magnetfabrik bonn

Neofer® p and Sprox® – setting new standards for polymer-bonded magnet materials

Neofer® p and Sprox® – polymer-bonded magnet materials for the most demanding requirements

Magnetfabrik Bonn: Expertise, experience, quality and service

The speed of developments in sensor technology has sparked off an unexpected boom in the polymer-bonded magnet materials industry, particularly in fields where maximum levels of precision, process reliability and dependability are needed in conjunction with acceptable costs. Magnetfabrik Bonn has played a decisive role in this development. Our extensive skills in all aspects of materials, production techniques and applications coupled with 75 years of experience have made us one of the leading experts in this field. Day in, day out, magnets from Bonn are being used with considerable success whether in the automotive industry, in machine tools or in automation technology. They are doing their job in synchronous motors, in small-power motors and generators, as switching magnets, in clutches, timers, speed sensors, speedometers, in fuel gauges, toys and much more. In many fields it is already impossible to imagine a world without contactless and hence wear-free position detection, angular measurement or travel measurement.

Responsibility from A to Z

The demands on polymer-bonded magnets are becoming ever more complex. Which is why we rely on research and development, the expertise of our staff, an intensive dialog with our customers' specialists and our own production facilities. The result is innovative, competitive products and system solutions which help our customers to keep abreast of the market successfully. Our commitment to a quality management system compliant with DIN ISO 9001: 2000 and ISO/TS 16949: 2002 and an environment management system compliant with ISO 14001: 2004 helps us to take on the responsibility of keeping our products at the cutting edge.

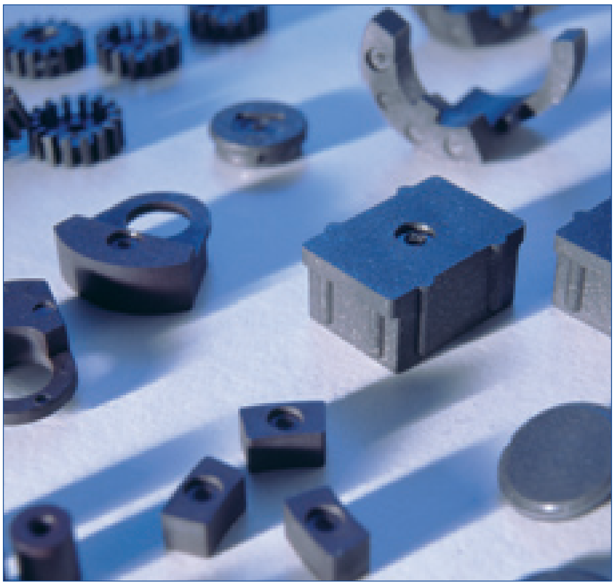
TÜV CERT
DIN EN ISO 9001:2000
ISO/TS 16949:2002
Zertifikat: 01 111 70013

TÜV CERT
ISO 14001:2004
Zertifikat: 01 104 052181

Production of polymer-bonded magnets

Injection molding

Sprox® magnets are manufactured from isotropic or anisotropic magnet materials. Barium ferrite or strontium ferrite powder is compounded with thermoplastic binders to form a granulate suitable for injection molding. The granulate is then processed in customized injection molding machines using specially developed tools.
This inexpensive material can be magnetized in a variety of patterns by applying magnetic fields in the injection molding machine. Subsequent magnetization is often not required. This technique is particularly cost-effective for long production runs.



The Neofer® p magnets use an isotropic NdFeB-based rare-earth material which is compounded with thermoplastic binders. The isotropic materials Neofer® 37/60p through 41/100p are magnetized after they have been shaped. This means that any form of magnetization can be implemented.

