

# ACCIAIERIE VALBRUNA



*Magival*





**MAGIVAL** is a range of ferritic stainless steels, with a high degree of machinability, developed for magnetic applications where there are requirements for:

- high magnetic permeability
- low coercive force.

It is wholly produced by Valbruna in Vicenza - Italy; from melting to cold working. Carefully controlled chemical analyses and sophisticated working processes create a ferritic structure which is highly sensitive to variations in a magnetic field. This

avoids the need for expensive heat treatment by the user after machining. Due to its extreme ease of magnetization and demagnetization, the **MAGIVAL** steels can be used to advantage in the manufacture of:

- magnetic cores
- solenoid valves
- electromagnetic devices
- flow regulators
- relays.



Valbruna hot rolling mill

Very often, knowing the value of the coercive force,  $H_c$ , is not sufficient to complete a design involving the use of soft ferromagnetic material. The determination of its hysteresis loop and normal magnetisation curve gives a complete evaluation of the magnetic properties of the steel to be used in the manufacture of cores for solenoid valves or magnetic devices.

In Valbruna's laboratories the magnetic properties of ferritic stainless steel are determined by a **permeameter** and a **coercimeter**.

#### *The permeameter*

Carries out hysteresis loops and measurements of normal magnetization on soft magnetic steels. With the aid of a SANFORD-BENNET yoke, measurements can be taken on bar or samples of round, square, flat, hexagonal or polygonal section. The unit is completely automatic: checks on the parameters  $B_r$ ,  $H_c$ ,  $B_{sat}$ ,  $H_{sat}$ ,  $J_{sat}$ ,  $\mu_{max}$  and the processing of the data are carried out through a dedicated software.

#### *The coercimeter*

This is an automatic precision apparatus which enables the coercive force to be measured on samples of steel of any form and also on machined parts or components assembled with other materials.



Permeameter and coercimeter





## MG 1

**Standards of reference:** AFNOR Z 8 CF 17  
ASTM A 838 ALLOY 1  
ASTM A 582 430 F  
DIN 17440 W.-Nr. 1.4105

**Chemical analysis:**

C	Si	Mn	Cr	Mo	P	S
0,03	0,50	0,60	17,50	0,30	0,025	0,30

**D.C. magnetic properties\*\*:**

$J_{sat}$ :	$\approx 1,60$ T		
$\mu_{max}$ :	$\geq 1000$	(< Ø 16 mm)	
	$\geq 700$	(≥ Ø 16 mm)	
$B_R^*$ :	$\leq 0,8$ T		( $B_R^* \leq 80\,000$ gauss)
$H_c^*$ :	$\leq 240$ A/m	(< Ø 16 mm)	( $H_c^* \leq 3$ Oe)
	$\leq 320$ A/m	(≥ Ø 16 mm)	( $H_c^* \leq 4$ Oe)

\* From 1 T (10<sup>4</sup> gauss)

**Physical properties:**

Density:	7,62 Kg/dm <sup>3</sup>
Electrical resistivity:	600 μΩmm
Mean coefficient of thermal expansion:	11,9 (10 <sup>-6</sup> • k <sup>-1</sup> )
Modulus of elasticity:	200 (KN/mm <sup>2</sup> )
Curie temperature :	$\approx 670$ C°

Hardness:  $H_{RB} = 75 \div 85$

**Heat treatment and finishing:** annealed and centreless ground

The best-known type, finding wide use in the automobile industries and for household electrical apparatus and appliances.

