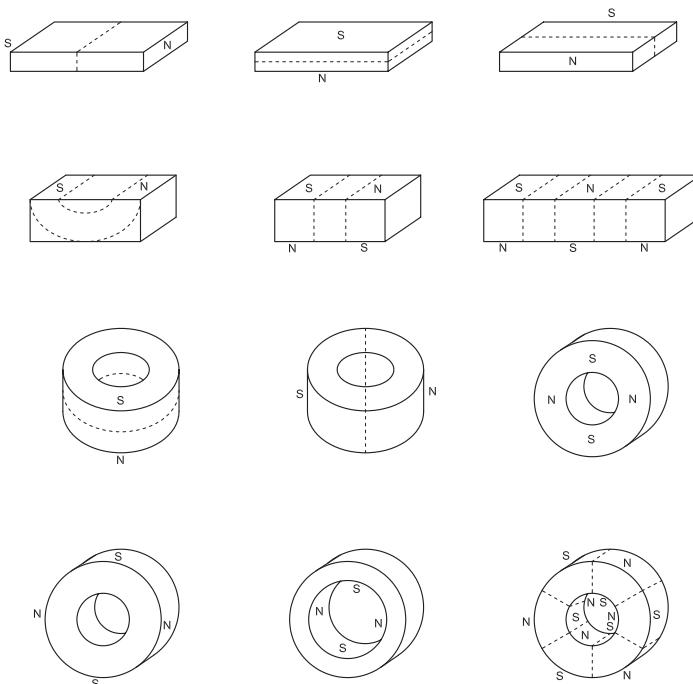


# Magnets and their specifications

Magnets are available in multiple specifications on the market. Almost all dimensions and geometries can be realised. To activate the reed switch a magnet (magnet field) is needed. The different magnet materials have either more positive or negative specifications, depending on the dimension and geometries as well as on the environment. Most preferred and used forms are cylinders, rectangles, rings and discs. Depending on the different requirements, magnets can be magnetised in many different ways (see picture # 37).

Furthermore each magnet material has a different mag-

net force as well as a different flux density. Additionally to dimension and material, other factors exist that define the energy of a magnet. These are mounting position, environment and other magnetic field which influence the interaction between reed sensor/switch and magnet. In applications where a magnet is used to activate a reed sensor/switch, the environmental temperature needs to be considered (in the application as well as in storage). High temperatures can cause irreversible damage and will have heavy impact on the magnetic force and the long term stability. AlNiCo magnets are best suitable for applications up to 450°C.



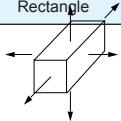
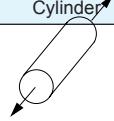
(Figure #37. An assortment of magnets are shown. Magnets can be formed and made into almost any shape.)

## General Information to magnet material

Magnets have reversible and irreversible demagnetisation specifications. Be specially careful with shock, vibration, strong and close external magnetic fields as well as high temperatures. All these factors influence the magnetic force and the long term stability in different intensities. Preferably the magnet is mounted on the moving part of the application. Professional tuning of magnet and reed switch can improve the functionality of the whole sensor-magnet system.

	LOW	HIGH		
costs	Ferrite	AlNiCo	NdFeB	SmCo
energy (WxHmax.)	Ferrite	AlNiCo	SmCo	NdFeB
working temperature	NdFeB	Ferrite	SmCo	AlNiCo
corrosion - resistant	NdFeB	SmCo	AlNiCo	Ferrite
opposing field - resistant	AlNiCo	Ferrite	NdFeB	SmCo
mechanical strength	Ferrite	SmCo	NdFeB	AlNiCo
temperature coefficient	AlNiCo	SmCo	NdFeB	Ferrite

## AlNiCo - Magnets

AlNiCo Features	Standard geometric and magnetization	
<ul style="list-style-type: none"> <li>working temperature from -250 to 450 °C</li> <li>low temperature coefficient</li> </ul>		

Raw materials for AlNiCo magnets are aluminium nickel, cobalt, iron and titanium. AlNiCos are produced in a sintering - casting procedure. The hard material needs to be processed by grinding to be cost effective. Due to its specifications, the best dimension is a remarkably longer length than its diameter. In combination with reed sensors / switches we recommend a length / diameter ratio of more than 4. AlNiCo magnets have an excellent temperature stability. Negative are the high raw material prices. Cylindrical AlNiCo magnets can be used with all MEDER reed sensors / switches without any problems.

AlNiCo Magnetic Values according to DIN 17410		Min.	Typ.	Max.	Units
Energy Product	(B x H) max.	35	39.8		kJ/ m <sup>3</sup>
Remanence			1210		mT
Reverse Temperature Coefficients of B <sub>r</sub>			0.02%		%/K
Coercivity	H <sub>cB</sub>	47.0	51.3		kA/m
Coercivity	H <sub>cJ</sub>	48.0	51.7		kA/m
Reverse Temperature Coefficients of H <sub>cJ</sub>	-	-	-		%/K
Density			7.4		g/cm <sup>3</sup>
Max. Operating Temperature				450	°C

All details correspond to manufacturers information

## Rare - Earth Magnets

SmCo Features	Standard geometric and magnetization		
	Disc	Rectangle	Cylinder
<ul style="list-style-type: none"> <li>• high energy density</li> <li>• small size</li> <li>• working temperature up to 250 °C</li> <li>• best opposing field-resistance</li> <li>• available plastic bounded</li> </ul>			