Compression molding

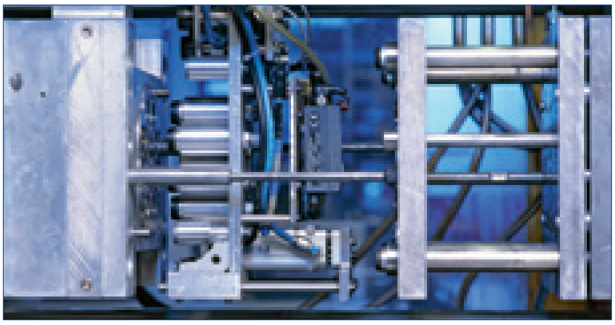
In this process, NdFeB powder is compounded with thermosetting resins. The actual pressing operation is carried out in tools and machines commonly used in powder metallurgy.
After they have been shaped, the moldings are thermally cured to give them mechanical stability.
The materials Neofer® 62/60p and Neofer® 55/100p can be compression molded to form common shapes such as blocks, disks, rings, flat sections and segments with and without holes. The higher filling level and resulting increase in density considerably enhance the magnetic properties in comparison with injection-molded products.

Shaping polymer-bonded magnets

The advantage of the injection molding process for producing magnets lies in the wide range of shapes that can be produced. It is also possible for inserts such as axles, bushes or rings to be molded around, with the inserts being loaded by hand or fully automatically, depending on the quantity produced. The costs of assembly operations can be reduced as such materials allow press-fit, snap-fit and positive-fit connections with motor shafts etc. By contrast, the compression molding technique only allows simpler geometries. Both production processes allow products to be manufactured within such tight tolerances that no reworking is generally necessary. Depending on the size of the molding, the tolerances that can be achieved are in the range 0.03 through 0.25 mm. Mechanical reworking of the completed molding is generally not required. As required, however, polymer-bonded materials can be turned, drilled, milled and ground as they are not as brittle as sintered materials. Constant testing and monitoring throughout the production process ensures consistent quality.

Magnetic and physical properties

The proportion of synthetic plastic materials of typically ten percent by weight (injection molding) and four percent by weight (compression molding) mean that the magnetic properties lie below those of unmixed material. On the other hand, with anisotropic grades, it is possible to achieve a directional magnetization during the injection molding process. This in turn improves the magnetic properties.



