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/m³	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/m³	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/m³	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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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.

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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 °C = 176 °F *
M	-0.115	-0.65	100°C = 212 °F *
H	-0.110	-0.60	120°C = 248 °F
SH	-0.105	-0.55	150 °C = 302 °F
UH	-0.100	-0.55	180 °C = 356 °F
EH	-0.095	-0.50	200 °C = 392 °F
VH / AH	-0.090	-0.49	230 °C = 446 °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

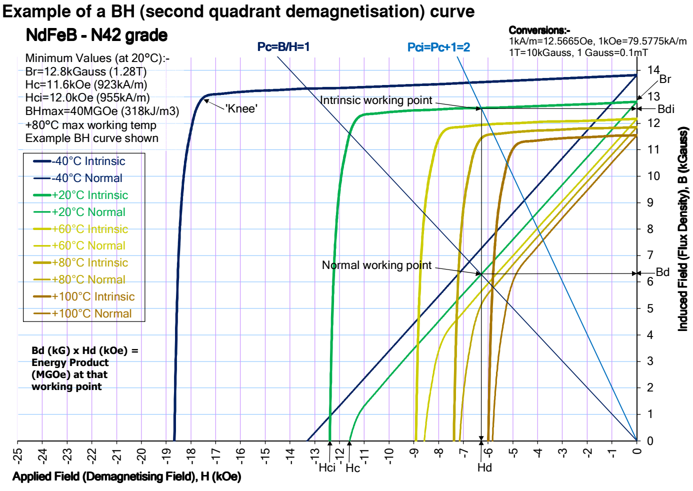
Physical Characteristics (Typical)

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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