Sintered Neodymium Magnets

Introduction

Magnetic characteristics of sintered neodymium magnets

Features of sintered neodymium magnets

1. Typical magnetic properties of sintered neodymium magnets
2. Temperature coefficients of sintered neodymium magnets
3. Other characteristic physical properties
4. Surface treatment
5. Forms of supply

Precautions regarding safety and use

Contents Update: September 2022

⚠The details can be found by referring to the appended individual delivery specifications. All specifications are subject to change without notice.

Sintered Neodymium Magnets

Introduction

Sintered neodymium iron boron (NdFeB) magnets have excellent permanent magnetic properties and high-performance price ratio compared with traditional permanent magnets. Neodymium magnets mainly comprised of iron, neodymium, boron and other trace elements. They are the third generation of permanent magnet developed in the 1980s and offer the strongest magnetic power today. With the excellent magnetic characteristics, neodymium magnets offer flexibility for new designs or are replacing older materials like Alnico and Ceramic in many applications. Sintered neodymium magnets are widely used in the fields of transportation, energy, communications, intelligence manufacture, intelligent drive.

A powder metallurgy process is used in producing sintered neodymium magnets. Although sintered neodymium magnets are mechanically stronger than samarium cobalt magnet and less brittle than other magnets, it should not be used as a structural component. Selection of sintered neodymium magnet is limited by temperature due to its irreversible loss and moderately high reversible temperature coefficient of B_r and H_{cJ}. The maximum application temperature is 200 °C for high

coercivity grades. Neodymium magnets are more prone to oxidation than any other magnet alloys. If neodymium magnets are to be exposed to humidity, chemically aggressive media such as acids, alkaline solutions salts and harmful gases, coating is recommended.

Features of sintered neodymium magnets

1. Typical magnetic properties of sintered neodymium magnets

Magnetic properties of different manufacturers vary slightly. Following data are only for reference when designing and selecting materials.

Grade		Residual magnetic flux density B_r		Coercive force H_{cB}		Intrinsic coercive force H_{cJ}		Maximum energy product $(BH)_{max}$		Work Temperature T_w
		T	kGs	kA/m	kOe	kA/m	kOe	kJ/m^3	MGOe	℃
		Range		Min		Min		Range		Reference
N	**N30**	1.08-1.13	10.8-11.3	796	10.0	955	12	223-247	28-31	80
	N33	1.13-1.17	11.3-11.7	836	10.5	955	12	247-271	31-34	80
	N35	1.17-1.22	11.7-12.2	860	10.8	955	12	263-287	33-36	80
	N38	1.22-1.25	12.2-12.5	860	10.8	955	12	287-310	36-39	80
	N40	1.25-1.28	12.5-12.8	860	10.8	955	12	302-326	38-41	80
	N42	1.28-1.32	12.8-13.2	860	10.8	955	12	318-342	40-43	80
	N45	1.32-1.38	13.2-13.8	860	10.8	955	12	342-366	43-46	80
	N48	1.38-1.42	13.8-14.2	860	10.8	955	12	366-390	46-49	80
	N50	1.40-1.45	14.0-14.5	860	10.8	955	12	382-406	48-51	80
	N52	1.43-1.48	14.3-14.8	836	10.5	955	12	398-422	50-53	80
	N54	1.45-1.49	14.5-14.9	836	10.5	876	11	406-438	51-55	80
	N56	1.48-1.52	14.8-15.2	836	10.5	876	11	414-454	52-57	80

