Technical Data Sheet - Ferrite Magnets / Ceramic Magnets

Ferrite Magnets / Ceramic Magnets

Ferrite Magnets are also known as Ceramic Magnets, Ceramic Ferrite Magnets, Feroba Magnets and Hard Ferrite Magnets.
Ceramic Ferrite magnets are one of the most widely used permanent magnet materials in the world.
Ferrite magnets are a low cost magnet material perfectly suited for higher volume production runs.

They are termed ceramic due to their excellent electrical insulation ability.
Ferrite magnets are superb in damp, wet or marine environments – Ferrite magnets are corrosion free.
Because the iron is already in a stable oxidized form in its structure, the iron cannot oxidize ("rust") any further when in water.

Strontium Ferrite (SrO.6Fe2O3) magnets and Barium Ferrite (BaO.6Fe2O3) magnets are the two types of ceramic Ferrite magnet.
The Strontium Ferrite magnets are the most commonly manufactured due to having stronger magnetic properties.

The Ferrite magnets (Ceramic magnets) have a characteristic "pencil lead" colour (i.e. a dark grey colour).

They are ferrimagnetic in magnetic performance (good magnetic field and power but, size for size, not as powerful as NdFeB or SmCo).
Ferrite Magnets are extremely popular in motor, generator, loudspeaker and marine designs but are found in almost all industries.
e.g. Automotive, Sensor, Machines, Aerospace, Military, Advertising, Electrical/Electronic, Academic, Design House, and R&D.

Ferrite magnets can be used at temperatures up to a maximum of +250 degrees C (in a few situations perhaps up to +300 degrees C).

There are presently 27 grades of Ferrite Magnet available.
The two main grades used today are C5 (also known as Feroba2, Fer2, Y30 and HF26/18) and C8 (also known as Feroba3, Fer3 and Y30H-1).
C5 / Y30 is a general choice of Ferrite Magnet for applications such as overband magnets.
C8 / Y30H-1 is a better choice for applications such as loudspeakers and sometimes also motors (C8 has a similar Br to C5 but has a higher Hc and Hci).

Ferrite magnets can be produced in many shapes and sizes. Machining to size is limited to grinding processes - the electrically insulating Ferrite material does not allow wire spark erosion.
As such, the main shapes are blocks, discs, rings, arcs, and rods. Other shapes and custom sizes may well be possible but tooling charges may apply.

NOTE:- Ferrite magnets are not the same as soft ferrites (as used in transformers) - they are totally different in operation.
"Transformer" ferrites do not retain magnetism (soft ferrite). Ferrite magnets are permanent magnets - they retain their magnetism (hard ferrite).

