

Permanent Magnet Materials

Basic Technical Questions

What is a Permanent Magnet?

A permanent magnet is a material that continues to emit a magnetic field after the applied magnetising field has been removed. Also known as “hard” magnets, unlike the “soft” magnets produced by other companies within the MMG/TT electronics group. In this case “hard” or “soft” refer to the magnetic properties **not** their physical condition.

What types of material are there?

There are a great many different materials. These are the main commercial materials in order of power or strength:

ALNICO	AL uminium NI ckel and CO balt alloys.	<i>Medium cost</i>
Ferrite	Usually Strontium Ferrite but could be Barium Ferrite	<i>Lowest cost</i>
Samarium Cobalt	(SmCo) A first generation rare earth magnet	<i>Tends to be expensive</i>
Neodymium-Iron-Boron	(Neo or NdFeB) A second-generation rare earth magnet	<i>Between Alnico and SmCo in cost</i>

What is meant by Anisotropic and Isotropic magnets?

Anisotropic magnets have a magnetic axis determined at the pressing stage of manufacture. Once this has been carried out the axis cannot be changed. **Isotropic** magnets have no preferred axis and can be magnetised in any direction. (Isotropic magnets will always exhibit lower magnetic performance when compared to Anisotropic).

How is a Magnet's Magnetic Performance Measured?

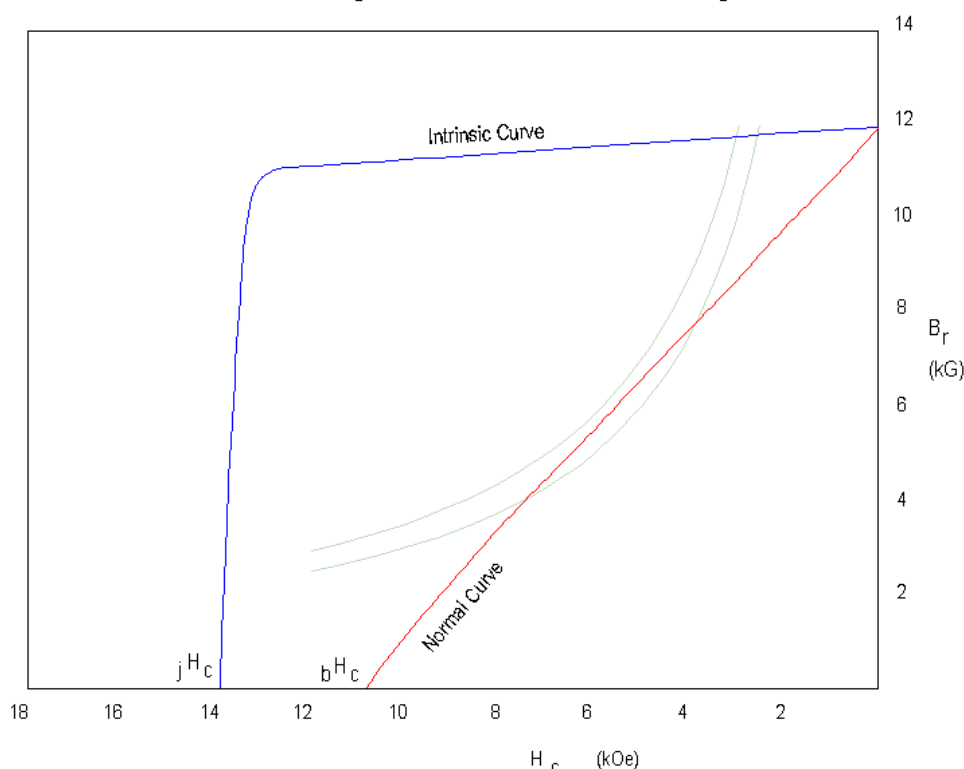
1) Flux or Gaussmeter

Using a Hall effect probe - a measurement of magnetic flux density in a given position. Suppliers or users do not usually quote this.

2) Demagnetisation Curve

This is the absolute performance of any magnetic material and will be found in all manufacturers data or in the MMPA or DIN standards.

Second Quadrant Demagnetisation Curve for NdFeB grade N33H.



The Main points are:

1) Remanence (Br)

This is measured in Gauss or Tesla – **In this case 12kG**

2) Coercivity (bHc – Normal Coercivity, jHc – Intrinsic Coercivity)

This is measured in Oersteds or kA/m²

In this case: **bHc = 10.8 kOe**
 jHc = 14 kOe

Normal coercivity is the applied field required to reduce the external field generated by the magnet to zero.

Intrinsic coercivity is the applied field required to fully demagnetise the material.

3) BHmax – Maximum energy stored within the magnet

This is measured in MGOe or kJ/m³

In this case 33MGO

A simple way to remember the Demag curve points

Think of it as a ski slope!

- The top of the hill is Remanence (Br)
- The bottom of the hill is Coercivity (bHc or jHc)
- Where the sharp drop starts is the BHmax.

Some Material Comparisons

MATERIAL	Br kG	BHc kOe	jHc kOe	BHmax MGOe	COMMENTS
ALNICO 5	12.6	0.65	0.63	5.4	
FERRITE C8	3.7	3.0	3.25	3.3	
SmCo 2:17	10.3	7.5	12.0	24	7 times stronger than Ferrite C8
NdFeB N35	12.1	11.4	12.0	35	Over 10 times stronger than Ferrite C8

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