Technical Data Sheet - NdFeB Magnets / Neodymium Iron Boron Magnets

NdFeB Magnets, Neodymium Iron Boron Magnets, Neodymium Magnets

NdFeB magnets are also know as Neo, Neodymium Iron Boron, NdBFe, NIB, Super Strength, and Rare Earth Magnets (although SmCo also shares this term).
This data sheet covers the standard production range of NdFeB magnets (currently 61 grades) that are commonly in use. They are used in nearly all Industries.
Automotive, Aerospace, Wind Turbine, Military, White Goods, Lighting, Food Preparation, Separation, Motor and Generator Industries are just a few example Industries.
Our NdFeB magnets are all REACH and ROHS compliant. They do not contain any SVHC. NdFeB is produced to ISO9001 and ISO14001 Quality Control Standards.
CofC, MSDS and PPAP is available for our NdFeB magnets. TS16949 is available. FAIR is available.
NdFeB magnets can be made in blocks, discs, rings, arcs, spheres, triangles, trapezoids and many other shapes as stock and custom items.
We manufacture NdFeB assemblies. We have a NDA (Confidentiality Agreement) form if you require peace of mind relating to confidentiality.

The most common range of NdFeB (Nxx versions) will usually operate at up to +80 degrees C. The temperature ratings are guideline values.
Higher temperature versions (NxxM, NxxH, NxxSH, NxxUH, NxxEH, NxxVH/AH) are rated from up to +100 degrees C to a maximum of up to +230 degrees C.
The total magnetic circuit (magnet shape, other components, surrounding environmental conditions) can impact on the actual maximum temperature and performance.
In some applications the temperature at which significant weakening is seen may be at or slightly above the recommended maximum temperature.
In some applications the temperature at which significant weakening is seen may be noticeably below the recommended maximum temperature.

All NdFeB magnets should have some form of protective coating to minimise and ideally prevent corrosion. Uncoated is not advised. The default / standard protective coating is Ni-Cu-Ni plating. Other coatings/finishes exist (over 40 finishes are currently available). Where maximum corrosion resistance is required for NdFeB, consider using the increased corrosion resistance range of NdFeB alloys.

If you require assistance on the grade(s) to select, please contact us. We will safely guide you (and explain it all) based on your requirements. The process may involve discussing confidential details relating to your application - we can do this under NDA / Confidentiality Agreement.

Chinese Standard - commonly used in UK, Europe and now Globally

Minimum Values

Nxx?? Material		Br		Hc (Hcb)		Hci (Hcj)		BHmax	
		mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe
N27		1,030	10,300	796	10,000	955	12,000	199	25
N30		1,080	10,800	796	10,000	955	12,000	223	28
N33		1,130	11,300	836	10,500	955	12,000	247	31
N35		1,170	11,700	867	10,900	955	12,000	263	33
N38		1,210	12,100	899	11,300	955	12,000	287	36
N40		1,240	12,400	923	11,600	955	12,000	302	38
N42		1,280	12,800	923	11,600	955	12,000	318	40
N45		1,320	13,200	875	11,000	955	12,000	342	43
N48		1,380	13,800	836	10,500	875	11,000	366	46
N50		1,400	14,000	796	10,000	875	11,000	382	48
N52		1,430	14,300	796	10,000	875	11,000	398	50
N54		1,450	14,500	796	10,000	875	11,000	406	51
N27	M	1,030	10,300	796	10,000	1,114	14,000	199	25
N30	M	1,080	10,800	796	10,000	1,114	14,000	223	28
N33	M	1,130	11,300	836	10,500	1,114	14,000	247	31
N35	M	1,170	11,700	867	10,900	1,114	14,000	263	33
N38	M	1,210	12,100	899	11,300	1,114	14,000	286	36
N40	M	1,240	12,400	923	11,600	1,114	14,000	302	38
N42	M	1,280	12,800	923	11,600	1,114	14,000	318	40
N45	M	1,320	13,200	875	11,000	1,114	14,000	342	43
N48	M	1,370	13,700	1,035	13,000	1,114	14,000	366	46
N50	M	1,400	14,000	1,035	13,000	1,114	14,000	382	48
N52	M	1,420	14,200	995	12,500	1,114	14,000	390	49
N27	H	1,030	10,300	796	10,000	1,353	17,000	199	25
N30	H	1,080	10,800	796	10,000	1,353	17,000	223	28
N33	H	1,130	11,300	836	10,500	1,353	17,000	247	31
N35	H	1,170	11,700	867	10,900	1,353	17,000	263	33
N38	H	1,210	12,100	899	11,300	1,353	17,000	286	36
N40	H	1,240	12,400	923	11,600	1,353	17,000	302	38
N42	H	1,280	12,800	955	12,000	1,353	17,000	318	40
N45	H	1,320	13,200	995	12,500	1,353	17,000	342	43
N48	H	1,370	13,700	995	12,500	1,353	17,000	366	46
N50	H	1,400	1,400	995	12,500	1,353	17,000	382	48
N52	H	1,410	14,100	995	12,500	1,353	17,000	382	48
N27	SH	1,030	10,300	804	10,100	1,592	20,000	199	25
N30	SH	1,080	10,800	804	10,100	1,592	20,000	223	28
N33	SH	1,130	11,300	844	10,600	1,592	20,000	247	31
N35	SH	1,170	11,700	875	11,000	1,592	20,000	263	33
N38	SH	1,210	12,100	907	11,400	1,592	20,000	286	36
N40	SH	1,240	12,400	939	11,800	1,592	20,000	302	38
N42	SH	1,280	12,800	963	12,100	1,592	20,000	318	40
N45	SH	1,320	13,200	1,003	12,100	1,592	20,000	342	43
N48	SH	1,360	13,600	1,003	12,600	1,592	20,000	358	45
N27	UH	1,030	10,300	764	9,600	1,989	25,000	199	25
N30	UH	1,080	10,800	812	10,200	1,989	25,000	223	28
N33	UH	1,130	11,300	851	10,700	1,989	25,000	247	31
N35	UH	1,170	11,700	875	11,000	1,989	25,000	263	33
N38	UH	1,210	12,100	875	11,000	1,989	25,000	287	36
N40	UH	1,240	12,400	899	11,300	1,989	25,000	302	38
N42	UH	1,280	12,800	899	11,300	1,989	25,000	318	40
N45	UH	1,320	13,200	899	11,300	1,989	25,000	334	42
N48	UH	1,360	13,600	899	11,300	1,989	25,000	350	44
N27	EH	1,030	10,300	780	9,800	2,387	30,000	199	25
N30	EH	1,080	10,800	812	10,200	2,387	30,000	223	28
N33	EH	1,130	11,300	836	10,500	2,387	30,000	247	31
N35	EH	1,170	11,700	875	11,000	2,387	30,000	263	33
N38	EH	1,220	12,200	899	11,000	2,387	30,000	287	36
N40	EH	1,240	12,400	899	11,300	2,387	30,000	295	37
N42	EH	1,280	12,800	899	11,300	2,387	30,000	310	39
N27	VH / AH	1,030	10,300	772	9,700	2,785	35,000	199	25
N30	VH / AH	1,080	10,800	812	10,200	2,785	35,000	223	28
N33	VH / AH	1,140	11,400	851	10,700	2,785	35,000	247	31
N35	VH / AH	1,170	11,700	875	11,000	2,785	35,000	263	33
N38	VH / AH	1,220	12,200	875	11,000	2,785	35,000	287	36

American Standard - not commonly used

Typical Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe
24/41	1,000	10,000	764	9,600	3,263	41,000	190	24.0
26/32	1,050	10,500	803	10,090	2,507	31,500	205	26.0
28/23	1,050	10,500	820	10,300	1,830	23,000	225	28.0
28/32	1,073	10,730	835	10,490	2,507	31,500	225	28.0
30/19	1,130	11,300	859	10,800	1,512	19,000	240	30.0
30/27	1,130	11,300	859	10,800	2,149	27,000	240	30.0
32/16	1,180	11,800	891	11,200	1,273	16,000	255	32.0
32/31	1,160	11,600	883	11,100	2,467	31,000	255	32.0
34/22	1,196	11,960	915	11,500	1,771	22,250	270	34.0
36/19	1,231	12,310	917	11,520	1,523	19,140	285	36.0
36/26	1,220	12,200	931	11,700	2,069	26,000	285	36.0
38/15	1,250	12,500	955	12,000	1,194	15,000	300	38.0
38/23	1,240	12,400	955	12,000	1,830	23,000	300	38.0
40/15	1,280	12,800	955	12,000	1,194	15,000	320	40.0
40/23	1,290	12,900	987	12,400	1,830	23,000	320	40.0
42/15	1,310	13,100	1,011	12,700	1,194	15,000	335	42.0
44/15	1,350	13,500	1,035	13,000	1,194	15,000	350	44.0
48/11	1,375	13,750	820	10,300	875	11,000	380	48.0
50/11	1,410	14,100	820	10,300	875	11,000	400	50.0

European Standard (IEC 60404-8-1) - not commonly used

Minimum Values

Material	Group code	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
		mT	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
170/190	R7-1-1	980	9800	700	8795	1900	23875	170	21.4
210/130	R7-1-2	1060	10600	790	9925	1300	16335	210	26.4
250/120	R7-1-3	1130	11300	840	10555	1200	15080	250	31.4
290/80	R7-1-4	1230	12300	700	8795	800	10055	290	36.4
200/190	R7-1-5	1060	10600	760	9550	1900	23875	200	25.1
240/180	R7-1-6	1160	11600	840	10555	1800	22620	240	30.2
280/120	R7-1-7	1240	12400	900	11310	1200	15080	280	35.2
320/88	R7-1-8	1310	13100	800	10055	880	11060	320	40.2
210/240	R7-1-9	1060	10600	760	9550	2400	30160	210	26.4
240/200	R7-1-10	1160	11600	840	10555	2000	25130	240	30.2
310/130	R7-1-11	1300	13000	900	11310	1300	16335	310	39.0
250/240	R7-1-12	1200	12000	830	10430	2400	30160	250	31.4
260/200	R7-1-13	1210	12100	840	10555	2000	25130	260	32.7
340/130	R7-1-14	1330	13300	920	11560	1300	16335	340	42.7
360/90	R7-1-15	1350	13500	800	10055	900	11310	360	45.2