## MG 2

**Standards of reference:** ASTM A 838 ALLOY 2

**Chemical analysis:**

C	Si	Mn	Cr	Mo	P	S
0,03	1,30	0,60	17,50	0,25	0,025	0,30

**D.C. magnetic properties\*\*:**

$J_{sat}$ :	$\approx 1,60$ T		
$\mu_{max}$ :	$\geq 1200$	(< Ø 16 mm)	
	$\geq 800$	(≥ Ø 16 mm)	
$B_R^*$ :	$\leq 0,8$ T		( $B_R^* \leq 80\,000$ gauss)
$H_c^*$ :	$\leq 200$ A/m	(< Ø 16 mm)	( $H_c^* \leq 2,5$ Oe)
	$\leq 320$ A/m	(≥ Ø 16 mm)	( $H_c^* \leq 4$ Oe)

\* From 1 T (10<sup>4</sup> gauss)

**Physical properties:**

Density:	7,59 Kg/dm <sup>3</sup>
Electrical resistivity:	760 μΩmm
Mean coefficient of thermal expansion:	11,9 (10 <sup>-6</sup> • k <sup>-1</sup> )
Modulus of elasticity:	200 (KN/mm <sup>2</sup> )
Curie temperature :	$\approx 660$ C°

Hardness:  $H_{RB} = 80 \div 90$

**Heat treatment and finishing:** annealed and centreless ground

Used in components of magnetic devices where high values of magnetic permeability and low values of coercive force are required.

\*\* Other characteristics can be agreed at the enquiry stage.

## Profiles and finishes

• **Magival profiles:**

Round	Square	Hexagon	Flat	Square-billet	Profile

• **Magival finishes:**

hot rolled, pickled or sand-blasted; drawn; peeled and reeled; centreless ground.

### Heat treatment on finished parts

All kinds of machining alter to some extent the magnetic properties of the material. Magival in annealed and centreless ground condition has been studied and produced to guarantee the best magnetic properties to the finished part without any final heat treatment. In case of MAGIVAL supplied in hot rolled and descaled, peeled and reeled or drawn conditions the finished parts may require a special annealing treatment after the final machining to achieve the appropriate magnetic properties.





## MG 3

**Standards of reference:** AFNOR Z 8 CDF 19 02  
ASTM A 582 XM 34

**Chemical analysis:**

C	Si	Mn	Cr	Mo	P	S
0,03	0,80	0,60	18,00	1,60	0,025	0,30

**D.C. magnetic properties\*\*:**

$J_{sat}$ :	$\approx 1,60$ T		
$\mu_{max}$ :	$\geq 1000$	(< Ø 16 mm)	
	$\geq 700$	(≥ Ø 16 mm)	
$B_R^*$ :	$\leq 0,8$ T		( $B_R^* \leq 80\,000$ gauss)
$H_C^*$ :	$\leq 240$ A/m	(< Ø 16 mm)	( $H_C^* \leq 3$ Oe)
	$\leq 320$ A/m	(≥ Ø 16 mm)	( $H_C^* \leq 4$ Oe)

\* From 1 T ( $10^4$  gauss)

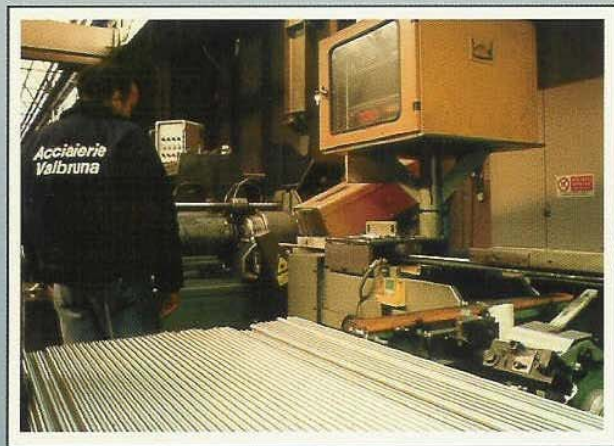
**Physical properties:**

Density:	7,80 Kg/dm <sup>3</sup>
Electrical resistivity:	650 $\mu\Omega$ mm
Mean coefficient of thermal expansion:	12 ( $10^{-6} \cdot k^{-1}$ )
Modulus of elasticity:	225 (KN/mm <sup>2</sup> )
Curie temperature:	$\approx 670$ C°

Hardness:  $H_{RB} = 80 \div 90$

**Heat treatment and finishing:** annealed and centreless ground

Its field of application is as for MG 1, it is used where a greater resistance to corrosion is required, thanks to its molybdenum content.