Sintered Neodymium Magnets

M	**N30M**	1.08-1.13	10.8-11.3	796	10.0	1114	14	223-247	28-31	100
	N33M	1.13-1.17	11.3-11.7	836	10.5	1114	14	247-271	31-34	100
	N35M	1.17-1.22	11.7-12.2	868	10.9	1114	14	263-287	33-36	100
	N38M	1.22-1.25	12.2-12.5	899	11.3	1114	14	287-310	36-39	100
	N40M	1.25-1.28	12.5-12.8	923	11.6	1114	14	302-326	38-41	100
	N42M	1.28-1.32	12.8-13.2	955	12.0	1114	14	318-342	40-43	100
	N45M	1.32-1.38	13.2-13.8	995	12.5	1114	14	342-366	43-46	100
	N48M	1.38-1.42	13.8-14.2	1027	12.9	1114	14	366-390	46-49	100
	N50M	1.40-1.45	14.0-14.5	1033	13.0	1114	14	382-406	48-51	100
	N52M	1.43-1.48	14.3-14.8	1050	13.2	1114	14	398-422	50-53	100
	N54M	1.45-1.49	14.5-14.9	1050	13.2	1114	14	406-438	51-55	100
H	**N30H**	1.08-1.13	10.8-11.3	796	10.0	1353	17	223-247	28-31	120
	N33H	1.13-1.17	11.3-11.7	836	10.5	1353	17	247-271	31-34	120
	N35H	1.17-1.22	11.7-12.2	868	10.9	1353	17	263-287	33-36	120
	N38H	1.22-1.25	12.2-12.5	899	11.3	1353	17	287-310	36-39	120
	N40H	1.25-1.28	12.5-12.8	923	11.6	1353	17	302-326	38-41	120
	N42H	1.28-1.32	12.8-13.2	955	12.0	1353	17	318-342	40-43	120
	N45H	1.32-1.36	13.2-13.6	995	12.5	1353	17	342-366	43-46	120
	N48H	1.38-1.42	13.8-14.2	1027	12.9	1353	17	366-390	46-49	120
	N50H	1.40-1.45	14.0-14.5	1043	13.1	1353	17	382-406	48-51	120
	N52H	1.43-1.48	14.3-14.8	1059	13.3	1353	17	398-422	50-53	120
	N54H	1.45-1.49	14.5-14.9	1059	13.3	1273	16	406-446	51-55	120
SH	**N30SH**	1.08-1.13	10.8-11.3	804	10.1	1592	20	223-247	28-31	150
	N33SH	1.13-1.17	11.3-11.8	844	10.6	1592	20	247-271	31-34	150
	N35SH	1.17-1.22	11.7-12.2	876	11.0	1592	20	263-287	33-36	150
	N38SH	1.22-1.25	12.2-12.5	907	11.4	1592	20	287-310	36-39	150
	N40SH	1.25-1.28	12.5-12.8	939	11.8	1592	20	302-326	38-41	150
	N42SH	1.28-1.32	12.8-13.2	955	12.0	1592	20	318-342	40-43	150
	N45SH	1.32-1.36	13.2-13.6	995	12.5	1592	20	342-366	43-46	150
	N48SH	1.38-1.42	13.8-14.2	1035	13.0	1592	20	366-390	46-49	150
	N50SH	1.40-1.45	14.0-14.5	1043	13.1	1592	20	382-406	48-51	150
UH	**N28UH**	1.04-1.08	10.4-10.8	764	9.6	1990	25	207-231	26-29	180
	N30UH	1.08-1.13	10.8-11.3	812	10.2	1990	25	223-247	28-31	180

Sintered Neodymium Magnets

	N33UH	1.13-1.17	11.3-11.7	852	10.7	1990	25	247-271	31-34	180
	N35UH	1.17-1.22	11.7-12.2	860	10.8	1990	25	263-287	33-36	180
	N38UH	1.22-1.25	12.2-12.5	907	11.4	1990	25	287-310	36-39	180
	N40UH	1.25-1.28	12.5-12.8	923	11.6	1990	25	302-326	38-41	180
	N42UH	1.28-1.32	12.8-13.2	971	12.2	1990	25	318-342	40-43	180
	N45UH	1.32-1.36	13.2-13.6	1003	12.6	1990	25	342-366	43-46	180
	N48UH	1.38-1.42	13.8-14.2	1031	12.9	1990	25	366-390	46-49	180
EH	**N28EH**	1.04-1.08	10.4-10.8	780	9.8	2388	30	207-231	26-29	200
	N30EH	1.08-1.13	10.8-11.3	820	10.3	2388	30	223-247	28-31	200
	N33EH	1.13-1.17	11.3-11.7	860	10.8	2388	30	247-271	31-34	200
	N35EH	1.17-1.22	11.7-12.2	884	11.1	2388	30	263-287	33-36	200
	N38EH	1.22-1.25	12.2-12.5	923	11.6	2388	30	287-310	36-39	200
	N40EH	1.25-1.28	12.5-12.8	947	11.9	2388	30	302-326	38-41	200
	N42EH	1.28-1.32	12.8-13.2	970	12.2	2388	30	318-342	40-43	200
	N45EH	1.32-1.36	13.2-13.6	1003	12.6	2388	30	342-366	43-46	200
AH	**N28AH**	1.04-1.08	10.4-10.8	787	9.9	2786	35	207-231	26-29	230
	N30AH	1.08-1.13	10.8-11.3	819	10.3	2786	35	223-247	28-31	230
	N33AH	1.13-1.17	11.3-11.7	843	10.6	2786	35	247-271	31-34	230
	N35AH	1.17-1.22	11.7-12.2	884	11.1	2786	35	263-287	33-36	230
	N38AH	1.22-1.25	12.2-12.5	915	11.5	2786	35	287-310	36-39	230