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bsi. ISO 9001 Quality Management
FM31278

Direction of Magnetisation, DoM

NdFeB magnets are sintered anisotropic materials - they have a preferred direction of magnetisation locked in their structure. So the magnet can only be magnetised in one axis - any attempt to magnetise in another axis results in very little performance. Each NdFeB magnet has a Direction of Magnetisation (DoM). In drawings the poles are labelled (with a North or a South). Or the magnet shape has an arrow inside it - this a arrow points to the North pole face (the other end is the South pole face). Sometimes one dimension in the description ends in a letter "A". The A (Alignment or Axis) indicates the DoM axis it is magnetised in. The value ending mmA or inchA is the distance between North and South Pole faces. e.g. D10mm x 2mmA is an axially magnetised magnet; 40mm x 20mm x 10mmA has 10mm between the North and South faces. The North pole face of a permanent magnet is a North seeking pole (it seeks the geographic North). By scientific definition of unlike poles attracting, the Earth's geographic North pole is actually a magnetic South pole. We use this definition for DoM.

Technical Data Sheet - NdFeB Magnets / Neodymium Iron Boron Magnets

Temperature Ratings (Please note - your application will affect the performance available)

MAGNET TYPE SUFFIX	Rev. Temp. Coef. of Induction (Br), α, %/°C (20-100°C)	Rev. Temp. Coef. of Intrinsic Coercivity (Hci), β, %/°C (20-100°C)	Max. Working Temperature (based on a High working point)
	-0.120	-0.70	$80\,^{0}C = 176\,^{0}F$ *
M	-0.115	-0.65	$100^{0}C = 212\,^{0}F$ *
H	-0.110	-0.60	$120^{0}C = 248\,^{0}F$
SH	-0.105	-0.55	$150\,^{0}C = 302\,^{0}F$
UH	-0.100	-0.55	$180\,^{0}C = 356\,^{0}F$
EH	-0.095	-0.50	$200\,^{0}C = 392\,^{0}F$
VH / AH	-0.090	-0.49	$230\,^{0}C = 446\,^{0}F$

* Please note that N54, N52, N50, N52M and N50M are rated to a maximum of 60°C (140°F).

Coatings Available

NdFeB should always be given a protective coating to minimise corrosion risk. There are currently over 40 options for magnet finish.
Nickel Copper Nickel (NiCuNi) is the standard (default) coating. This NiCuNi coating is applied unless otherwise requested.
A Zinc (Zn) coating is sometimes used as an alternative to NiCuNi - it is not a shiny as the Nickel finish and is not as good on corrosion resistance.
Nickel Copper Nickel plus Epoxy provides a double coating with improved corrosion resisting properties.
Gold and Silver plating is actually a Gold or Silver layer on top of standard NiCuNi. Black nickel finish is a dull grey/black colour.
Undamaged coatings will prolong magnet lifetime but only if the magnets are used in good environmental conditions (e.g. warm, dry, no humidity).
It is impossible to guarantee that NdFeB magnets will be free from long term corrosion. For such requirements consider plated SmCo and any Ferrite magnets.
When using glue you are bonding onto the plating or coating rather than the material itself. If the plating or coating fails, the magnet may become free to move.

Nickel-Copper-Nickel (Ni-Cu-Ni) [standard coating]	Everlube (6102G, 10047)	Nickel (Ni)	Zinc (Zn)
Nickel-Copper plus Black Nickel	White Zinc	Black Zinc	Epoxy (Black)
Epoxy (Grey)	Copper (NiCu)	Copper (NiCuNiCu)	Tin (Sn)
Gold (Au) [this is actually NiCuNi plus Gold]	Ni-Cu-Ni plus Rubber	Zn plus Rubber	Zinc Chromate
Silver (Ag) [this is actually NiCuNi plus Silver]	Parylene C	Ni-Cu-Ni plus Parylene C	Ni-Cu-Ni-Au-ParyleneC
Phosphate Passivation	PTFE ("Teflon®") in white	PTFE ("Teflon®") in silvery	PTFE ("Teflon®") in grey
PTFE ("Teflon®") in black	Titanium (Ti)	Titanium Nitride (TiN)	(Zinc-Nickel) ZnNi
Chrome (black)	Chrome (bright/standard)	Ni-Cu-Ni plus Everlube	Ni-Cu-Ni plus Epoxy	Ni-Cu-Ni plus PTFE
Zn plus Everlube	Tin (Sn) plus Parylene C	Rhodium	Potted (various)
Coloured (red, green, blue, pink, purple, etc)	Painted (various)	Adhesive / Silicone Seal (assemblies)	Potted (various - assemblies)
Uncoated (bare – recommend vacuum packing as well)	Plastic encased (this fits around pre-coated magnets to give additional protection and is not hermetic)		
Other coatings may be possible - please let us know your requirements.			

Relative Coating Performance - Examples (your application and its environmental condition may give different results)

PLATING APPLIED 6 commonly coating examples given (other coatings exist)	Overall Thickness (1 micron = 1/1000th mm) (1 micron = 0.03937 mil) (1 inch = 1000 mil)	Pressure Cooker Test (PCT) Test is:- 2 bar, 120°C and 100% RH (hours until corrosion could start to be noted)	Salt Spray Test Test is:- 5% NaCl solution at 35°C (hours until corrosion could start to be noted)
Nickel Copper Nickel (NiCuNi)	15-21 microns	48 hours	24 hours
NiCu + Black Nickel	15-21 microns	48 hours	24 hours
NiCuNi + Black Epoxy	20-28 microns	72 hours	48 hours
NiCuNi + Gold	16-23 microns	72 hours	36 hours
NiCuNi + Silver	16-23 microns	48 hours	24 hours
Zinc	7-15 microns	24 hours	12 hours

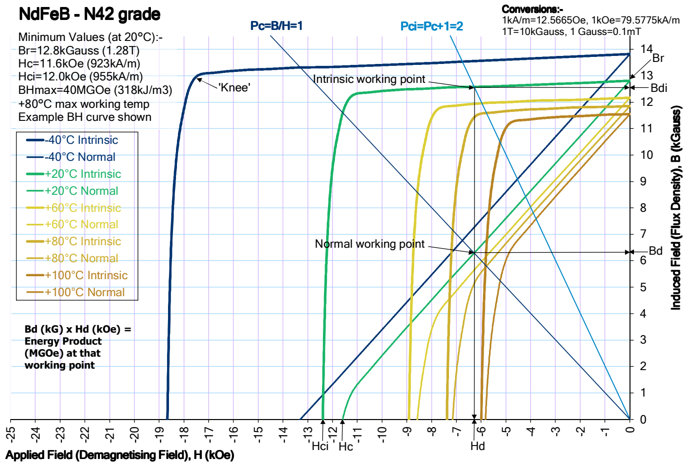
Physical Characteristics (Typical)

Characteristic	Symbol	Unit	Value
Density	D	g/cm^3	7.5
Vickers Hardness	Hv	D.P.N	570
Compression Strength	C.S	N/mm^2	780
Coefficient of Thermal Expansion	C//	$10^{-6}/°C$	3.4
	C⊥	$10^{-6}/°C$	-4.8
Electrical Resistivity	ρ	μ Ω.cm	150
Temperature coefficient of resistivity	α	$10^{-4}/°C$	2
Electrical Conductivity	σ	$10^{6}S/m$	0.667
Thermal Conductivity	k	kCal/(m.h.°C)	7.7
Specific Heat Capacity	c	kCal/(kg.°C)	0.12
Tensile Strength	σ_{UTS}, or S_U	kg/mm^2	8
Young's Modulus	λ / E	$10^{11}N/m^2$	1.6
Flexural Strength	β	$10^{-12}m^2/N$	9.8
Compressibility	σ	$10^{-12}m^2/N$	9.8
Rigidity	E.I	N/m^2	0.64
Poisson's Ratio	ν		0.24
Curie Temperature	Tc	°C	310

Dimensional Tolerances

The standard NdFeB magnet tolerance is +/-0.1mm. It is possible to produce most shapes to +/-0.05mm tolerances but the magnet may cost more.
For tighter tolerances we would have to review the shape to inform you of the tolerances we could achieve (most applications +/-0.05mm is the best).
The shape and finish determines the tolerances that can be achieved. Please contact us for a free and without obligation quotation.

Example of a BH (second quadrant demagnetisation) curve



Additional Notes

The magnet shape, its environment, and the actual application affect how the NdFeB magnet will perform.
Temperature is important as well as damp or wet conditions.
When determining suitability, you should analyse the Intrinsic curve not the Normal curve.
By keeping the intrinsic working point above the 'knee' and ideally at the BHmax working point maximum performance is possible.
If you have any more questions, require technical assistance and would like a quotation, simply contact us.

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Technical Data Sheet - NdFeB Magnets / Neodymium Iron Boron Magnets

Superior Corrosion Resisting NdFeB Range

Neodymium Iron Boron (NdFeB) Magnets with Superior Corrosion Resistance (SCR).