Grinder

## MG 4

**Standards of reference:** Steel similar to  
ASTM 838 - ALLOY 2  
with Molybdenum 1,50  $\div$  2,20 %

**Chemical analysis:**

C	Si	Mn	Cr	Mo	P	S	N
0,02	1,30	0,60	18,00	1,60	0,025	0,30	0,02

**D.C. magnetic properties\*\*:**

$J_{sat}$ :	$\approx 1,60$ T		
$\mu_{max}$ :	$\geq 1200$	(< Ø 16 mm)	
	$\geq 800$	(≥ Ø 16 mm)	
$B_R^*$ :	$\leq 0,8$ T		( $B_R^* \leq 80\,000$ gauss)
$H_C^*$ :	$\leq 200$ A/m	(< Ø 16 mm)	( $H_C^* \leq 2,5$ Oe)
	$\leq 320$ A/m	(≥ Ø 16 mm)	( $H_C^* \leq 4$ Oe)

\* From 1 T ( $10^4$  gauss)

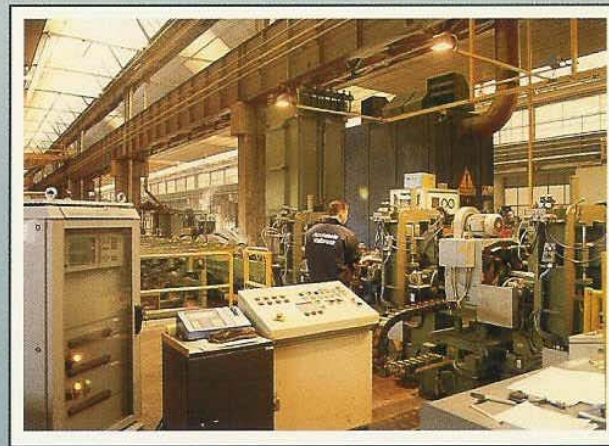
**Physical properties:**

Density:	7,78 Kg/dm <sup>3</sup>
Electrical resistivity:	760 $\mu\Omega$ mm
Mean coefficient of thermal expansion:	12 ( $10^{-6} \cdot k^{-1}$ )
Modulus of elasticity:	225 (KN/mm <sup>2</sup> )
Curie temperature :	$\approx 660$ C°

Hardness:  $H_{RB} = 80 \div 90$

**Heat treatment and finishing:** annealed and centreless ground

Its composition has been developed for applications requiring better magnetic characteristics and high corrosion resistance. These properties are obtained thanks to a low content of interstitial elements and a high molybdenum content.



