ArcelorMittal USA

Plate

HP Magnet Plate Steel

Introduction

ArcelorMittal USA's HP (High Permeability) magnet plate steel has been developed to meet the special requirements of large fabricated DC magnets. This low carbon steel provides high density, low hysteresis loss and powerful induction properties and is available in plate thicknesses up to and including 16 inches. (Heavier gauges can be supplied by special arrangement with ArcelorMittal USA).

HP magnet plate steel is an ideal magnet steel because it is considered "soft" and thus easy to magnetize and demagnetize. It is also fully silicon killed. This means that silicon is used as a deoxidizing agent to reduce unwanted oxygen in the steel and thus minimize internal inclusions for a more homogeneous internal structure.

HP magnet steel can be furnished to an ultrasonic quality level equal to that defined by ASTM A435.

When more stringent internal soundness is required, this steel may be specified with Fineline® processing, a unique ArcelorMittal USA plate method of refining, which can reduce non-metallic inclusions even more than ArcelorMittal USA conventional processing. With Fineline, quality levels up to and including ASTM A578 Level C may be specified. In addition, special ultrasonic examination utilizing flat bottom hole calibration standards can be specified and may be applied to critical portions of the section thickness. This testing method uses 100% scan to the following criterion:

Plate Thickness Inches	1" to 4" Incl.	Over 4" To 8" Incl.	Over 8" To 12" Incl.	Over 12" To 16" Incl.
Flat Bottom Hole Diameter, in.	1/8	1/4	3/8	1/2

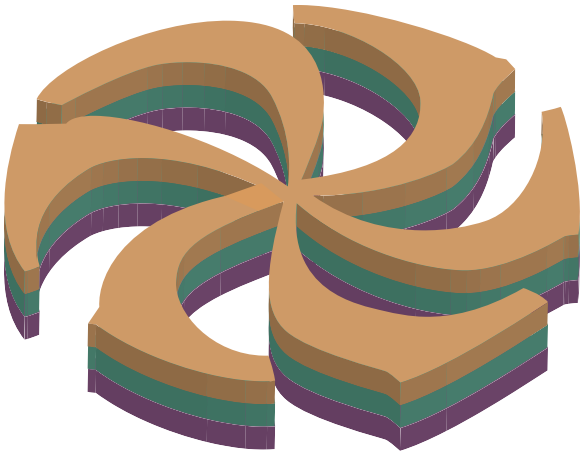
Applications

One of the most exciting and common uses of HP magnet steel is in the field of high-energy physics.

This area of science probes into the atomic nucleus of matter through the use of a particle-accelerator or atom-smashing facility. Among the vast and complex array of laboratory equipment in such facilities are massive plate steel cores in which powerful magnetic fields are induced to provide the switching, bending, pulsing and steering functions in manipulating electron and proton beams during experiments with nuclear particles.

In addition to its use in high-energy physics research, HP magnet steel is frequently specified for other applications where uniform magnetic qualities are required and have been specified in a number of Magnetic Resonance Imaging (MRI) units as well as for use in shielding for hospital MRI rooms.

In general, HP magnet steel is designed for use wherever high magnetic permeability or high saturation values are required. Its exceptional magnetic qualities result from careful control of sulfur and residual elements plus the special deoxidation practice which minimizes non-metallic inclusions.



HP Magnet Steel in the form of an 11-3/4 in. thick gascut components for a pole plate for the TRIUMF H- Cyclotron, the world's largest. Negatively charged particles circulate through the magnetic field from these six huge electromagnets and are accelerated through 1500 widening spiral turns to almost 75% of the speed of light.

Chemistry

Element	Composition %
Carbon (C)	0.08 Max.
Manganese (Mn)	0.25 - 0.45
Phosphorus (P)	0.025 Max.
Sulfur (S)	0.025 Max.
Silicon (Si)	0.50 Max.
Cu + Ni + Cr + Mo = 0.50 Max.	

HP magnet steel is fully killed.

Availability

HP magnet steel is furnished in thicknesses 1/4 in. to 16 in. inclusive. Heavier gauges can be supplied by special arrangement.

Heat Treatment

Optimum magnetic properties of HP magnet steel are obtained through a full-anneal heat treatment. This consists of heating to 1600 – 1700ºF, holding for a sufficient time to attain uniform temperature throughout the thickness, and then cooling slowly. An example of a specified heat treatment: hold 1 hour per inch of thickness at 1650ºF, cool at 50ºF max. per hour to 1000ºF, then air cool. Other applications, such as shielding, may not require annealing.

