General Information

A neodymium magnet (also known as NdFeB, NIB, or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron, and boron to form the $Nd_2Fe_{14}B$ tetragonal crystalline structure. Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet made. They have replaced other types of magnet in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives, and magnetic fasteners.

The tetragonal $Nd_2Fe_{14}B$ crystal structure has exceptionally high uniaxial magnetocrystalline anisotropy (HA~7 teslas). This gives the compound the potential to have high coercivity (i.e., resistance to being demagnetized). The compound also has a high saturation magnetization (Js ~1.6 T or 16 kG) and typically 1.3 teslas. Therefore, as the maximum energy density is proportional to J_s^2, this magnetic phase has the potential for storing large amounts of magnetic energy (BH_{max} ~ 512 kJ/m^3 or 64 MG·Oe), considerably more than samarium cobalt (SmCo) magnets, which were the first type of rare earth magnet to be commercialized. In practice, the magnetic properties of neodymium magnets depend on the alloy composition, microstructure, and manufacturing technique employed.

Sintered $Nd_2Fe_{14}B$ tends to be vulnerable to corrosion. In particular, corrosion along grain boundaries may cause deterioration of a sintered magnet. This problem is addressed in many commercial products by adding a protective coating. Nickel plating or two-layered copper-nickel plating are the standard methods, although plating with other metals or polymer and lacquer protective coatings is also in use.

There are two principal neodymium magnet manufacturing routes:

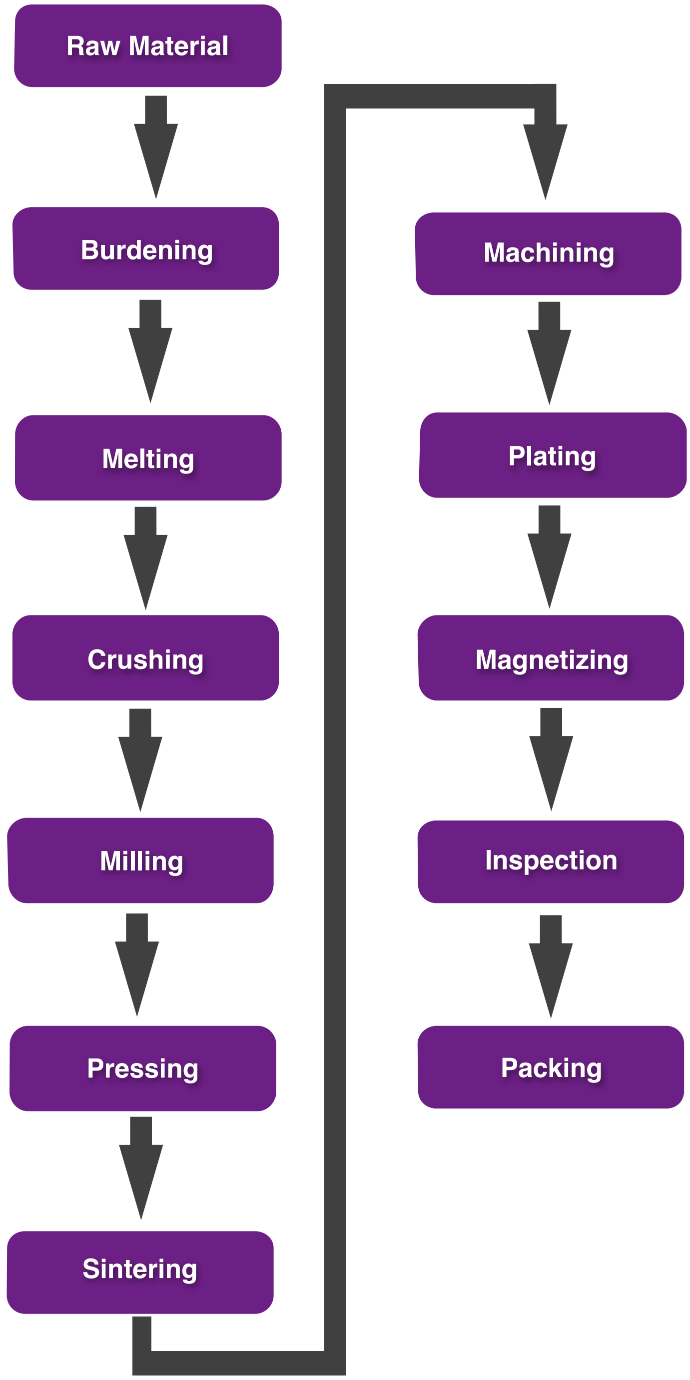
- The classical powder metallurgy or sintered magnet process
- The rapid solidification or bonded magnet process

Sintered Nd-magnets are prepared by the raw materials being melted in a furnace, cast into a mold and cooled to form ingots. The ingots are pulverized and milled to tiny particles. This undergoes a process of liquid-phase sintering whereby the powder is magnetically aligned into dense blocks which are then heat-treated, cut to shape, surface treated and magnetized.