NdFeB magnets are the most powerful magnets available. They provide maximum performance from a minimum size.
Our REACH and ROHS compliant NdFeB magnets do not contain SVHC. They are produced to ISO9001 and ISO14001. TS16949 is available as is PPAP and CofC.
There are 72 grades of Superior Corrosion Resisting (SCR) NdFeB magnets. Their improved alloys provide corrosion resistance superior to standard grades.
Like that standard range, the SCR grades of NdFeB magnet exist with several maximum recommended temperature ratings - from +60 deg C up to +230 deg C.
The shape of the magnet, the total magnetic circuit and the application determines the actual maximum possible operating temperature.
The Superior Corrosion Resisting grades still require a protective coating. They offer reduced rates of corrosion compared to standard NdFeB material.
The Superior Corrosion Resisting grades do not stop corrosion. Plated/coated SmCo may be an alternative to consider for low corrosion or ferrite for no corrosion in water.
The normal coating is usually a Ni-Cu-Ni plating. Other coatings/finishes exist (over 40 finishes available for the 72 grades). actual maximum temperature rating depends on the
The Standard NdFeB magnets (another technical data sheet exists for these 55 grades) have a limited corrosion resistance (in a PCT test, the mass loss after 4 days is <100mg/cm^2).
Magnets with NxxyyT (where xx is the BHmax in MGOe and yy is the Hci identifier) have improved corrosion resistance within the alloy itself (in a PCT test, the mass loss after 3 days is <50mg/cm^2).
Magnets with L-NxxyyT (where xx is the BHmax in MGOe and yy is the Hci identifier) have the best corrosion resistance within the alloy itself (in a PCT test, the mass loss after 7 days is <10mg/cm^2).
For note, N stands for NdFeB, the following two numbers (xx) is the BHmax (maximum energy product) in MGOe and any letters at the end (yy) relates to the Hci (Intrinsic Coercivity) rating (indirectly a temperature ra
The NxxyyT and L-NxxyyT Superior Corrosion Resisting ranges are very expensive compared to the standard NdFeB range. For alternative superior corrosion protection, plated SmCo or Ferrite may be considered.
NdFeB magnets can be made in blocks, discs, rings, arcs, spheres, triangles, trapezoids and many other shapes, including assemblies.
If you are unsure of which material or grade would be best for your application, please contact us - we will advise you accordingly (all under NDA / Confidentiality Agreement if required).

Chinese SCR Standard - used globally, especially in UK and EU

Minimum Values

Material		Br		Hc (Hcb)		Hci (Hcj)		BHmax	
		mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe
N27	T	1,030	10,300	796	10,000	955	12,000	199	25
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N38	T	1,210	12,100	899	11,300	955	12,000	287	36
N40	T	1,240	12,400	923	11,600	955	12,000	302	38
N42	T	1,280	12,800	923	11,600	955	12,000	318	40
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N52	T	1,430	14,300	796	10,000	875	11,000	398	50
N27	MT	1,030	10,300	796	10,000	1,114	14,000	199	25
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N45	HT	1,320	13,200	995	12,500	1,353	17,000	342	43
N48	HT	1,370	13,700	995	12,500	1,353	17,000	366	46
N27	SHT	1,030	10,300	804	10,100	1,592	20,000	199	25
N30	SHT	1,080	10,800	804	10,100	1,592	20,000	223	28
N33	SHT	1,130	11,300	844	10,600	1,592	20,000	247	31
N35	SHT	1,170	11,700	875	11,000	1,592	20,000	263	33
N38	SHT	1,210	12,100	907	11,400	1,592	20,000	286	36
N40	SHT	1,240	12,400	939	11,800	1,592	20,000	302	38
N42	SHT	1,280	12,800	963	12,100	1,592	20,000	318	40
N45	SHT	1,320	13,200	1,003	12,600	1,592	20,000	342	43
L-N27	SHT	1,030	10,300	804	10,100	1,592	20,000	199	25
L-N30	SHT	1,080	10,800	804	10,100	1,592	20,000	223	28
L-N33	SHT	1,130	11,300	844	10,600	1,592	20,000	247	31
L-N35	SHT	1,170	11,700	875	11,000	1,592	20,000	263	33
L-N38	SHT	1,210	12,100	907	11,400	1,592	20,000	286	36
L-N40	SHT	1,240	12,400	939	11,800	1,592	20,000	302	38
L-N42	SHT	1,280	12,800	963	12,100	1,592	20,000	318	40
L-N45	SHT	1,320	13,200	1,003	12,600	1,592	20,000	342	43
N27	UHT	1,030	10,300	764	9,600	1,989	25,000	199	25
N30	UHT	1,080	10,800	812	10,200	1,989	25,000	223	28
N33	UHT	1,130	11,300	851	10,700	1,989	25,000	247	31
N35	UHT	1,170	11,700	875	11,000	1,989	25,000	263	33
N38	UHT	1,210	12,100	875	11,000	1,989	25,000	287	36
N40	UHT	1,240	12,400	899	11,300	1,989	25,000	302	38
L-N27	UHT	1,030	10,300	764	9,600	1,989	25,000	199	25
L-N30	UHT	1,080	10,800	812	10,200	1,989	25,000	223	28
L-N33	UHT	1,130	11,300	851	10,700	1,989	25,000	247	31
L-N35	UHT	1,170	11,700	875	11,000	1,989	25,000	263	33
L-N38	UHT	1,210	12,100	875	11,000	1,989	25,000	287	36
L-N40	UHT	1,240	12,400	899	11,300	1,989	25,000	302	38
N27	EHT	1,030	10,300	780	9,800	2,387	30,000	199	25
N30	EHT	1,080	10,800	812	10,200	2,387	30,000	223	28
N33	EHT	1,130	11,300	836	10,500	2,387	30,000	247	31
N35	EHT	1,170	11,700	875	11,000	2,387	30,000	263	33
N38	EHT	1,220	12,200	899	11,300	2,387	30,000	287	36
L-N27	EHT	1,030	10,300	780	9,800	2,387	30,000	199	25
L-N30	EHT	1,080	10,800	812	10,200	2,387	30,000	223	28
L-N33	EHT	1,130	11,300	836	10,500	2,387	30,000	247	31
L-N35	EHT	1,170	11,700	875	11,000	2,387	30,000	263	33
L-N38	EHT	1,220	12,200	899	11,300	2,387	30,000	287	36
L-N27	VHT / AHT	1,030	10,300	772	9,700	2,785	35,000	199	25
L-N30	VHT / AHT	1,080	10,800	812	10,200	2,785	35,000	223	28
L-N33	VHT / AHT	1,140	11,400	851	10,700	2,785	35,000	247	31
L-N35	VHT / AHT	1,170	11,700	875	11,000	2,785	35,000	263	33

American non-SCR Standard (standard material)

Typical Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe
24/41	1,000	10,000	764	9,600	3,263	41,000	190	24.0
26/32	1,050	10,500	803	10,090	2,507	31,500	205	26.0
28/23	1,050	10,500	820	10,300	1,830	23,000	225	28.0
28/32	1,073	10,730	835	10,490	2,507	31,500	225	28.0
30/19	1,130	11,300	859	10,800	1,512	19,000	240	30.0
30/27	1,130	11,300	859	10,800	2,149	27,000	240	30.0
32/16	1,180	11,800	891	11,200	1,273	16,000	255	32.0
32/31	1,160	11,600	883	11,100	2,467	31,000	255	32.0
34/22	1,196	11,960	915	11,500	1,771	22,250	270	34.0
36/19	1,231	12,310	917	11,520	1,523	19,140	285	36.0
36/26	1,220	12,200	931	11,700	2,069	26,000	285	36.0
38/15	1,250	12,500	955	12,000	1,194	15,000	300	38.0
38/23	1,240	12,400	955	12,000	1,830	23,000	300	38.0
40/15	1,280	12,800	955	12,000	1,194	15,000	320	40.0
40/23	1,290	12,900	987	12,400	1,830	23,000	320	40.0
42/15	1,310	13,100	1,011	12,700	1,194	15,000	335	42.0
44/15	1,350	13,500	1,035	13,000	1,194	15,000	350	44.0
48/11	1,375	13,750	820	10,300	875	11,000	380	48.0
50/11	1,410	14,100	820	10,300	875	11,000	400	50.0

European non-SCR Standard (IEC 60404-8-1) (standard material)

Minimum Values

Material	Group code	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
		mT	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
170/190	R7-1-1	980	9800	700	8795	1900	23875	170	21.4
210/130	R7-1-2	1060	10600	790	9925	1300	16335	210	26.4
250/120	R7-1-3	1130	11300	840	10555	1200	15080	250	31.4
290/80	R7-1-4	1230	12300	700	8795	800	10055	290	36.4
200/190	R7-1-5	1060	10600	760	9550	1900	23875	200	25.1
240/180	R7-1-6	1160	11600	840	10555	1800	22620	240	30.2
280/120	R7-1-7	1240	12400	900	11310	1200	15080	280	35.2
320/88	R7-1-8	1310	13100	800	10055	880	11060	320	40.2
210/240	R7-1-9	1060	10600	760	9550	2400	30160	210	26.4
240/200	R7-1-10	1160	11600	840	10555	2000	25130	240	30.2
310/130	R7-1-11	1300	13000	900	11310	1300	16335	310	39.0
250/240	R7-1-12	1200	12000	830	10430	2400	30160	250	31.4
260/200	R7-1-13	1210	12100	840	10555	2000	25130	260	32.7
340/130	R7-1-14	1330	13300	920	11560	1300	16335	340	42.7
360/90	R7-1-15	1350	13500	800	10055	900	11310	360	45.2

Direction of Magnetisation

NdFeB magnets are sintered anisotropic materials - they have a preferred direction of magnetisation locked in their structure. So the magnet can only be magnetised in one axis - any attempt to magnetise in another axis results in very little performance.
Each NdFeB magnet has a Direction of Magnetisation (DoM). In drawings the poles are labelled (with a North or a South). Or the magnet shape has an arrow inside it - this a arrow points to the North pole face (the other end is the South pole face).
Sometimes one dimension in the description ends in a letter "A". The A (Alignment or Axis) indicates the DoM axis it is magnetised in. The value ending mmA or inchA is the distance between North and South Pole faces.
e.g. D10mm x 2mmA is an axially magnetised magnet; 40mm x 20mm x 10mmA has 10mm between the North and South faces.
The North pole face of a permanent magnet is a North seeking pole (it seeks the geographic North). By scientific definition of unlike poles attracting, the Earth's geographic North pole is actually a magnetic South pole. We use this definition for DoM.