Chinese Standard - increasingly popular in UK, EU and globally

Typical Values

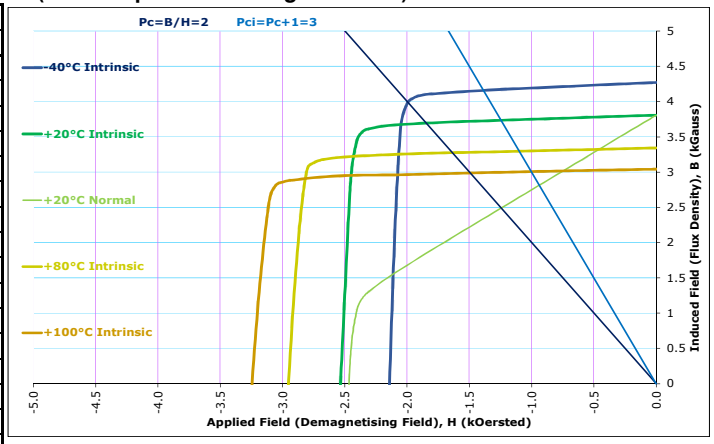
Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	mT	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
Y8T	200-235	2.0-2.35	125-160	1.57-2.01	210-280	2.64-3.52	6.5-9.5	0.8-1.2
Y10T	200-235	2.0-2.35	128-160	1.61-2.01	210-280	2.64-3.52	6.4-9.6	0.8-1.2
Y20	320-380	3.2-3.8	135-190	1.70-2.39	140-195	1.76-2.45	18.0-22.0	2.3-2.8
Y22H	310-360	3.1-3.6	220-250	2.76-3.14	280-320	3.52-4.02	20.0-24.0	2.5-3.0
Y23	320-370	3.2-3.7	170-190	2.14-2.39	190-230	2.39-2.89	20.0-25.5	2.5-3.2
Y25	360-400	3.6-4.0	135-170	1.70-2.14	140-200	1.76-2.51	22.5-28.0	2.8-3.5
Y26H	360-390	3.6-3.9	220-250	2.76-3.14	225-255	2.83-3.20	23.0-28.0	2.9-3.5
Y26H-1	360-390	3.6-3.9	200-250	2.51-3.14	225-255	2.83-3.20	23.0-28.0	2.9-3.5
Y26H-2	360-380	3.6-3.8	263-288	3.30-3.62	318-350	4.00-4.40	24.0-28.0	3.0-3.5
Y27H	370-400	3.7-4.0	205-250	2.58-3.14	210-255	2.64-3.20	25.0-29.0	3.1-3.6
Y28	370-400	3.7-4.0	175-210	2.20-2.64	180-220	2.26-2.76	26.0-30.0	3.3-3.8
Y28H-1	380-400	3.8-4.0	240-260	3.02-3.27	250-280	3.14-3.52	27.0-30.0	3.4-3.8
Y28H-2	360-380	3.3-3.8	271-295	3.41-3.71	382-405	4.80-5.09	26.0-30.0	3.3-3.8
Y30	370-400	3.7-4.0	175-210	2.20-2.64	180-220	2.26-2.76	26.0-30.0	3.3-3.8
Y30BH	380-390	3.8-3.9	223-235	2.80-2.95	231-245	2.90-3.08	27.0-30.0	3.4-3.8
Y30H-1	380-400	3.8-4.0	230-275	2.89-3.46	235-290	2.95-3.64	27.0-32.0	3.4-4.0
Y30H-2	395-415	3.95-4.15	275-300	3.46-3.77	310-335	3.90-4.21	27.0-32.5	3.4-4.1
Y32	400-420	4.0-4.2	160-190	2.01-2.39	165-195	2.07-2.45	30.0-33.5	3.8-4.2
Y32H-1	400-420	4.0-4.2	190-230	2.39-2.89	230-250	2.89-3.14	31.5-35.0	4.0-4.4
Y32H-2	400-440	4.0-4.4	224-240	2.81-3.02	230-250	2.89-3.14	31.0-34.0	3.9-4.3
Y33	410-430	4.1-4.3	220-250	2.76-3.14	225-255	2.83-3.20	31.5-35.0	4.0-4.4
Y33H	410-430	4.1-4.3	250-270	3.14-3.39	250-275	3.14-3.46	31.5-35.0	4.0-4.4
Y34	420-440	4.2-4.4	200-230	2.51-2.89	205-235	2.58-2.95	32.5-36.0	4.1-4.5
Y35	430-450	4.3-4.5	215-239	2.70-3.00	217-241	2.73-3.03	33.1-38.2	4.2-4.8
Y36	430-450	4.3-4.5	247-271	3.10-3.41	250-274	3.14-3.44	35.1-38.3	4.4-4.8
Y38	440-460	4.4-4.6	285-305	3.58-3.83	294-310	3.69-3.90	36.6-40.6	4.6-5.1
Y40	440-460	4.4-4.6	330-354	4.15-4.45	340-360	4.27-4.52	37.5-41.8	4.7-5.3

American Standard - used in UK but being replaced by Chinese

Typical Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	mT	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
C1	230	2.30	148	1.86	258	3.50	8.36	1.05
C5	380	3.80	191	2.40	199	2.50	27.0	3.40
C7	340	3.40	258	3.23	318	4.00	21.9	2.75
C8 / C8A	385	3.85	235	2.95	242	3.05	27.8	3.50
C8B	420	4.20	232	2.91	236	2.96	32.8	4.12
C9	380	3.80	280	3.52	320	4.01	26.4	3.32
C10	400	4.00	280	3.52	284	3.57	30.4	3.82
C11	430	4.30	200	2.51	204	2.56	34.4	4.32
C12	400	4.00	290	3.65	318	4.00	32.0	4.00

Example of a BH curve (second quadrant demagnetisation)



Quick Cross Reference Guide

C5 = Feroba2 = Fer2 = Y30 = HF26/18
C8/C8A = Feroba3 = Fer3 = Y30H-1.
C1 = Y10T / Y8T
C7 = Y26H-2
C8B = Y33
C9 = Y30H-2
C10 = Y33H
C11 = Y34
C12 = Y30H-2.

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Technical Data Sheet - Ferrite Magnets / Ceramic Magnets