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Injection molded materials

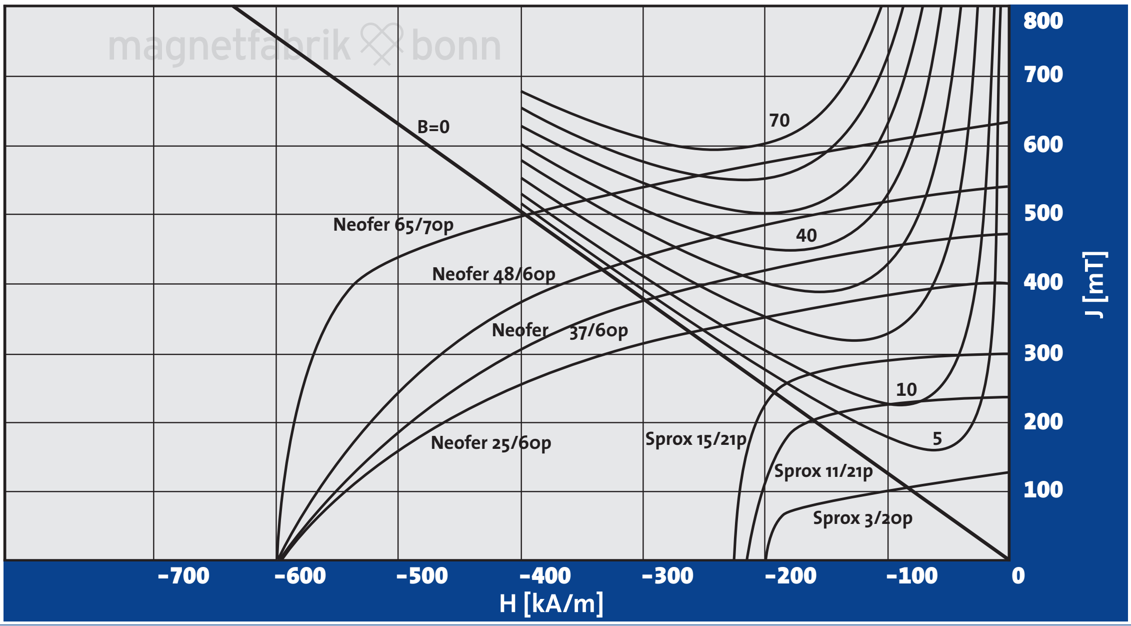
			Minimum values				Typical values				
Designation	Code as per DIN IEC 60404-8-1	i/a	B_r [mT]	H_{cB} [kA/m]	H_{cJ} [kA/m]	BH_{max} [kJ/m³]	TC B_r [%/K]	Density [g/cm³]	Water absorbtion [%]	Max.operating temperature[1] [°C]	Binder
Sprox 3/20p	Hard ferrite 2.7/20p	i	128	85	200	2.7	-0.19	3.20	0.20	160	PA 6
Sprox 10/20p	Hard ferrite 10/20p	a	222	151	207	9.8	-0.19	3.20	0.20	160	PA 6
Sprox 10/20p	Hard ferrite 10/22p	a	220	155	223	10	-0.19	3.35	0.01	200	PPS
Sprox 11/22p	Hard ferrite 10/24p	a	225	159	239	10	-0.19	3.20	0.05	130	PA 12
Sprox 11/21p	Hard ferrite 10/21p	a	230	159	215	10.3	-0.19	3.20	0.20	160	PA 6
Sprox 14/21p	Hard ferrite 14/20p	a	269	179	207	14.3	-0.19	3.40	0.15	160	PA 6
Sprox 13/21p	Hard ferrite 15/22p	a	273	179	222	14.7	-0.19	3.55	0.15	160	PA 6
Sprox 15/22p	Hard ferrite 15/21p	a	275	179	214	15.1	-0.19	3.57	0.04	130	PA 12
Sprox 15/21p	Hard ferrite 16/23p	a	290	189	226	16.5	-0.19	3.79	0.13	160	PA 6
Neofer 25/60p	REFeB 27/60p	i	400	260	630	27	-0.12	4.35	0.05	140	PA 11
Neofer 31/100p	REFeB 30/100p	i	400	290	1000	30	-0.12	4.50	0.05	140	PA 11
Neofer 41/100p	REFeB 36/100p	i	460	310	1000	36	-0.12	4.85	0.05	140	PA 11
Neofer 37/60p	REFeB 37/60p	i	470	300	600	37	-0.12	4.60	0.05	140	PA 11
Neofer 39/60p	REFeB 39/60p	i	485	310	600	39	-0.12	4.80	0.05	140	PA 11
Neofer 44/60p	REFeB 44/60p	i	520	320	600	44	-0.12	5.00	0.05	140	PA 11
Neofer 48/60p	REFeB 48/60p	i	540	330	600	48	-0.12	5.10	0.05	140	PA 11
Neofer 55/50p	REFeB 52/52p	i	580	330	520	52	-0.12	4.90	0.05	130	PA 11
Neofer 65/70p	REFeB 64/60p	i	630	400	600	64	-0.12	5.75	0.05	130	PA 12

Compression molded materials

			Minimum values				Typical values				
Designation	Code as per DIN IEC 60404-8-1	i/a	B_r [mT]	H_{cB} [kA/m]	H_{cJ} [kA/m]	BH_{max} [kJ/m³]	TC B_r [%/K]	Density [g/cm³]	Water absorbtion [%]	Max.operating temperature[1] [°C]	Binder
Neofer 55/100p	REFeB 55/100p	i	580	400	1000	55	-0.12	5.90	n.a.	140	Epoxy resin
Neofer 62/60p	REFeB 62/60p	i	650	380	600	62	-0.12	5.90	n.a.	140	Epoxy resin

1 The maximum operating temperature for a magnet materials is dependent on the specific application, the type of magnet and the magnet geometry. Do not hasitate to contact our Applcation Engineers for more information.