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Technical Data Sheet - NdFeB Magnets / Neodymium Iron Boron Magnets

Superior Corrosion Resisting NdFeB Range

Corrosion Resistance - Realistic Example Results

MAGNET TYPE (xx is BHmax in MGOe and yy is the Hci identifier lettering)	PCT Test Result (mg lost / cm^2)	Test Condition
Nxxyy (Standard NdFeB)	<100 {4}	Pressure Cooker Test, PCT, is performed at 130°C, 2.7bar, 85% humidity. The magnets are weighed before and after testing. The result is the amount of mass lost per unit of magnet surface area. It is expressed in milligrams lost per square centimetre of total magnet surface area after {} days.
NxxyyT (lower corrosion loss NdFeB)	<50 {3}	
L-NxxyyT (lowest corrosion loss NdFeB)	<10 {7}	

Temperature Ratings (Please note - your application will affect the performance available)

MAGNET TYPE SUFFIX	Rev.Temp.Coef. of Induction (Br), α, %/°C (20-100°C)	Rev.Temp.Coef. of Intrinsic Coercivity (Hci), β, %/°C (20-100°C)	Max. Working Temperature (based on High working point)
NxxT	-0.110	-0.60	80 ^{0}C = 176 ^{0}F *
NxxMT	-0.110	-0.60	100^{0}C = 212 ^{0}F
NxxHT	-0.110	-0.60	120^{0}C = 248 ^{0}F
NxxSHT	-0.110	-0.60	150 ^{0}C = 302 ^{0}F
L-NxxSHT	-0.100	-0.50	150 ^{0}C = 302 ^{0}F
NxxUHT	-0.100	-0.50	180 ^{0}C = 356 ^{0}F
L-NxxUHT	-0.100	-0.50	180 ^{0}C = 356 ^{0}F
NxxEHT	-0.100	-0.50	200 ^{0}C = 392 ^{0}F
L-NxxEHT	-0.100	-0.50	200 ^{0}C = 392 ^{0}F
L-NxxVHT	-0.100	-0.50	230 ^{0}C = 446 ^{0}F

* Please note that N52, N52T, N50, N50T and N50MT are rated to a maximum of 60°C (140°F).

Coatings Available

NdFeB should always be given a protective coating to reduce any risk of corrosion. There are currently over 40 options for magnet finish:-

Nickel-Copper-Nickel (Ni-Cu-Ni) [standard coating]	Everlube (6102G, 10047)	Nickel (Ni)	Zinc (Zn)
Nickel-Copper plus Black Nickel	White Zinc	Black Zinc	Epoxy (Black)
Epoxy (Grey)	Copper (NiCu)	Copper (NiCuNiCu)	Tin (Sn)
Gold (Au) [this is actually NiCuNi plus Gold]	Ni-Cu-Ni plus Rubber	Zn plus Rubber	Zinc Chromate
Silver (Ag) [this is actually NiCuNi plus Silver]	Parylene C	Ni-Cu-Ni plus Parylene C	Ni-Cu-Ni-Au-ParyleneC
Phosphate Passivation	PTFE ("Teflon®") in white	PTFE ("Teflon®") in silvery	PTFE ("Teflon®") in grey
PTFE ("Teflon®") in black	Titanium (Ti)	Titanium Nitride (TiN)	(Zinc-Nickel) ZnNi
Chrome (black) Chrome (bright/standard)	Ni-Cu-Ni plus Everlube	Ni-Cu-Ni plus Epoxy	Ni-Cu-Ni plus PTFE
Zn plus Everlube	Tin (Sn) plus Parylene C	Rhodium	Potted (various)
Coloured (red, green, blue, pink, purple, etc)	Painted (various)	Adhesive / Silicone Seal (assemblies)	Potted (various - assemblies)
Uncoated (bare – recommend vacuum packing as well)	Plastic encased (this fits around pre-coated magnets to give additional protection and is not hermetic)		
Other coatings may be possible - please let us know your requirements.			

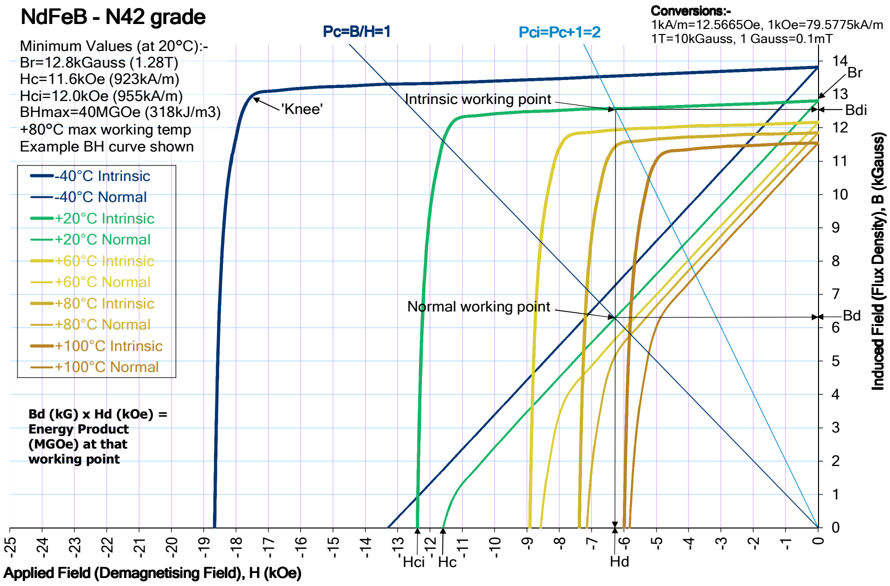
Tolerances

The standard magnet tolerances are +/-0.1mm. For a small additional fee +/-0.05mm is possible for virtually all the magnet shapes.
Our Precision Magnetics range offers tolerances down to as small as +/-0.005mm but is subject to minimum production runs of 100k pieces and we will state the tolerances achievable.
The shape and finish determines the tolerances that can be achieved. Please feel free to contact us for a free and without obligation quotation.

Physical Characteristics (typical values)

Characteristic	Symbol	Unit	Value
Density	D	g/cm^3	7.5
Vickers Hardness	Hv	D.P.N	570
Compression Strength	C.S	N/mm^2	780
Coefficient of Thermal Expansion	C//	10^{-6}/°C	3.4
	C⊥	10^{-6}/°C	-4.8
Electrical Resistivity	ρ	μ Ω.cm	150
Temperature coefficient of resistivity	α	10^{-4}/°C	2
Electrical Conductivity	σ	10^6S/m	0.667
Thermal Conductivity	k	kCal/(m.h.°C)	7.7
Specific Heat Capacity	c	kCal/(kg.°C)	0.12
Tensile Strength	σ_{UTS}, or S_U	kg/mm^2	8
Young's Modulus	λ / E	10^{11}N/m^2	1.6
Flexural Strength	β	$10^{-12}m^2$/N	9.8
Compressibility	σ	$10^{-12}m^2$/N	9.8
Rigidity	E.I	N/m^2	0.64
Poisson's Ratio	ν		0.24
Curie Temperature	Tc	°C	310

Example of a BH (second quadrant demagnetisation) curve



Additional Notes

The magnet shape, its environment, and the actual application affect how the NdFeB magnet will perform. Temperature is important as well as damp or wet conditions.
When determining suitability, you should analyse the Intrinsic curve not the Normal curve.
By keeping the intrinsic working point above the 'knee' and ideally at the BHmax working point maximum performance is possible.
If you have any more questions, require technical assistance and would like a quotation, simply contact us.
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Technical Data Sheet - Samarium Cobalt Magnets, SmCo Magnets

Samarium Cobalt Magnets, SmCo Magnets

Samarium Cobalt magnets (SmCo) is the sister Rare Earth Magnet to NdFeB. SmCo is sometimes called a Rare Earth Cobalt magnet. SmCo magnets exist in two alloy varieties.
Sm_1Co_5 (SmCo1:5) is the original SmCo alloy. Sm_2Co_{17} (SmCo2:17) is the more common used and stronger SmCo alloy with SmCo26 being the most popular variety.
Sm_1Co_5 contains mainly Sm and Co and contains no iron (Fe) so it has excellent corrosion resistance -it should never corrode with water.
Sm_2Co_{17} is mainly Sm and Co but also contains Cu, Hf &/or Zr, sometimes Pr, and Fe. The low free iron content in Sm_2Co_{17} means it is technically prone to a little surface corrosion when in water.
Sm_2Co_{17} is regarded as having good to very good corrosion resistance (far superior to NdFeB) in most applications. A simple coating of NiCuNi will very likely solve any risk of corrosion.
Samarium Cobalt magnets (SmCo) may be weaker than NdFeB magnets at room temperature but SmCo will often outperform NdFeB above +150°C to +180°C (subject to the application and grade).
SmCo magnets are ideal for aerospace, automotive, sensor, loudspeaker, motor and military applications. In mission critical applications they are an ideal first choice.
SmCo magnets offer minimal change in magnetic output over a small temperature change (with far less variation than NdFeB or ferrite; only Alnico is better).
The Low Temperature Coefficient (LTC) versions have less variation in magnetic output with temperature change (due to added Gd and Er).
SmCo magnets performance over a massive range of temperatures (from near to -273°C up to +350°C).
The H versions of Sm_2Co_{17} have higher Hci and operate up to +350°C rather than +300°C. SmCo550 is capable of up to +550°C.
SmCo and NdFeB could be interchangeable e.g. SmCo30 should perform very similarly to N30 at ambient temperature.