Mechanical Properties

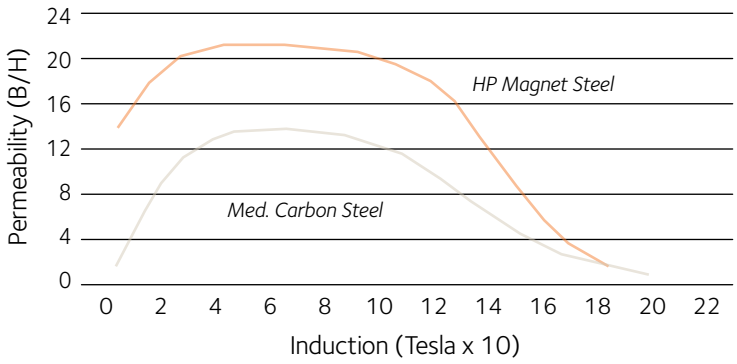
Normally, ArcelorMittal USA magnet steels are not supplied to mechanical property requirements. However, mechanical properties that have been obtained through testing are as follows:

Yield Strength, psi	25,000
Tensile Strength, psi	35,000
Elongation in 2 in.	30%

General Conditions for Delivery

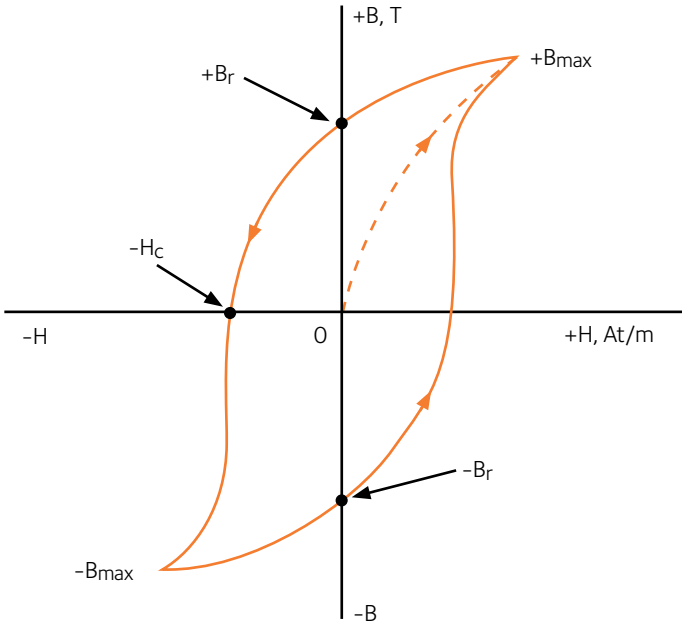
Material furnished under this specification shall conform to General Requirements for Delivery of Rolled Steel Plates for Structural Use (ASTM A6).

Comparison of the Relative Permeability of HP Magnet and Medium Carbon Steels



Note: the datum contained here are actual test values obtained by testing at ArcelorMittal USA and should not be considered minimum values offered or guaranteed. Magnetic properties should be considered to be characteristic for low-carbon steels. Actual testing is not normally performed.

Typical Hysteresis Loop for HP Magnet Steel



Fabrication

Fabrication procedures for HP magnet plate steel are similar to those used for ordinary carbon steels.

Shearing

Heavy-duty shearing equipment with sharp blades is suggested for cutting plates up to and including 1-1/2 inches thick.

Thermal Cutting

For thicknesses exceeding 1-1/2 inches, use of oxy-gas equipment is suggested. Preheating or postheating is not required.

ArcelorMittal USA has facilities for supplying gascut components up to and including 25 inches thick and has the capacity for machining components. Inquiries should be directed to the ArcelorMittal USA plate sales department at 610-383-3220.

Machining

Fabrication of magnet plate components frequently requires machining of all surfaces to close tolerances. Speeds and feeds should be elected in accordance with standard practices for machining low carbon steels.

Welding

ArcelorMittal USA HP magnet plate steel can be welded by any of the techniques regularly applied to low carbon steels. Should weld repairs be necessary on heavy thickness plates, mild steel electrodes conforming to E60XX or E7018 may be used. Repairs should be made prior to heat treatment to provide deposited welds with magnetic characteristics similar to the base or parent metal. In special cases, low hydrogen-coated ingot iron electrodes may be procured.

Further Information

For additional information on HP magnet steel for your particular application, contact the ArcelorMittal USA Plate Customer Technical Service Department (Ryan VanderMeulen) at: T +1 610 383 2705 or email: ryan.vandermeulen@arcelormittal.com

ArcelorMittal USA
Corporate Office
1 South Dearborn Street
18th Floor
Chicago, IL 60603-9888
USA

T +1 800 422 9422
www.arcelormittal.com

ArcelorMittal USA
Plate
ARC Building
139 Modena Road
Coatesville, PA 19320-0911
USA

T +1 800 966 5352
www.arcelormittal.com

ArcelorMittal USA
Plate
250 West U.S. Highway 12
Burns Harbor, IN 46304-9745
USA

T +1 800 422 9422
www.arcelormittal.com

December 2010