The above-mentioned data of magnetic properties and physical properties are given at room temperature (20℃).

The max working temperature of magnet is changeable due to length-diameter ratio, coating thickness and other environment factors.

Additional grades are available. Please contact us for information.

- **Grain Boundary Diffusion (GBD) is an important new advance in neodymium magnets production technology.**

  “GBD NdFeB” magnets offer a combination of high energy density and temperature stability at moderate cost by reducing the amount of Dysprosium

(Dy) (GBDD) and Terbium (Tb) (GBDT) used. This process enhances coercivity while limiting the adverse effects on remanence, when compared to traditional NdFeB manufacturing methods.

2. Temperature coefficients of sintered neodymium magnets

With higher H_{cJ} value, sintered neodymium magnets are stable during high temperature. The following data are reference values in Chinese national standard (GB/T 13560-2017).

Grade	Temperature ℃	Temperature Coefficients		Unit
		of B_r	of H_{cJ}	
N Serie	20℃~100℃	-0.090~-0.124	-0.70~-0.82	%/℃
M Serie	20℃~100℃	-0.090~-0.124	-0.65~-0.80	%/℃
H Serie	20℃~100℃	-0.090~-0.124	-0.60~-0.75	%/℃
SH Serie	20℃~100℃	-0.090~-0.122	-0.55~-0.70	%/℃
	20℃~150℃	-0.095~-0.124	-0.50~-0.65	%/℃
UH Serie	20℃~100℃	-0.090~-0.120	-0.53~-0.66	%/℃
	20℃~180℃	-0.095~-0.122	-0.48~-0.61	%/℃
EH Serie	20℃~100℃	-0.090~-0.120	-0.50~-0.62	%/℃
	20℃~200℃	-0.095~-0.122	-0.46~-0.58	%/℃
AH Serie	20℃~100℃	-0.090~-0.120	-0.47~-0.60	%/℃
	20℃~200℃	-0.095~-0.122	-0.45~-0.56	%/℃
Curie Temperature T_c		583~623		K
Recoil Permeability μ_{rac}		1.05		-

3. Other characteristic physical properties

Following data are only for reference when designing and selecting materials, not as product acceptance standards.

Item	Value	Unit
Density	7.40~7.70	g/cm^3
Vickers Hardness (HV)	500~700	HV
Compressive Strength	1000~1100	MPa
Tensile Strength	80~90	MPa
Bending Strength	150~400	MPa
Thermal Conductivity	8~10	W/(m·K)
Young`s Modulus	150~200	GPa
Electrical Resistivity (20℃)	C∥1.4~1.6	μΩ·m
	C ⊥1.2~1.4	

4. Surface treatment

Surface protective treatment is the necessary procedure for the Neodymium magnets, especially sintered Neodymium magnets since Nd-rich phase possesses very strong oxidation tendency. The type and thickness of the coating depends on the prevalent environmental influences in the application.