Sm_1Co_5 (1:5 alloy) Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCo16 (1:5)	0.81-0.85	8.1-8.5	620-660	7.8-8.3	1194-1830	15-23	110-127	14-16
SmCo18 (1:5)	0.85-0.90	8.5-9.0	660-700	8.3-8.8	1194-1830	15-23	127-143	16-18
SmCo20 (1:5)	0.90-0.94	9.0-9.4	680-725	8.5-9.1	1194-1830	15-23	150-167	19-21
SmCo22 (1:5)	0.92-0.96	9.2-9.6	710-750	8.9-9.4	1194-1830	15-23	160-175	20-22
SmCo24 (1:5)	0.96-1.00	9.6-10.0	730-770	9.2-9.7	1194-1830	15-23	175-190	22-24
SmCo18S (1:5)	0.85-0.90	8.5-9.0	660-700	8.3-8.8	1433-2000	18-25	135-151	17-19
SmCo20S (1:5)	0.90-0.94	9.0-9.4	680-725	8.5-9.1	1433-2000	18-25	143-160	18-20
SmCo22S (1:5)	0.92-0.96	9.2-9.6	710-750	8.9-9.4	1433-2000	18-25	160-175	20-22

Low Temperature Coefficient Sm_1Co_5 (1:5 alloy) Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCo10LTC (1:5)	0.59-0.63	5.9-6.3	460-493	5.8-6.2	1430-1830	18-23	68-80	8.5-10

Rev.Temp.Coef. of Induction (Br), α, %/°C :-
(+20 to +100°C) = -0.004, (+100 to +200°C) = -0.021, (+200 to +300°C) = -0.041.

Sm_2Co_{17} (2:17 alloy) Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCo24L	0.95-1.02	9.5-10.2	557-716	7.0-9.0	636-955	8-12	175-191	22-24
SmCo26L	1.02-1.05	10.2-10.5	557-748	7.0-9.4	636-955	8-12	191-207	24-26
SmCo28L	1.03-1.08	10.3-10.8	557-765	7.0-9.9	636-955	8-12	207-220	26-28
SmCo30L	1.08-1.15	10.8-11.5	557-795	7.0-10.0	636-955	8-12	220-240	28-30
SmCo32L	1.10-1.15	11.0-11.5	557-810	7.0-10.2	636-955	8-12	230-255	29-32
SmCo26M	1.02-1.05	10.2-10.5	716-780	9.0-9.8	955-1273	12-16	191-207	24-26
SmCo28M	1.03-1.08	10.3-10.8	716-796	9.0-10.0	955-1273	12-16	207-220	26-28
SmCo30M	1.08-1.10	10.8-11.0	716-835	9.0-10.5	955-1273	12-16	220-240	28-30
SmCo32M	1.10-1.13	11.0-11.3	716-845	9.0-10.6	955-1273	12-16	230-255	29-32
SmCo22	0.93-0.97	9.3-9.7	676-740	8.5-9.3	>1433	>18	160-183	20-23
SmCo24	0.95-1.02	9.5-10.2	700-750	8.7-9.4	>1433	>18	175-191	22-24
SmCo26	1.02-1.05	10.2-10.5	750-780	9.4-9.8	>1434	>19	191-207	24-26
SmCo28	1.03-1.08	10.3-10.8	756-796	9.5-10.0	>1435	>20	207-220	26-28
SmCo30	1.08-1.10	10.8-11.0	788-835	9.9-10.5	>1436	>21	220-240	28-30
SmCo32	1.10-1.13	11.0-11.3	811 -845	10.2-10.6	>1194	>15	230-255	29-32
SmCo24H	0.95-1.02	9.5-10.2	700-750	8.7-9.4	>1990	>25	175-191	22-24
SmCo26H	1.02-1.05	10.2-10.5	750-780	9.4-9.8	>1990	>25	191-207	24-26
SmCo28H	1.03-1.08	10.3-10.8	756-796	9.5-10.0	>1990	>25	207-220	26-28
SmCo30H	1.08-1.10	10.8-11.0	788-835	9.9-10.5	>1990	>25	220-240	28-30
SmCo32H	1.10-1.13	11.0-11.3	812 -860	10.2-10.8	>1990	>25	230-255	29-32

Low Temperature Coefficient Sm_2Co_{17} (2:17 alloy) Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCo22LTC	0.94-0.98	9.4-9.8	668-715	8.4-9.0	1194-1591	15-20	161-183	21-23

Rev.Temp.Coef. of Induction (Br), a, %/°C :-
(-50 to +20°C) = +0.005, (+20 to +100°C) = +0.012, (+100 to +200°C) = +0.006, (+200 to +300°C) = -0.025.

Ultra High Temperature SmCo Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCo550	~0.984	~9.84	~761	~9.5	~1957	~24.5	~190	~24

400°C - Br~0.797T, Hc~591kA/m, Hci~955kA/m; 500°C - Br~0.704T, Hc~504kA/m, Hci~689kA/m
550°C - Br~0.661T, Hc~447kA/m, Hci~536kA/m

Bonded Sm_1Co_5 (1:5 alloy) Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCoB6	0.4	4.0	280	3.5	800	10	30-50	3.8-6.3
SmCoB10	0.5	5.0	320	4.0	800	10	50-65	6.3-8.2

Bonded Sm_2Co_{17} (2:17 alloy) Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCoB10	0.6	6.0	360	4.5	800	10	65-80	8.2-10.0
SmCoB12	0.7	7.0	400	5.0	800	10	80-95	10.0-12.0

Plastic Bonded SmCo Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
SmCoP3	0.3-0.4	3.0-4.0	199-279	2.5-3.5	716-1194	9.0-15.0	20-28	2.5-3.5
SmCoP5	0.35-0.55	3.5-5.5	247-358	3.1-4.5	716-1194	9.0-15.0	32-52	4.0-6.5
SmCoP8	0.55-0.68	5.5-6.8	334-462	4.2-5.8	716-1194	9.0-15.0	48-64	6.0-8.0

Max Working Temperature
(Please note - your application will affect the performance available)

Material	Maximum recommended
Sm1Co5 (1:5)	+250 degrees C
Sm2Co17 (2:17)	+250 (L) / +300 / +350 (H) degrees C
Bonded Sm1Co5 (1:5)	+120 degrees C (binder fails)
Bonded Sm2Co17 (2:17)	+120 degrees C (binder fails)
Plastic bonded SmCo	+120 degrees C (binder fails)

Temperature coefficients (values given for 20-100 deg C)

Rev.Temp.Coef. of Induction (Br), α, %/°C	Rev.Temp.Coef. of Intrinsic Coercivity (Hci), β, %/°C
-0.050 (Sm1Co5)	-0.30 (Sm1Co5)
-0.045 (Sm1Co5 S)	-0.28 (Sm1Co5 S)
-0.035 (Sm2Co17)	-0.20 (Sm2Co17)
-0.050 (Bonded Sm1Co5)	-0.25 (Bonded Sm1Co5)
-0.030 (Bonded Sm2Co17)	-0.20 (Bonded Sm2Co17)
-0.040 (Plastic Bonded SmCo)	-0.20 (Plastic Bonded SmCo)

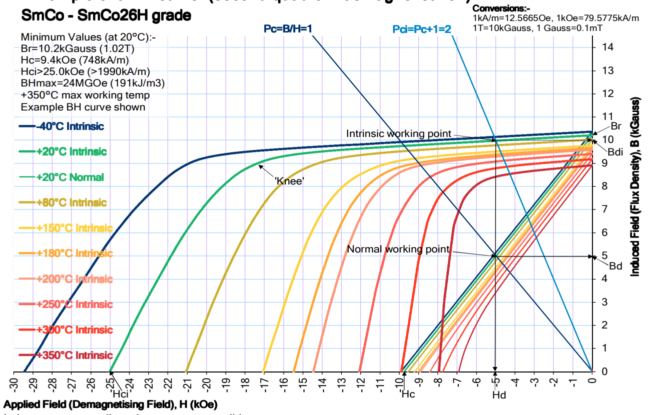
Corrosion Resistance

Corrosion resistance:- SmCo(1:5) Exellent (has no iron); SmCo(2:17) Good to Very Good (has some free iron).
SmCo magnets can usually be used in humid applications without any need for a protective coating.
In wet envrironments, coating of SmCo(2:17) in NiCuNi is recommended to avoid surface corrosion issues.
Epoxy coating is also a commonly used coating for SmCo. ZnNi is also sometimes used (not so common).
NiCuNi plated SmCo is claimed by some to limit chipping and allows for soldering as well but is rarely done.