Demagnetization curves for Sprox® and Neofer® p

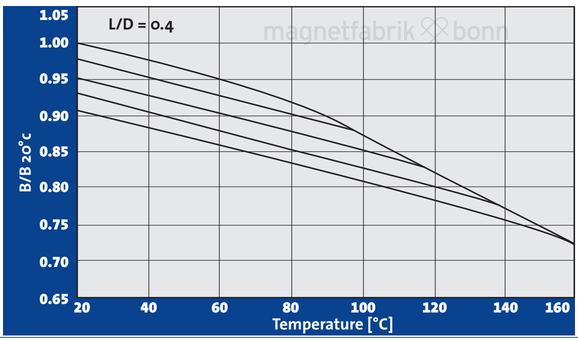


Temperature behavior

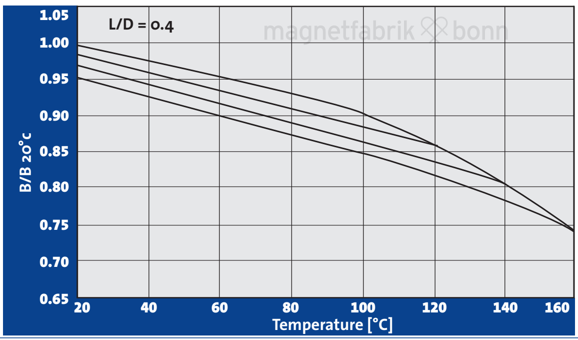
The temperature coefficient of remanence for Sprox® magnets is approximately -0.19 %/K, the intrinsic coercivity H_{cJ} on the other hand has a positive coefficient of approximately +0.4 %/K.
The reversible temperature coefficient for Neofer® p magnets is approximately -0.12 %/K. It should be noted that irreversible losses may also occur at high temperatures. The operating temperatures derived from this also depend on the dimensions of the magnet.

Irreversible losses (short-term temperature behavior[2])

Neofer® 37/60p, 44/60p, 62/60p



Neofer® 31/100p, 55/100p



2 Time-dependent irreversible losses also occur with the Neofer® p group of materials. You will find further information on the influence of temperature on permanent magnets in our Applications Brief 1/2008. You can download this from www.magnetfabrik.de.

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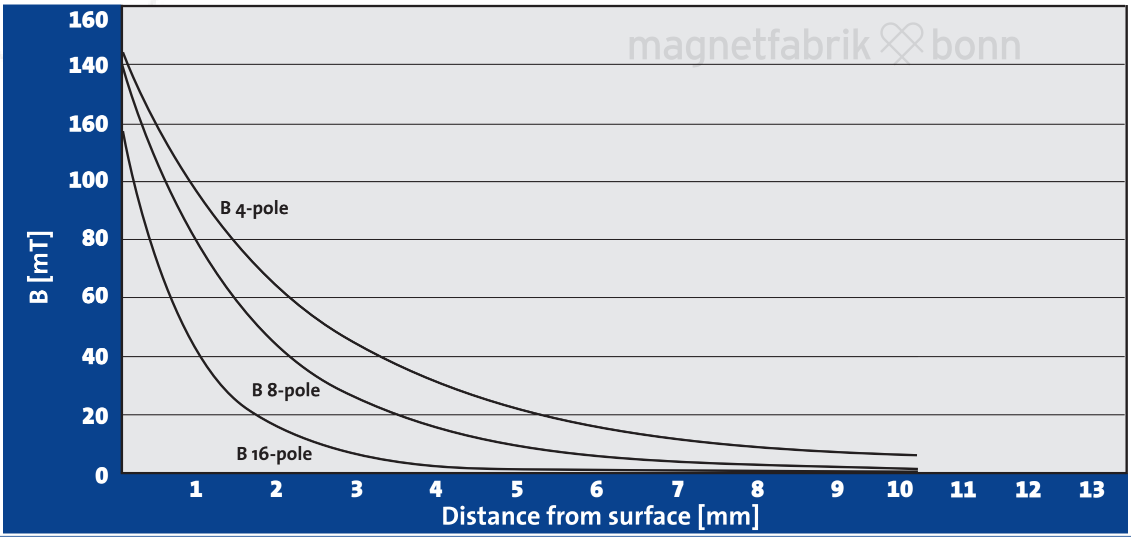
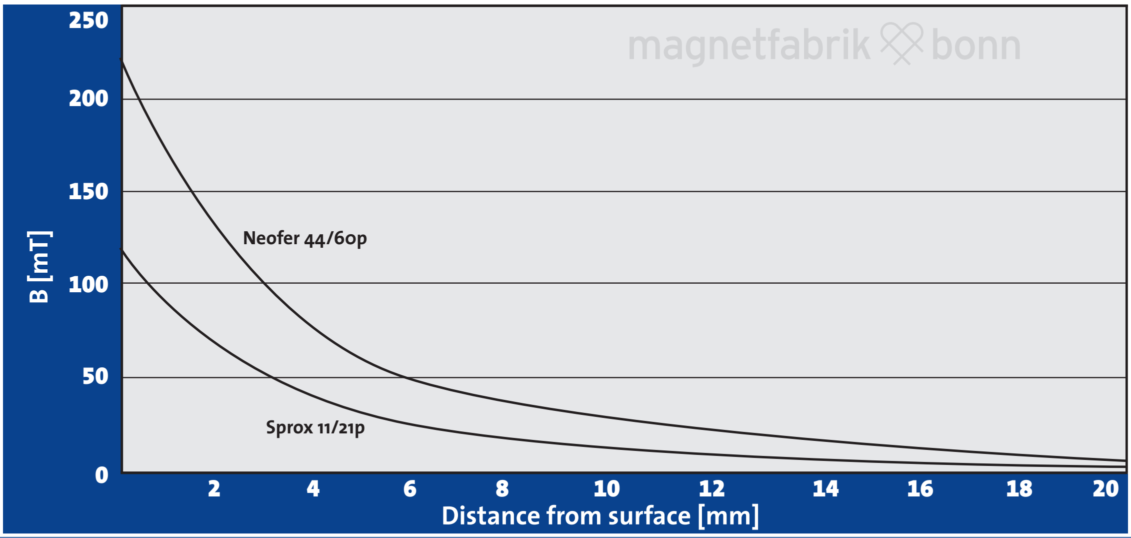
Magnetization