European Standard (IEC 60404-8-1) - not popular in UK or USA

Minimum/Typical Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	mT	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
HF8/22	200/220	2.00/2.20	125/140	1.57/1.76	220/230	2.76/2.89	6.5/6.8	0.8/1.1
HF20/19	320/333	3.20/3.33	170/190	2.14/2.39	190/200	2.39/2.51	20.0/21.0	2.5/2.7
HF20/28	310/325	3.10/3.25	220/230	2.76/2.89	280/290	3.52/3.64	20.0/21.0	2.5/2.7
HF22/30	350/365	3.50/3.65	255/265	3.20/3.33	290/300	3.64/3.77	22.0/23.5	2.8/3.0
HF24/16	350/365	3.50/3.65	155/175	1.95/2.20	160/180	2.01/2.26	24.0/25.5	3.0/3.2
HF24/23	350/365	3.50/3.65	220/230	2.76/2.89	230/240	2.89/3.01	24.0/25.5	3.0/3.2
HF24/35	360/370	3.60/3.70	260/270	3.27/3.39	350/360	4.40/4.52	24.0/25.5	3.0/3.2
HF26/16	370/380	3.70/3.80	155/175	1.95/2.20	160/180	2.01/2.26	26.0/27.0	3.2/3.4
HF26/18	370/380	3.70/3.80	175/185	2.20/2.33	180/190	2.26/2.39	26.0/27.0	3.3/3.4
HF26/24	370/380	3.70/3.80	230/240	2.89/3.01	240/250	3.01/3.14	26.0/27.0	3.3/3.4
HF26/26	370/380	3.70/3.80	230/240	2.89/3.01	260/270	3.27/3.39	26.0/27.0	3.3/3.4
HF26/30	385/395	3.85/3.95	260/270	3.27/3.39	300/310	3.77/3.89	26.0/27.0	3.3/3.4
HF28/26	385/395	3.85/3.95	250/265	3.14/3.33	260/275	3.27/3.45	28.0/30.0	3.5/3.8
HF28/28	385/395	3.85/3.95	260/270	3.27/3.39	280/290	3.50/3.60	28.0/30.0	3.5/3.8
HF30/26	395/405	3.95/4.05	250/260	3.14/3.33	260/270	3.27/3.39	30.0/31.5	3.8/3.9
HF32/17	410/420	4.10/4.20	160/170	2.01/2.14	165/175	2.07/2.20	32.0/33.0	4.0/4.1
HF32/22	410/420	4.10/4.20	215/225	2.70/2.83	220/230	2.76/2.89	32.0/33.0	4.0/4.1
HF32/25	410/420	4.10/4.20	240/250	3.01/3.14	250/260	3.14/3.27	32.0/33.0	4.0/4.1

Tolerances

Tolerances:- +/-3% is common. +/-0.25mm is also commonly used. The tolerance available will depend on the size and shape of the magnet.

Corrosion Resistance

Corrosion resistance is excellent. Ferrite magnets are essentially made from oxides of iron and Strontium and Barium.

They cannot corrode in water. They are sometimes regarded as being 'magnetic rust'.

Maximum and Minimum Working Temperatures (Please note - your application will affect the performance available)

The maximum recommended operating temperature is +250 to +300 degrees C.

The minimum operating temperature varies with the magnet shape and magnetic circuit.

It could be as low as -60 degrees C but may be as high as 0 (zero) degrees C.

Temperature coefficients

Rev. Temp. Coef. of Induction (Br), α, %/°C	Rev. Temp. Coef. of Intrinsic Coercivity (Hci), β, %/°C
-0.2	**(+) 0.27**

Physical Characteristics

Characteristic	Symbol	Unit	Value
Density	D	g/cc	4.9 to 5.1
Vickers Hardness	Hv	D.P.N	400 to 700
Compression Strength	C.S	N/mm^2	680-720
Coefficient of Thermal Expansion	C//	10^{-6}/°C	15
	C⊥	10^{-6}/°C	10
Specific Heat Capacity	c	J/kg°C	795-855
Electrical Resistivity	ρ	μ Ω.cm	1x10^{10}
Thermal Conductivity	k	W/cm°C	0.029
Modulus of Elasticity	λ / E	Pa	1.8x10^{11}
Compression Strength	C.S.	Pa	895x10^6
Tensile Strength	σ_{UTS} or S_U	Pa	34x10^6
Flexural Strength	σ	Pa	62x10^6
Hardness		Mohs	7
Poisson's Ratio	ν		0.28
Curie Temperature	Tc	°C	450

Additional Notes

Ferrite / Ceramic magnets are permanent magnets. They have no relationship to soft magnetic ferrites.

Ferrite Magnets, termed Hard ferrites, are not the same as soft ferrites as would be used in transformers.

The term Hard relates to the fact that when the Ferrite magnet is exposed to a short external magnetic field, the Ferrite magnets retains magnetism due to it having a high coercivity, Hc.

Soft ferrite material (as used in transformer cores) does not retain magnetism after exposure to the same short magnetic field due to soft ferrite materials having low coercivity, Hc.

The high coercive force of Ferrite magnets means they are classified as hard materials, like all the other permanent magnets.

The Ferrite magnets has a more complete name of Hard Hexagonal Ferrite permanent magnets.

The magnet shape, its environment, and the actual application affect how the Ferrite magnet will perform.

When determining suitability, you should always assess the Intrinsic curve rather than the Normal curve.

Maximum performance is possible by keeping the intrinsic working point above the 'knee' and ideally at the BHmax working point.

In Ferrite magnets the Hci actually increases with rising temperature (a benefit in electric motors).

At higher temperatures the resistance to demagnetising increases in Ferrite magnets.

Demagnetisation is possible in colder temperatures (e.g. freezing conditions) - a higher working point reduces the risk.

Ferrite magnets have excellent corrosion resistance - they do not rust or degrade when in water.

Anisotropic grades (direction of magnetisation locked in structure) are stronger than isotropic grades.

Isotropic (unoriented) grade example:- C1; Anisotropic (oriented) grade examples:- C5, C7, C8.

If you have any more questions, require technical assistance or would like a quotation, simply contact us.

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