Physical Characteristics (excluding bonded variants)

Characteristic	Symbol	Unit	Value
Density Sm1Co5	D	g/cm^3	8.2-8.4
Density Sm2Co17	D	g/cm^3	8.3-8.5
Vickers Hardness Sm1Co5	Hv	D.P.N.	500-600
Vickers Hardness Sm2Co17	Hv	D.P.N.	450-500
Compression Strength Sm1Co5	C.S.	N/mm^2	900-1000
Compression Strength Sm2Co17	C.S.	N/mm^2	650-800
Coefficient of Thermal Expansion Sm1Co5	C//	$10^{-6}/°C$	6
	C⊥	$10^{-6}/°C$	13
Coefficient of Thermal Expansion Sm2Co17	C//	$10^{-6}/°C$	8-10
	C⊥	$10^{-6}/°C$	11
Electrical Resistivity Sm1Co5	ρ	$\mu\ \Omega$.cm	5-6
Electrical Resistivity Sm2Co17	ρ	$\mu\ \Omega$.cm	80-90
Electrical Conductivity Sm1Co5	σ	$10^6 S/m$	16.6-20
Electrical Conductivity Sm2Co17	σ	$10^6 S/m$	1.11-1.25
Thermal Conductivity Sm1Co5	k	kCal/(m.h.°C)	11
Thermal Conductivity Sm2Co17	k	kCal/(m.h.°C)	10
Specific Heat Capacity Sm1Co5	c	kCal/(kg.°C)	0.08
Specific Heat Capacity Sm2Co17	c	kCal/(kg.°C)	0.09
Tensile Strength Sm1Co5	σ_{UTS} or S_U	kg/mm^2	4.1
Tensile Strength Sm2Co17	σ_{UTS} or S_U	kg/mm^2	3.6
Young's Modulus Sm1Co5	λ / E	$10^{11} N/m^2$	1.6
Young's Modulus Sm2Co17	λ / E	$10^{11} N/m^2$	1.2
Flexural Strength Sm1Co5	σ	N/mm^2	120
Flexural Strength Sm2Co17	σ	N/mm^2	110
Compressive strength Sm1Co5	σ	N/mm^2	650
Compressive strength Sm2Co17	σ	N/mm^2	800
Rigidity	E.I	N/m^2	150
Poisson's Ratio	ν		0.27
Curie Temperature Sm1Co5	Tc	°C	700-750
Curie Temperature Sm2Co17	Tc	°C	800-850

Example of a BH curve (second quadrant demagnetisation)



Additional Notes

SmCo magnets will outperform NdFeB magnets at temperatures above +150°C to +180°C.
SmCo magnets can be used at cryogenic temperatures (i.e. towards absolute zero, -273°C).
The magnet shape, its environment, and the actual application affect how the NdFeB magnet will perform. Temperature is important as well as damp or wet conditions.
When determining suitability, you should analyse the Intrinsic curve not the Normal curve.
By keeping the intrinsic working point above the 'knee' and ideally at the BHmax working point maximum performance is possible.
If you have any more questions, require technical assistance and would like a quotation, simply contact us.

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Technical Data Sheet - Alnico Magnets

Alnico Magnets

Alnico magnets have the best temperature coefficients of any magnet material.
Alnico magnets should be regarded as the best choice in extremely high temperature applications.
Alnico magnets can be produced by Casting or Sintering. Alnico is also rarely made by Bonding within a binder.
Cast Alnico is the most common form of Alnico magnet. Casting is often used to get "near net shape" Alnico magnets.
Casting Alnico is cost effective for both low and high volume, for small and very large magnets.
Sintered Alnico is cost effective for medium to high volume runs due to tooling cost. The parts are generally small to medium.
Sintered Alnico magnets are not so commonly used due to lower magnetic performance and limitation to simpler shapes.
Anisotropic magnets have the direction of magnetisation (DoM) permanently within the structure and give the maximum performance.
Isotropic magnets can be magnetised in many ways as they have no preferred direction of magnetisation but give reduced performance.
Cast Alnico 5 is the most common grade of Alnico, with the LNG44 variant of Alnico 5 (Alcomax 3) being the most popular.
Alnico5, Alnico 8 and Alnico 9 all exist with several sub-grades with differing performance characteristics.
Where the shape is new, tooling charges may apply. It is common for the magnet pole faces to be machined to finish.
Alnico produced to specific Br, Hc, Hci and BHmax may be possible but at extra cost. Keeping within normal grades is advised.
Custom or bespoke magnet shapes may carry an additional tooling cost and even a minimum order charge.
Alnico Assemblies are also possible.

Anisotropic Cast Alnico

Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m³	MGOe
Alnico 5 (Alnico5_LNG34)	1.10	11.0	50	0.63	52	0.65	34	4.25
Alnico 5 (Alnico5_LNG37)	1.18	11.8	50	0.61	51	0.64	37	4.63
Alnico 5 (Alnico5_LNG40)	1.20	12.0	50	0.63	52	0.65	40	5.00
Alnico 5 (Alnico5_LNG44)	1.25	12.5	50	0.65	54	0.68	44	5.50
Alnico 6 (Alnico6_LNG28)	1.15	11.5	58	0.73	60	0.75	28	3.50
Alnico 5DG (Alnico5DG_LNG52)	1.30	13.0	56	0.70	58	0.73	52	6.50
Alnico 5-7 (Alnico5-7_LNG60)	1.35	13.5	58	0.73	60	0.75	60	7.50
Alnico 8 (Alnico8_LNGT38)	0.80	8.0	110	1.38	112	1.4	38	4.75
Alnico 8 (Alnico8_LNGT40)	0.85	8.5	115	1.44	117	1.46	40	5.00
Alnico 8 (Alnico8_LNGT44)	0.90	9.0	115	1.44	117	1.46	44	5.50
Alnico 8HC (Alnico8HC_LNGT36J)	0.72	7.2	150	1.88	152	1.90	36	4.50
Alnico 9 (Alnico9_LNGT60)	1.00	10.0	110	1.38	112	1.4	60	7.50
Alnico 9 (Alnico9_LNGT72)	1.05	10.5	115	1.44	117	1.46	72	9.00
Alnico 9 (Alnico9_LNGT80)	1.08	10.8	120	1.50	122	1.53	80	10.00

Alnico 5 (LNG44) = Alcomax 3 = Alnico 500 = LNG44
Alnico 6 (LNG28) = Alcomax 4 = Alnico 400 = LNG28
Alnico 5DG (LNG52) = Alcomax 3SC = Alnico 600 = LNG52
Alnico 5-7 (LNG60) = Columax = Alnico 700 = LNG60
Alnico 8 (LNGT44) = Hycomax 3 = Alnico 8HE = LNGT44
Alnico 8 (LNGT40) = Hycomax 2 = Alnico 8H = LNGT40
Alnico 8 (LNGT38) = Alnico 8B = LNGT38
Alnico 8HC (LNGT36J) = Alnico 8HC = LNGT36J

Anisotropic Sintered Alnico

Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m³	MGOe
Alnico 5 (Alnico5_FLNG34)	1.15	11.5	48	0.60	50	0.63	34	4.25
Alnico 6 (Alnico6_FLNG28)	1.10	11.0	58	0.73	60	0.75	28	3.50
Alnico 8HC (Alnico8HC_FLNG36J)	0.72	7.2	150	1.88	152	1.90	36	4.50
Alnico 8 (Alnico8_FLNGT38)	0.80	8.0	110	1.38	112	1.40	38	4.75
Alnico 8 (Alnico8_FLNGT44)	0.85	8.5	120	1.50	122	1.53	44	5.50
Alnico 8 (Alnico8_FLNGT48)	0.92	9.2	125	1.56	127	1.59	48	5.50

Isotropic Cast Alnico

Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m³	MGOe
Alnico 3 (Alnico3_LN10)	0.65	6.5	38	0.48	40	0.50	10	1.25
Alnico 2 (Alnico2_LNG12)	0.75	7.5	45	0.56	46	0.58	12	1.50
Alnico 8 (Alnico8_LNG18)	0.55	5.5	90	1.13	97	1.21	18	2.25

Isotropic Sintered Alnico

Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m³	MGOe
Alnico 3 (Alnico3_FLN10)	0.65	6.5	40	0.50	42	0.53	10	1.25
Alnico 2 (Alnico2_FLNG12)	0.75	7.5	45	0.56	46	0.58	12	1.50
Alnico 8 (Alnico8_FLNGT18)	0.60	6.0	95	1.19	98	1.23	18	2.25
Alnico 8 (Alnico8_FLNGT20)	0.62	6.2	100	1.25	105	1.31	20	2.50

Bonded Alnico

Typical Range of Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	T	kG	kA/m	kOe	kA/m	kOe	kJ/m³	MGOe
Alnico_BLN7	0.31	3.1	79	1.00	103	0.85	6.77	0.86
Alnico_BLN8	0.34	3.4	83	1.05	107	1.00	7.96	1.00

Physical Characteristics (Typical)

Characteristic	Symbol	Unit	Value
Density	D	g/cc	6.9-7.3
Vickers Hardness	Hv	D.P.N	520-700
Curie Temperature	Tc	°C	800
Compression Strength	C.S	N/mm²	300-400
Coefficient of Thermal Expansion	C//	10^{-6}/°C	11.5-13
	C⊥	10^{-6}/°C	11.5-13
Electrical Resistivity	ρ	$\mu\,\Omega$.cm	45-70
Tensile Strength	σ_{UTS} or S_U	x10^6 Pa	20-450 (37 LNG44)
Hardness		Rockwell	45-55
Curie Temperature	Tc	°C	810-860

Max Working Temperature
(Please note - your application will affect the performance available)

Material	Maximum recommended temperature
Alnico 2	450 degrees C
Alnico 3	450 degrees C
Alnico 5	525 degrees C
Alnico 6	525 degrees C
Alnico 5DG	525 degrees C
Alnico 5-7	525 degrees C
Alnico 8	550 degrees C
Alnico 8HC	550 degrees C
Alnico 9	550 degrees C
Bonded Alnico	150-200 degrees C (binder limiting)

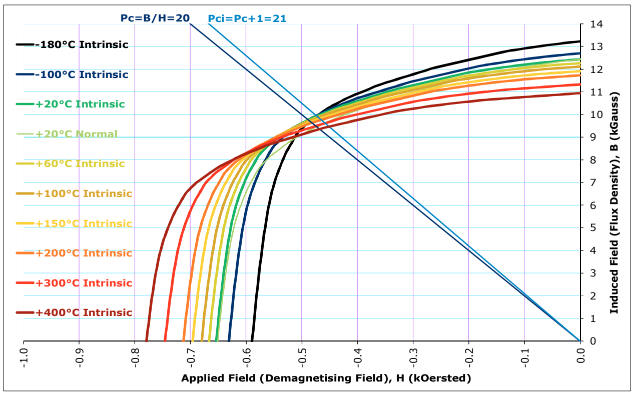
Corrosion Resistance

Alnico is regarded as having very good to excellent corrosion resistance for most applications.
Because iron exists within the Alnico alloy, corrosion may be seen during prolonged exposure to water.
Alnico can be coated or painted (e.g. Red Paint) but this is often only for aesthetic purposes.