The flux density at the surface of the magnet decreases exponentially rather than linearly with increasing distance from the surface.

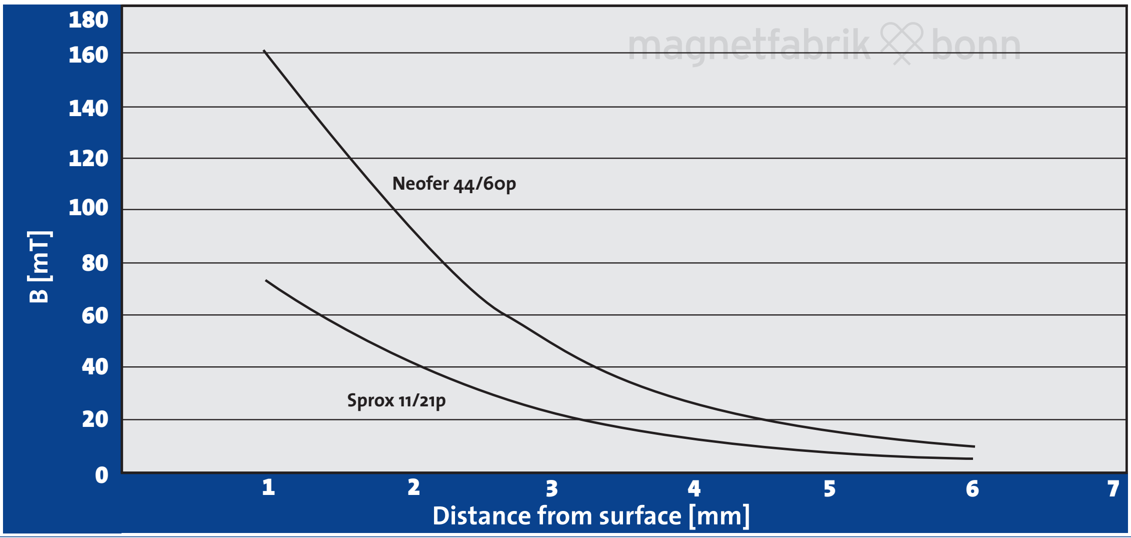
Example: Ring magnets from Sprox® 11/21p, external diameter 14.8 mm, multipole magnetized around the circumference