NdFeB Features	Standard geometric and magnetization		
	Disc	Flat Rectangle	Ring
<ul style="list-style-type: none"> <li>• high energy density</li> <li>• small size</li> <li>• working temperature up to 180 °C</li> <li>• lower prices compared to SmCo</li> <li>• available plastic bounded</li> </ul>			

Rare - Earth magnets like SmCo and NdFeB have the highest energy density per volume and weight and also

the best demagnetisation resistance. Following below, we compare other magnets with the same energy:

- Hartferrit = Volumen 6 cm<sup>3</sup>
- AlNiCo = Volumen 4 cm<sup>3</sup>
- SmCo = Volumen 1 cm<sup>3</sup>
- NdFeB = Volumen 0.5 cm<sup>3</sup>

Both magnets are produced by sintering and can only be processed by grinding, due to the strength and brittle of the material. The temperature range goes up to + 250 °C. Very small magnets can be produced. Disadvantages are the high raw material prices and the lim-

ited availability of special alloys. The supply of different geometry, size and magnetisation allow many creative combination of reed sensor / switch and magnet and help to find the best functionality of the sensor - magnet system for each application.

SmCo <sub>5</sub> Magnetic Values according to DIN 17410		Min.	Typ.	Max.	Units
Energy Product	(B x H) max.	160	170		kJ/ m <sup>3</sup>
Remanence	B <sub>r</sub>	900	925		mT
Reverse Temperature Coefficients of B <sub>r</sub>			-0.042		%/K
Coercivity	H <sub>cB</sub>	680	2000		kA/m
Coercivity	H <sub>cJ</sub>	1750	-0.25		kA/m
Reverse Temperature Coefficients of H <sub>cJ</sub>					%/K
Density			8.3		g/cm <sup>3</sup>
Max. Operating Temperature				250	°C
All details correspond to manufacturers information					

NdFeB Magnetic Values according to DIN 17410		Min.	Typ.	Max.	Units
Energy Product	(B x H) max.	205	295		kJ/ m <sup>3</sup>
Remanence	B <sub>r</sub>	1180	1240		mT
Reverse Temperature Coefficients of B <sub>r</sub>			-0.1		%/K
Coercivity	H <sub>cB</sub>	680	920		kA/m
Coercivity	H <sub>cJ</sub>	1750	1900		kA/m
Reverse Temperature Coefficients of H <sub>cJ</sub>			-0.6		%/K
Density			7.6		g/cm <sup>3</sup>
Max. Operating Temperature				160	°C
All details correspond to manufacturers information					

## Hard ferrite - Magnets

Ferrit Features	Standard geometric and magnetization			
	Disc	Rectangle	Cylinder	Ring
<ul style="list-style-type: none"> <li>• cheapest magnet material</li> <li>• working temperature up to 300 °C</li> <li>• many options in form and magnetization</li> <li>• available plastic bounded</li> </ul>				

Hard ferrite magnets are produced with iron oxide and barium or strontium oxide. The raw materials are mixed together and normally pre sintered, to generate the magnetic phase. The pre sintered mixture then gets crushed. The resulting powder gets pressed together (wet or dry) either in a magnetic field (an - isotropic) or without a magnetic field (isotropic) and in the end sintered. Proceedings are only possible by grinding. Due to the low cost of the raw material, hard ferrite magnets are the cheapest magnet type out of the actual sup-

ply of magnets. Ferrites have a very good electrical isolation effect and are hard to demagnetise even in strong external magnetic fields. Corrosion tendency is low. Preferred shapes are long and thin but also round forms are easy to produce. Disadvantages are the high breakability and the low tensile strength. The strength and brittleness of hard ferrites are similar to ceramics. Furthermore the temperature resistance is limited and they have only a low energy to volume ratio.

Ferrit 28/26 Magnetic Values according to DIN 17410		Min.	Typ.	Max.	Units
Energy Product	(B x H) max.	28	30		kJ/ m <sup>3</sup>
Remanence	B <sub>r</sub>	385	395		mT
Reverse Temperature Coefficients of B <sub>r</sub>			-0.2		%/K
Coercivity	H <sub>cB</sub>	250	265		kA/m
Coercivity	H <sub>cJ</sub>	260	275		kA/m
Reverse Temperature Coefficients of H <sub>cJ</sub>			0.3		%/K
Density			4.85		g/cm <sup>3</sup>
Max. Operating Temperature				250	°C
All details correspond to manufacturers information					

## Handling information for magnets



The strong magnetic forces of attraction can cause skin bruises. Sufficient security distances need to be kept between each magnet and all other ferromagnetic elements!



A crash of magnets with high energy can produce splinters. Therefore always wear protection gloves and glasses!



Grinding dust of Rear – Earth Magnets is spontaneously inflammable. Always process with water!



Crashes of magnets can cause sparks. Handling and processing in EX – environment is therefore strictly prohibited!



Strong magnetic fields can influence electronic and electrical devices as well as data mediums. Don't bring magnets close to peace makers, navigation instruments, diskettes, plug-in boards etc.



For air cargo a special declaration maybe possible.



Radioactivity as well as joining together equal poles can reduce the magnetic force.



The highest defined working temperature must not be passed.

*For all questions concerning magnets and, of course, reed products, please consult your nearest MEDER sales office.*

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