Temperature coefficients

Rev.Temp.Coef. of Induction (Br), α, %/°C	Rev.Temp.Coef. of Intrinsic Coercivity (Hci), β, %/°C
-0.03 (Alnico 2, Cast)	-0.02 (Alnico 2, Cast)
-0.035 (Alnico 2, Sintered)	-0.025 (Alnico 2, Sintered)
-0.035 (Alnico 3, Cast)	-0.025 (Alnico 3, Cast)
-0.03 (Alnico 3, Sintered)	-0.02 (Alnico 3, Sintered)
-0.02 (Alnico 5, Cast and Sintered)	+0.01 (Alnico 5, Cast and Sintered)
-0.02 (Alnico 6, Cast and Sintered)	+0.03 (Alnico 6, Cast and Sintered)
-0.02 (Alnico 5DG, Cast)	+0.03 (Alnico 5DG, Cast)
-0.02 (Alnico 5-7, Cast)	+0.03 (Alnico 5-7, Cast)
-0.025 (Alnico 8, Cast and Sintered)	+0.01 (Alnico 8, Cast and Sintered)
-0.025 (Alnico 8HC, Cast and Sintered)	+0.01 (Alnico 8HC, Cast and Sintered)
-0.025 (Alnico 9, Cast and Sintered)	+0.01 (Alnico 9, Cast and Sintered)

Example Alnico second quadrant demagnetisation BH curve



Additional Information

The magnet shape, its environment, and the actual application affect how the Alnico magnet will perform.
The Intrinsic curve (not the Normal curve, although similar in shape for Alnico) is needed to assist in determining magnet suitability.
For Alnico, it is important to keep the working point above the "knee" of the Intrinsic curve to avoid severe demagnetisation.
Rotating machines and generators using Alnico need careful design due to the varying air gap during rotor rotation.
We can assist in designing in resistance to demagnetisation. We can guide you with your design options.
A length to diameter (L/D) ratio of at least 4 or 5 is a rule of thumb guide when using Alnico. A high L/D ratio is important for resisting demagnetising.
External demagnetising factors such as other magnets and electromagnets must be taken into account. They will put a field onto the magnet risking demagnetising it.
Even pushing two Alnico magnets in repulsion into each other can weaken their output. However careful handling will quickly resolve this. Alnico can be remagnetised.
The risk of demagnetisation of Alnico is reduced by improving the working point (e.g. use a longer magnet, increase the L/D ratio, use a higher Hc, introduce magnetic steel to the circuit, etc).
Alnico magnets have the best temperature coefficients of any magnet type. Alnico has the least change in field output over a change in temperature. They can also operate at the highest temperatures of any magnet.
Cast Alnico can have a blackened surface - this is the "As Cast" finish with the surface texture coming from the sand cast mold. Machining of the Alnico (e.g. precision ground pole faces) leaves a bright silvery metallic finish.
Very small air holes may be seen from time to time within the structure of cast Alnico magnets. This is natural for cast magnets (due to the casting process) and cannot be avoided.
If you have any more questions, require technical assistance and would like a reputable answer, simply contact us.
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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 37 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.

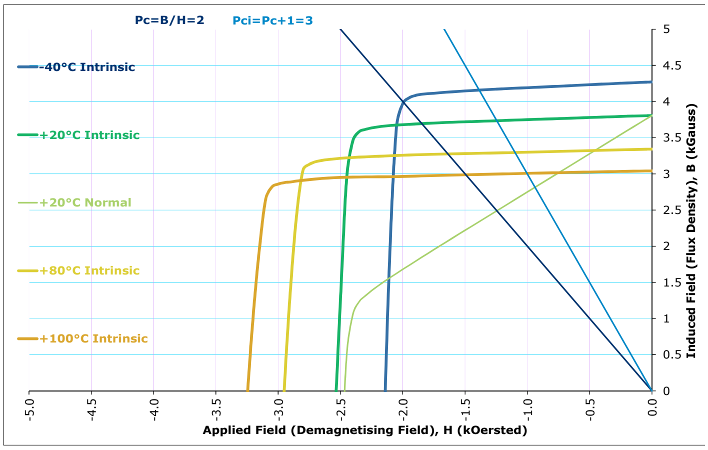
NOTE:- Ferrite magnets are not the same as soft ferrites (as used in transformers) - they are totally different in operation.
"Transformer" ferrites do not retain magnetism (soft ferrite). Ferrite magnets are permanent magnets - they retain their magnetism (hard ferrite).

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

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 ≅ C8C
C12 = Y30H-2.

Higher Performance / Specialist Ferrite Grades

Typical Values

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax	
	mT	kG	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe
4045	390-410	3.9-4.1	287-310	3.60-3.90	358-382	4.49-4.79	28.7-31.8	3.5-4.0
4229	415-435	4.15-4.35	215-239	2.70-3.00	219-243	2.75-3.05	30.3-33.4	3.7-4.2
4240	410-430	4.1-4.3	283-307	3.55-3.85	307-330	3.85-4.14	31.2-35.2	3.9-4.4
4350	420-440	4.2-4.4	294-326	3.69-4.09	386-410	4.84-5.15	33.4-36.6	4.1-4.6
4433	430-450	4.3-4.5	247-271	3.10-3.40	251-275	3.15-3.45	33.4-36.6	4.1-4.6
4545	440-460	4.4-4.6	318-350	3.99-4.39	347-370	4.35-4.64	36.6-39.8	4.5-5.0
4550	440-460	4.4-4.6	303-334	3.80-4.19	374-406	4.69-5.10	35.9-39.1	4.4-4.9
4636	450-470	4.5-4.7	266-290	3.34-3.64	274-298	3.44-3.74	38.8-42.0	4.8-5.3
4654	450-470	4.5-4.7	333-357	4.18-4.48	418-442	5.25-5.55	39.8-43.0	4.9-5.4
4748	460-480	4.6-4.8	328-352	4.12-4.42	368-392	4.62-4.92	41.5-44.7	5.2-5.6

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bsi. ISO 9001 Quality Management
FM31278

Technical Data Sheet - Ferrite Magnets / Ceramic Magnets

American Standard - used in UK but being replaced by Chinese nomenclature

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
C8C	430	4.30	199	2.50	203	2.55	34.2	4.29
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

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

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 - it really depends on the total magnetic circuit and the ferrite grade used.

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

Temperature coefficients

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

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 cannot corrode in water.
Ferrite magnets are essentially made from oxides of iron and Strontium and Barium.
They are sometimes regarded as being 'magnetic rust'.

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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Technical Data Sheet - Compression Bonded and Injection Molded Magnets

Compression Bonded & Injection Molded Magnets

The Compression Bonded Magnets and Injection Molded Magnets are sometimes also called Plastic Magnets. This is because the binder is usually a plastic or epoxy.
The magnet material can be NdFeB powder, SmCo powder, Ferrite (Ceramic) powder or Alnico powder. The magnet performance usually follows the percentage of magnetic material used.
It is also possible to have Hybrid Compression Bonded Magnets and Hybrid Injection Molded Magnets. These contain more than one magnet type e.g. NdFeB plus Ferrite, NdFeB plus SmCo.
The hybrid bonded magnets and hybrid molded magnets have magnetic properties which are a "blend" of the individual properties of each magnet material to allow "tuned" performance characteristics.
It is also possible to produce compression bonded and injection molded magnets with reduced magnetic performance by deliberately using less magnetic material (less "loading").
When the magnetic material content is less than 40 to 50 percent of the total material, the magnetic performance become too inconsistent and is not used in production.
Compression Bonded Magnets are also sometimes called Bonded Rare Earth Magnets (bremag) when the magnet material is a rare earth alloy material (NdFeB or SmCo).
The compression and injection processes may require a dedicated tooling (mold) to make the magnet to the required shape. New tooling could be very expensive.
A dedicated magnetising fixture tooling may be required - it depends on whether a coil fixture need producing to achieve the pattern (we check whether the pattern is possible when quoting).
The complexity of the magnetic field pattern is limited only by the ability to produce a magnetising fixture capable of magnetically saturating the required field pattern into the magnet.
When we look to provide a quotation we assess if we can use or modify existing tooling to try to avoid tooling charges. We also check whether the requested magnetising pattern is possible.

Compression Bonded Process

Compression molding is performed using a solid binder, assisting with a higher magnetic loading. The binder is usually a thermosetting epoxy or a plastic.
After pressing into the required shape, the binder is cured in an oven. The end material is isotropic - it can be magnetised in any direction subject to the magnetising coil fixture design.
Because the Compression Bonded Magnet is pressed inside tools, the tolerances achieved are very good and so no further machining is required after the magnets have been produced.
The compression bonded magnets coat and electrically insulate the magnet material resulting in low electrical conductivity. Such bonded magnets give lower eddy currents during operation.
Compression molding is cost effective when higher volumes are required - compression molded magnets are best produced in tens or hundreds of thousands of magnets per production run
The compression bonding process is limited to simpler shapes such as rectangles, rings, arcs and cylinders. A consistent cross sectional area is required along the pressing direction.
Compression bonded magnets offer higher magnetic performance than the injection molded magnets (due to higher magnetic loading).
The ratio of magnetic material powder to binder is higher in compression bonded magnets (i.e. a higher percentage of magnetic material is present in each unit volume of magnet - termed a "higher loading").

