high coefficient of expansion and low thermal conductivity, the steel is sensitive to thermal distorsions and local excessive heating, and should be welded with caution. Long intervals at temperatures higher than 300°C (570°F) induce carbide precipitations which stronghly decrease toughness and non-magnetism property. All standard welding procedures may 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.

Distorsions should be hammered between passes if, necessary.

Note: 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 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
* Lincoln Jungo 309	* Lincoln LMN 307
* Lincoln Arosta 309 Mo	* Saf Nertalic 51
* Böhler Fox A7	* Oerlikon Fluxinox 307L or 309 MoL
* Saf Safinox B Blindage	

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 flux cored wire of similar composition.

Example of products:

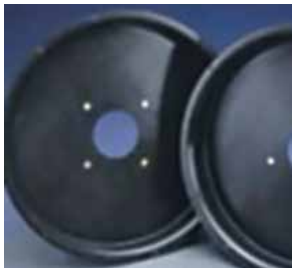
Coated Electrode for Manual Welding	Flux Core Wire for Semi-Automatic Welding
* Oerlikon Cito Mangan	* Böhler BM-FD
* Saf Safmanga	
* Lincoln Mangrod	
* Stulz Manganese - XL	

Welding products:

Weld Type		Heterogeneous welds	Homogeneous welds
Manual (main practice)		A5.4 E307 or A5.4 E308Mo	A5.13 EFeMn
Semi-automatic	Solid Wire	A5.2 ER307 or A5.9 ER308Mo	
	Flux Core Wire	A5.22 E307 T or A5.22 E308Mo T	A5.13 EFeMn







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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 armouring 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

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