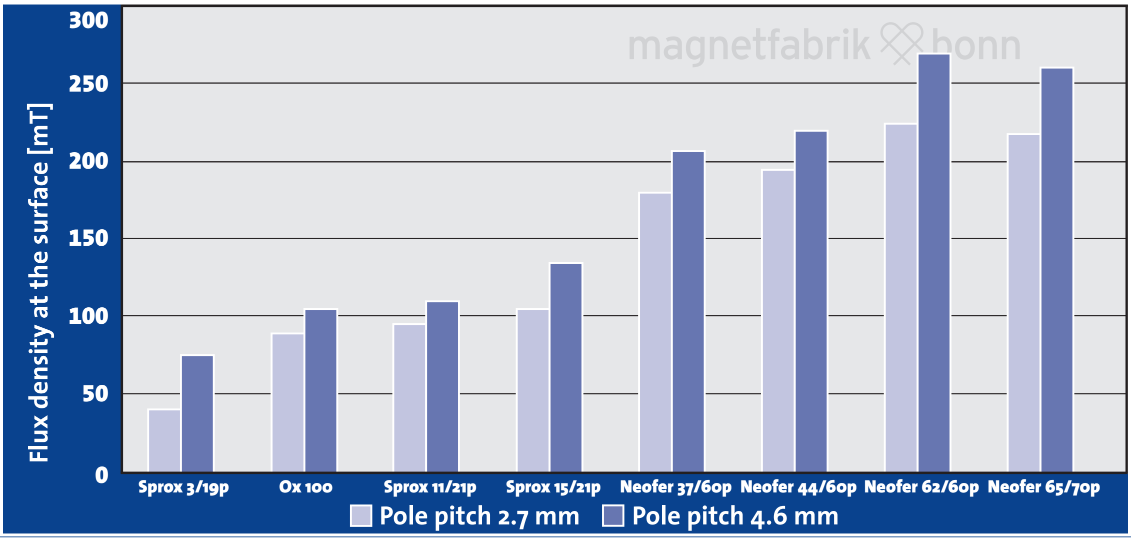
Example: Ring magnets from Sprox® 11/21p and Neofer® 44/60p, ext. dia. 14.8 x int. dia. 2.5 x height 8 mm, diametrically magnetized



Example: Sensor magnets from Sprox® 11/21p and Neofer® 44/60p, 4 x 4 x 2 mm, axially magnetized along the 2-mm axis



Flux density for various multipolar magnetized Sprox® and Neofer® p materials. The sintered hard-ferrite material Ox® 100 is also listed for the purposes of comparison.



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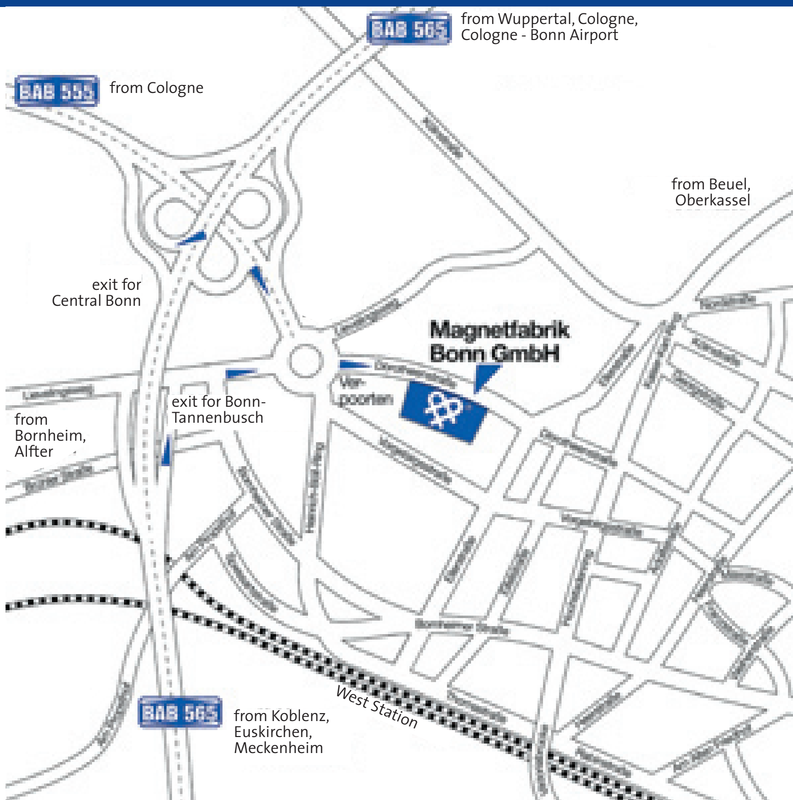

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