Injection Molded Process

Injection molding gives greater variety of shapes to be produced compared to Compression bonded. More complex shapes can potentially be achieved using injection molding.
Injection modling can be used for overmolding magnetic material over, around or within an assembly part (e.g. putting magnet material onto a rotor shaft).
When molding or overmolding, features such as knurling and slots on the non-magnet part can assist in mechanically fixing the magnet material in place.
The shapes applicable to the injection molded magnet process include rings, cylinders, more complex shapes, insert molds and overmolds.
It is also possible to use injection molding to put plastic around sintered and cast magnets to produce assembly parts.
The shapes are produced with very good tolerances. Injection molded magnets are generally more resistant to chipping than compression bonded magnets.
Because a lower viscosity is required in the injection process, a lower ratio of magnetic powder to binder is needed resulting in magnets with a lower percentage of magnetic material per unit volume.
Injection molded magnets offer lower magnetic performance than the compression bonded magnets (due to lower magnetic loading).
The magnetic field pattern can be added to the magnet during or after the injection molding process. Injection molded magnets are isotropic.
For cost effective magnet production, injection molded magnets are usually produced in tens or hundreds of thousands of magnets per production run.

Compression Bonded NdFeB range

Typical Values (based on samples tested)

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax		Density	Recoil Permeability (μr)	Rev.Temp.Coef. of Induction (Br), α, %/°C	Maximum working temperature (°C)
	mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe	g/cm^3			
CompBondedNdFeB-6	550-620	5500-6200	285-370	3600-4600	600-755	7500-9500	44-56	5.5-7.0	5.5-6.1	1.15	-0.13	100
CompBondedNdFeB-8L	600-640	6000-6400	360-400	4500-5000	715-800	9000-10000	56-64	7.0-8.0	5.6-6.1	1.15	-0.13	110
CompBondedNdFeB-8	620-690	6200-6900	385-445	4800-5600	640-800	8000-10000	64-72	8.0-9.0	5.8-6.1	1.15	-0.13	120
CompBondedNdFeB-8SR	620-660	6200-6600	410-465	5200-5800	880-1120	11000-14000	64-72	8.0-9.0	5.8-6.1	1.13	-0.13	150
CompBondedNdFeB-8H	610-650	6100-6500	410-455	5200-5700	1190-1440	15000-18000	64-72	8.0-9.0	5.9-6.2	1.15	-0.07	125
CompBondedNdFeB-9	650-700	6500-7000	400-440	5000-5500	640-800	8000-10000	70-76	8.8-9.5	5.8-6.1	1.22	-0.12	120
CompBondedNdFeB-10	680-720	6800-7200	420-470	5300-5900	640-800	8000-10000	76-84	9.5-10.5	5.8-6.1	1.22	-0.11	120
CompBondedNdFeB-11	700-740	7000-7400	445-480	5600-6000	680-800	8500-10000	80-88	10.0-11.0	5.8-6.1	1.22	-0.11	120
CompBondedNdFeB-11L	700-740	7000-7400	400-440	5000-5500	520-640	6500-8000	78-84	9.8-10.5	5.8-6.1	1.26	-0.11	110
CompBondedNdFeB-12L	740-800	7400-7800	420-455	5300-5700	520-600	6500-7500	84-92	10.5-11.5	5.8-6.1	1.26	-0.11	110

Injection Molded NdFeB magnet range

Typical Values (based on samples tested)

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax		Density	Recoil Permeability (μr)	Rev.Temp.Coef. of Induction (Br), α, %/°C	Maximum working temperature (°C)
	mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe	g/cm^3			
InjMoldedNdFeB-3	200-400	2000-4000	120-240	1500-3000	480-640	6000-8000	8-24	1.0-3.0	3.9-4.4	1.2	-0.15	100
InjMoldedNdFeB-4	400-460	4000-6000	250-335	3100-4200	575-735	7200-9200	28-36	3.5-4.5	4.4-4.9	1.2	-0.13	110
InjMoldedNdFeB-5	450-510	4500-5100	280-360	3500-4500	640-800	8000-10000	37-44	4.6-5.5	4.5-5.0	1.2	-0.13	120
InjMoldedNdFeB-6	510-560	5100-5600	295-375	3700-4700	640-800	8000-10000	44-52	5.5-6.5	4.7-5.1	1.13	-0.11	120
InjMoldedNdFeB-6H	480-560	4800-5600	335-400	4200-5000	1035-1355	13000-17000	40-52	5.0-6.5	4.8-5.2	1.13	-0.15	130
InjMoldedNdFeB-7	540-640	5400-6400	320-400	4000-5000	640-800	8000-10000	51-59	6.5-7.5	5.0-5.5	1.13	-0.11	120
InjMoldedNdFeB-5SR (PPS)	450-500	4500-5000	300-360	3800-4500	875-1115	11000-14000	36-44	4.5-5.4	4.9-5.4	1.13	-0.13	150

Bonded Ferrite magnet range

Typical Values (based on samples tested)

Material	Br		Hc (Hcb)		Hci (Hcj)		BHmax		Binder	Rev.Temp.Coef. of Induction (Br), α, %/°C	Rev.Temp.Coef. of Intrinsic Coercivity (Hci), β, %/°C
	mT	G	kA/m	Oe	kA/m	Oe	kJ/m^3	MGOe			
BondedFerrite_S62	239	2,390	171	2149	235	2953	11.1	1.39	PA6	-0.19	0.2~0.3
BondedFerrite_YN-16	275	2,750	175	2250	263	3300	12.5	1.6	Nitrile Rubber	-0.19	0.2~0.3
BondedFerrite_S65	276	2,760	185	2325	228	2865	15	1.88	PA6	-0.19	0.2~0.3
BondedFerrite_S67K	288	2,880	182	2287	217	2727	16.2	2.03	PA6	-0.19	0.2~0.3
BondedFerrite_S68	291	2,910	177	2224	211	2651	16.4	2.06	PA6	-0.19	0.2~0.3
BondedFerrite_F26S	282	2,820	187	2350	227	2852	15.6	1.96	PA12	-0.19	0.2~0.3
BondedFerrite_A27E	288	2,880	187	2350	227	2852	16.2	2.03	PA12	-0.19	0.2~0.3
BondedFerrite_A27N	294	2,940	184	2312	223	2802	16.9	2.12	PA12	-0.19	0.2~0.3

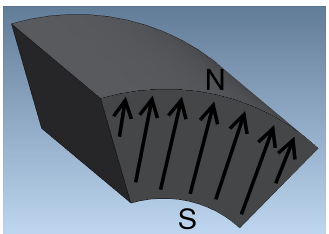
Bonded SmCo magnet range and Bonded Alnico magnet range

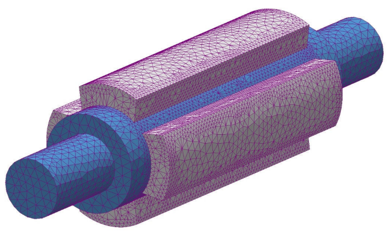
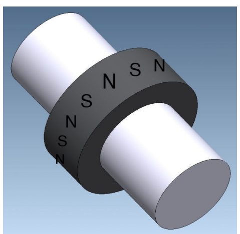
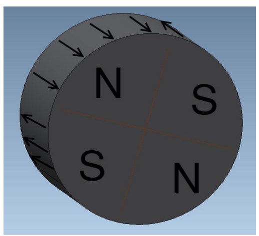
Please see the SmCo and Alnico data sheets for more information. Bonded SmCo and Bonded Alnico are not commonly used.

Custom grades, Custom shapes, Custom magnetic patterns

Because grades can be blended and loaded differently, a variety of grade possibilities exist. As such our list is not exhaustive - we can look to make custom grades.
We can also produce custom shapes with customised magnetic patterns (within reason - we assess each request for feasibility). Tooling charges may sometimes apply.
If you cannot find what you are looking for on this sheet, do not worry. Simply contact us with your requirment and we will review it and provide a quotation if the requirement is feasible to produce.

Examples of Compression Bonded Magnets and Injection Molded Magnets



Additional Notes

The magnet shape, its environment, and the actual application affect how the magnets will perform.
The Intrinsic curve is needed to assist in determining magnet suitability.
For Compression Bonded and Injection Molded Magnets binder is usually the limiting factor on suitability for applications. The binders, being thermo-elastomers, can soften with heat.
The processes of manufacture are better suited for high or very high volumes due to the possible high tooling charges.
The process produces isotropic magnets (i.e. they can be magnetised afterwards in any direction of magnetisation).
The magnetising pattern for the magnet is limited by whether the magnetising coil fixture can be produced to give the required magnetising pattern.
Any requirement to make special magnetising coil fixtures would carry an additional tooling charge.
The potential of two tooling charges usually results in high volume requirements being necessary to make production by this method cost effective.
Where possible we would always llok to use of modify existing tooling and magnetising fixtures.
Any tooling or magnetising fixtures would belong to us at all times.
Samples are not usually held in stock.
If you have any more questions, require technical assistance and would like a quotation, simply contact us.
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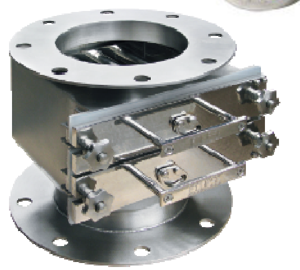
- Magnetic Assemblies – made to customer requirements – UK & China (JV) for production
- NdFeB magnets (Neodymium Iron Boron magnets) – Licensed NdFeB via our JV in China
- SmCo magnets (Samarium Cobalt magnets)
- Alnico magnets (cast and sintered)
- Ferrite magnets (Ceramic Magnets)
- Compression Bonded Magnets
- Injection Molded Magnets
- Flexible Rubber Magnets
- Electromagnets, Electro-permanent magnets
- Separators, Filters, Overbands, Lifters, Chucks, Tools, etc
- Other magnetic materials e.g. FeCrCo, PtCo, soft magnetic materials, ferrosheet
- Eclipse has ISO9001, ISO14001; our JV in China has ISO9001, TS16949, ISO14001



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