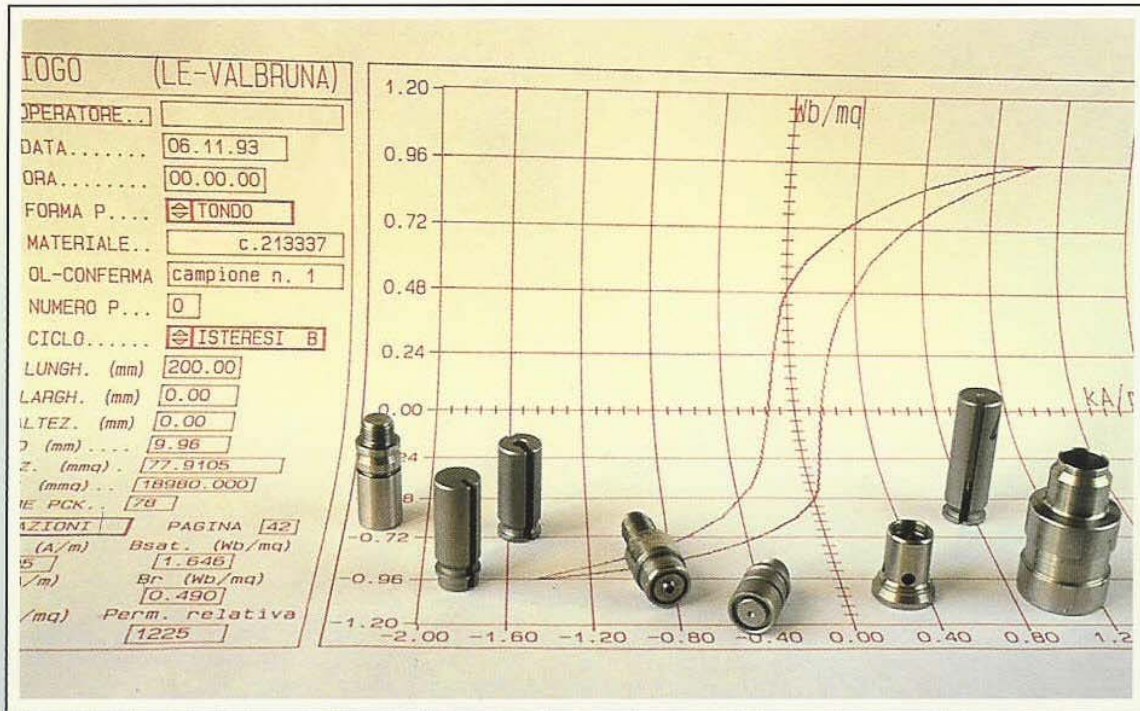
Non-destructive tests: eddy current and ultrasonic testing

**In addition, Valbruna produces:**

- any type of stainless steel with a ferritic structure for manufacture using soft magnetic material (e.g. AISI 430, W.-Nr. 1.4113, W.-Nr. 1.4510, W.-Nr. 1.4511, etc.)
- iron-silicon relay steels (ASTM A867).

The magnetic characteristics required can be agreed at the enquiry stage.





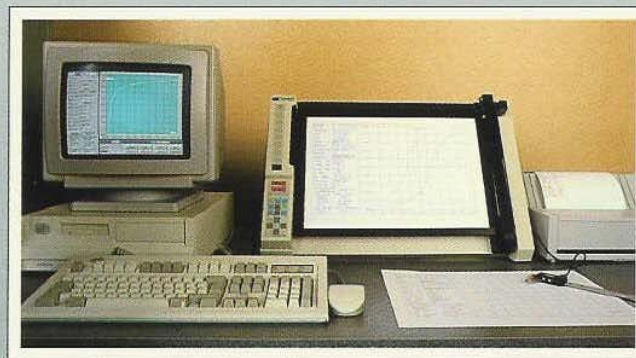
### Certification and approvals

All tests are carried out in accordance with the following standards:

- **Permeameter**
  - **ASTM 341** or **IEC 404-4** for straight length test specimens or bars
  - **ASTM 596** or **IEC 404-4** for toroidal test specimens
- **Coercimeter**
  - **ASTM 341** or **IEC 404-7**.

The steel is supplied accompanied by the following certificates:

- B and J normal magnetization curve
- Relative magnetic permeability curve
- Normal hysteresis loop
- Mechanical properties and/or hardness
- Non-destructive testing (eddy current and ultrasonic testing).



### Technical Assistance

The complete certification of mechanical and magnetic properties allows any type or kind of magnetic device to be designed. VALBRUNA's clients can take advantage of a free technical service which enables them to:

- establish the magnetic features of his product
- optimise the production processes
- evaluate the effect of any machining or other mechanical process on the magnetic properties
- select the heat treatment best suited to the product and evaluate its effect on the magnetic properties
- obtain advice and information regarding the production processes to be used
- request a call by a specialist at the Client's own offices.