According to different directions between tooling pressing and orientation, 2 categories as below:

- Parallel, this most common for sintered Nd magnets to use
- Vertical, special wire design in tooling for spectacular applications

Process Flow



Magnetic Property

1. PARALLEL DIRECTION BETWEEN TOOLING PRESSING AND ORIENTATION

Material Code Introduction：	N	XX	Y or YY
	Sintered Nd-Fe-B Magnets	Max. Energy Product	Max. Working Temp. Grade

Material Code	Residual Induction	Coercive Force	Intrinsic Coercive Force	Max. Energy Product	Max. Working Temperature
	Br(kGs)	Hcb(kOe)	Hcj(kOe)	BHmax(MGOe)	°C
N30	10.8-11.2	≥9.8	≥ 12.0	28-30	~80
N33	11.3-11.7	≥10.5	≥ 12.0	31-33	~80
N35	11.8-12.2	≥11.0	≥ 12.0	33-36	~80
N38	12.2-12.6	≥11.4	≥ 12.0	36-38	~80
N40	12.6-12.9	≥10.5	≥ 12.0	38-40	~80
N42	13.0-13.2	≥11.4	≥ 12.0	41-42	~80
N45	13.3-13.7	≥11.0	≥ 12.0	43-45	~80
N48	13.6-14.1	≥10.5	≥ 11.0	46-49	~80
N50	14.1-14.4	≥10.5	≥ 11.0	48-51	~80
N52	14.3~14.7	≥ 11.0	≥ 11.0	50~53	~80
N54	14.7~15.0	≥ 10.4	≥ 11.0	52~55	~70
N30M	10.8-11.2	≥9.8	≥ 14.0	28-30	~100
N33M	11.3-11.7	≥10.3	≥ 14.0	31-33	~100
N35M	11.7-12.1	≥11.2	≥ 14.0	33-35	~100
N38M	12.0-12.4	≥11.4	≥ 14.0	36-38	~100
N40M	12.5-12.9	≥11.4	≥ 14.0	38-40	~100
N42M	13.0-13.2	≥11.4	≥ 14.0	40-43	~100
N45M	13.3-13.7	≥11.4	≥ 14.0	43-45	~100
N48M	13.6-14.1	≥11.4	≥ 14.0	46-50	~100
N50M	14.0-14.4	≥11.4	≥ 14.0	48-51	~100
N52M	14.3-14.8	≥11.4	≥ 14.0	51-53	~100
N33H	11.4-11.7	≥10.3	≥ 17.0	31-34	~120
N35H	11.7-12.2	≥10.8	≥ 17.0	33-36	~120

N38H	12.2-12.6	≥11.4	≥ 17.0	36-38	~120
N40H	12.6-12.9	≥11.4	≥ 17.0	38-40	~120
N42H	12.8-13.2	≥11.4	≥ 17.0	40-43	~120
N44H	13.3-13.5	≥11.4	≥ 17.0	42-44	~120
N45H	13.6-13.8	≥11.4	≥ 17.0	44-46	~120
N48H	13.8-14.1	≥11.4	≥ 17.0	46-49	~120
N50H	14.0-14.4	≥11.4	≥ 16.0	48-51	~110
N30SH	10.8-11.3	≥10.3	≥ 20.0	28-31	~150
N33SH	11.3-11.7	≥10.8	≥ 20.0	31-33	~150
N35SH	11.8-12.2	≥11.4	≥ 20.0	33-35	~150
N38SH	12.0-12.4	≥11.4	≥ 20.0	36-38	~150
N40SH	12.4-12.8	≥11.4	≥ 20.0	38-41	~150
N42SH	13.0-13.3	≥11.4	≥ 20.0	40-42	~150
N45SH	13.3-13.7	≥11.4	≥ 20.0	42-46	~150
N48SH	13.6-14.2	≥11.4	≥ 19.0	46-49	~140
N50SH	13.9-14.3	≥11.4	≥ 19.0	48-51	~140
N28UH	10.2-10.8	≥9.8	≥ 25	26-29	~180
N30UH	10.8-11.4	≥10.1	≥ 25	28-31	~180
N33UH	11.4-11.8	≥10.3	≥ 25	31-34	~180
N35UH	11.5-12.2	≥10.8	≥ 25	33-36	~180
N38UH	12.2-12.6	≥11.4	≥ 25	36-39	~180
N40UH	12.5-12.9	≥11.4	≥ 25	38-41	~180
N42UH	12.8-13.2	≥11.4	≥ 25	40-43	~180
N45UH	13.2-13.6	≥11.4	≥ 25	43-46	~180
N28EH	10.4-10.8	≥9.8	≥ 30	26-29	~200
N30EH	10.8-11.4	≥10.1	≥ 30	28-31	~200
N33EH	11.4-11.8	≥10.3	≥ 30	31-34	~200
N35EH	11.7-12.2	≥10.8	≥ 30	33-36	~200
N38EH	12.2-12.6	≥11.5	≥ 30	36-39	~200
N40EH	12.5-12.9	≥11.5	≥ 28	38-41	~190
N42EH	12.8-13.2	≥11.5	≥ 28	40-43	~190