Sintered Neodymium Magnets

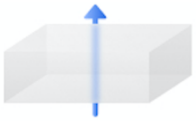
Coating	Thickness (μm)	Color	SST hrs	PCT hrs	Characteristics
White Zn	4-15	Bright blue	≥24	–	Poor corrosion resistance.
Color Zn	4-15	Shining color	≥48	–	Corrosion resistance is better than white Zn.
NiCuNi	5-20	Bright silver	≥48	≥48	Most regular used multi-layer coating. Excellent humidity and salt spray resistance.
Aluminum	2-15	Bright silver	≥24	≥24	Noticeable coating.
Epoxy	10-30	Black/Grey	≥72	≥72	Excellent humidity and salt spray resistance. Superior binding force.
Parylene	5-20	Colorless	≥96	–	Excellent humidity, salt spray, corrosive vapors, and solvents resistance. Free of pore.
Phosphating	1-3	Dark grey	–	–	Temporary protection.

5. Forms of supply

1) Types of magnetization

Sintered neodymium magnets are anisotropic materials - they have a preferred direction of magnetization locked into their structure. So the magnets can only be magnetized in one axis - any attempt to magnetize in another axis results in very little performance. Each sintered neodymium magnet has a direction of

magnetization.

Shape		Magnetization Direction
Block		Height/ Axial
Cylinder/Disk		Axial
		Diametral
Ring		Axial
		Diametral
		Radial
Segment		Diametral/Parallel
		Radial

2) Dimensional tolerances

Die-pressed sintered magnets usually need to be ground. The tolerance after grinding is normally ± 0.05mm; from case to case, values up to ± 0.02mm are possible. For tighter tolerances we would have to review the shape to inform you of the tolerances could achieve.

Precautions regarding safety and use

1. When a magnet is magnetized, strong attractive force or repulsive force arises between the magnet and other magnetic materials (magnet, yoke, rotor, stator, jig fixture, tool, etc.). A user's hand or finger may be sandwiched between the magnet and other magnetic materials during the handling or the assembling. Also, you may be injured by loss of balance of the body due to the attractive or repulsive force. Use appropriate jigs and take special care in handling the magnetized magnet. A magnetized magnet should be covered with a non-magnetic material such as wood or thick plastics and labeled as magnetized.
2. Sharp edge of a magnet may injure your finger. Protect fingers when needed.
3. When a magnet is magnetized in the winding coil, the magnet may fly out from the inside of the winding coil unexpectedly. It can be the cause of injury. Use a proper jig fixture and keep a magnet inside of the winding coil for safety.
4. When magnetized magnets are stacked, it is difficult to peel off, and chipping or a crack may occur. It is recommended to use spacers between the magnets. The stacked magnetized magnets are similar to one big magnet.
5. When a magnetized magnet is placed near the direct or alternating magnetic field, the demagnetization may occur.
6. A mechanical impact may be a cause of a fracture, a crack and a chipping of a magnet. Take special care during the handling of a magnetized magnet. Such a crack or a chipping may deteriorate the magnetic characteristic, the mechanical strength or the corrosion resistance. A broken piece of magnet may hurt your eyes or body.
7. Store magnets in the place without a mechanical impact. Keep the packaging materials of magnets to be dry. Keep the temperature above the dew point to prevent rust during the storage. Avoid water (rain, water used in the factory, etc.) to be splashed on the packaging material.

Sintered Neodymium Magnets

About MagnetSearcher

MagnetSearcher provides advanced neodymium magnets manufacturing services to engineers, designers, or procurement specialists worldwide.
At MagnetSearcher, you are no longer subject to the limits of your existing local suppliers. We integrate seamlessly with over 2,000 vetted manufacturing facilities across China. This means our customers can dynamically scale their product development needs or product output by sending manufacturing orders to MagnetSearcher.

2000+ Manufacturers

Put our highly vetted supplier network to work for you

500+ Magnet Experts

Get experienced magnet expert help when you need it

50000+ Magnets Quoted

Translates to better prices and lead times for you

20000+ Customers

Trusted by engineers and purchasing leaders worldwide

Contact Us

www.magnetsearcher.com

info@magnetsearcher.com

12/F, East Bay International Center,
Chaoyang District, Beijing, China, 100020