N28AH	10.4-10.8	≥9.8	≥ 34	26-29	~230
N30AH	10.8-11.4	≥9.8	≥ 34	28-31	~230
N33AH	11.4-11.8	≥9.8	≥ 34	31-34	~230
N35AH	11.7-12.2	≥9.8	≥ 34	33-36	~230

2. VERTICAL DIRECTION BETWEEN TOOLING PRESSING AND ORIENTATION

Material Code Introduction：	NR	XX	Y or YY
	Sintered Nd-Fe-B Ring Magnets	Max. Energy Product	Max. Working Temp. Grade

Material Code	Residual Induction	Coercive Force	Intrinsic Coercive Force	Max. Energy Product	Raw Material Grade
	Br(kGs)	Hcb(kOe)	Hcj(kOe)	BHmax(MGOe)	
NR30	10.8-11.2	≥9.8	≥ 12.0	28-30	N33
NR33	11.3-11.7	≥10.5	≥ 12.0	31-33	N35
NR35	11.8-12.2	≥11.0	≥ 12.0	33-36	N38
NR38	12.2-12.6	≥11.4	≥ 12.0	36-38	N40
NR40	12.6-12.9	≥10.5	≥ 12.0	38-40	N42
NR42	13.0-13.2	≥11.4	≥ 12.0	41-42	N45
NR30M	10.8-11.2	≥9.8	≥ 14.0	28-30	N33M
NR33M	11.3-11.7	≥10.3	≥ 14.0	31-33	N35M
NR35M	11.7-12.1	≥11.2	≥ 14.0	33-35	N38M
NR38M	12.0-12.4	≥11.4	≥ 14.0	36-38	N40M
NR40M	12.5-12.9	≥11.4	≥ 14.0	38-40	N42M
NR42M	13.0-13.2	≥11.4	≥ 14.0	40-43	N45M
NR33H	11.4-11.7	≥10.3	≥ 17.0	31-34	N35H
NR35H	11.7-12.2	≥10.8	≥ 17.0	33-36	N38H
NR38H	12.2-12.6	≥11.4	≥ 17.0	36-38	N40H
NR40H	12.6-12.9	≥11.4	≥ 17.0	38-40	N42H
NR30SH	10.8-11.3	≥10.3	≥ 20.0	28-31	N33SH
NR33SH	11.3-11.7	≥10.8	≥ 20.0	31-33	N35SH
NR35SH	11.8-12.2	≥11.4	≥ 20.0	33-35	N38SH
NR38SH	12.0-12.4	≥11.4	≥ 20.0	36-38	N40SH
NR40SH	12.4-12.8	≥11.4	≥ 20.0	38-41	N42SH

Surface Coating Types

Coating	Zn		Ni	Ni-Cu-Ni + Epoxy	Electro-phoresis	NiCuNi+ (Sn or Au or Ag,Cr)	Chromate
	White	Colour	Double layers				
Corrosion resistance	Good	Excellent	Excellent	Excellent	Very good	Very good	good

Physical Property

Temp.Coeff.of Br	-0.11%/℃
Temp.Coeff.of Hc	-0.60%/℃
Vickers Hardness	600Hv
Tensile Strength	8.0Kg/mm2
Specific Heat	0.12Kcal/Kg
Young's Modulus	1.6X10[11]N/m2
Poisson's Ratio	0.24
Curie Temperature	310-340℃
Density	7.4-7.6g/cm3
Electrical Resistivity	114μΩ..cm
Flexural Resistivity	25kg/mm
Coeff. Of Thermal Expansion	4X10-6/℃
Thermal Conductivity	7.7kcal/[m.h.℃]
Rigidity	0.64N/m2
Compressibility	9.8x10-12m2/N