

# Retaining magnets / Raw magnets

## Application / Designs / Structure / Materials of the magnets

### Application

Magnets are simple elements that help make solving tasks easier, more efficient, and more reliable.

If drilling is not allowed for fastening, for instance, so as not to damage corrosion protection layers, a retrofit/portable installation is desired, or only a temporary fix is required, this product group offers a large selection of suitable magnets.

### Designs

There are seven different magnet types based on a conceptual classification with respect to the shape and function:

Button-type magnets and U-magnets as well as retaining magnets that are disc-shaped or rod-shaped form the largest group along with screws with retaining magnet. The name retaining magnet bears such elements that are used for direct fastening. Raw magnets generally help to structure application-specific magnetic systems.

### Structure

Apart from button-type magnets / U-magnets and raw magnets, magnetic systems can also be used. Due to their structure, they have only one magnetic contact surface. Through magnetic return plates, the entire magnetic energy is concentrated on the attracting surface and the spatial effect of the magnetic field is restricted in order to prevent any magnetization of the environment.

### Materials of the magnet

Within various designs, various materials of the magnet are available to choose from. In order to meet application-specific conditions in as far as possible, the most important characteristics of the respective materials of the magnet are given in the following table.

### Materials of the magnet in comparison

Description	Hard ferrite (HF)	AlNiCo (AN)	SmCo (SC)	NdFeB (ND)
<b>Adhesive force</b>	strong	medium	strong	very strong
<b>Max. working temperature *</b>	≈ 200 °C	≈ 450 °C	≈ 200 °C	≈ 80 °C
<b>Adhesive force on heating</b>	lower	constantly good	lower	lower
<b>Corrosion resistance</b>	very good	very good	good	nickel plated - good
<b>Made from</b>	Iron oxide	Aluminum, nickel, cobalt and iron	Samarium and cobalt	Neodymium, iron and boron
<b>Production method</b>	Sintering	Sintering, casting	Sintering	Sintering
<b>Mechanical properties</b>	very hard, brittle	very hard, tough	very hard, brittle	very hard, brittle
<b>Machineability</b>	not possible	diamond grinding possible	not possible	not possible
<b>Demagnetisation capability</b>	moderate, by demagnetising fields	easy, by demagnetising fields	very difficult, only by large demagnetising	difficult, only by large demagnetising
<b>Price</b>	very reasonable	high	very high	reasonable

\* The max. temperature used is only a guide value because it also depends on the dimensions of the magnet.

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## Adhesive force / Influence factors

### Adhesive force

In addition to their shape and material, the actual achievable adhesive force of the magnets depends on several other factors.

Influence factors																													
<p><b>Air gap</b></p> <p>An air gap or materials, which are not magnetically permeable between the work piece and the magnet, have an insulating effect on the magnetic flux. The adhesive force is reduced depending on the distance.</p>	<table border="1"> <caption>Approximate data from the Adhesive force vs Air gap graph</caption> <thead> <tr> <th>Air gap in mm</th> <th>Adhesive force (%)</th> </tr> </thead> <tbody> <tr><td>0</td><td>100</td></tr> <tr><td>0.1</td><td>85</td></tr> <tr><td>0.2</td><td>65</td></tr> <tr><td>0.3</td><td>45</td></tr> <tr><td>0.4</td><td>30</td></tr> <tr><td>0.5</td><td>20</td></tr> <tr><td>0.6</td><td>10</td></tr> </tbody> </table>	Air gap in mm	Adhesive force (%)	0	100	0.1	85	0.2	65	0.3	45	0.4	30	0.5	20	0.6	10												
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<p><b>Work piece thickness</b></p> <p>A minimum thickness of the work piece should be maintained in order to not restrict the magnetic flux and therefore the adhesive force.</p>																													
<p><b>Material</b></p> <p>Steel and ferrous materials with a low proportion of carbon and alloyed materials promote the magnetic flux. Similarly, non-hardened work pieces conduct the magnetic flux better, which enables greater adhesive forces.</p>	<table border="1"> <tbody> <tr> <td>100%</td> <td>technical pure iron</td> <td>86%</td> <td>C60, X6Cr17</td> </tr> <tr> <td>95%</td> <td>St37, C15</td> <td>84%</td> <td>42CrMo4</td> </tr> <tr> <td>94%</td> <td>St44-2, 34CrNiMo6</td> <td>75%</td> <td>St50</td> </tr> <tr> <td>93%</td> <td>St52-3</td> <td>72%</td> <td>X155CrMo12</td> </tr> <tr> <td>92%</td> <td>90MnV8</td> <td>65%</td> <td>X210CrW12</td> </tr> <tr> <td>90%</td> <td>C45</td> <td>50%</td> <td>20MnCr5</td> </tr> <tr> <td>87%</td> <td>Ck45</td> <td>30%</td> <td>GG</td> </tr> </tbody> </table>	100%	technical pure iron	86%	C60, X6Cr17	95%	St37, C15	84%	42CrMo4	94%	St44-2, 34CrNiMo6	75%	St50	93%	St52-3	72%	X155CrMo12	92%	90MnV8	65%	X210CrW12	90%	C45	50%	20MnCr5	87%	Ck45	30%	GG
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<p><b>Work piece surface</b></p> <p>Excessive roughness or unevenness have the same effect as an air gap. They reduce the adhesive force.</p>																													
<p><b>Displacement force</b></p> <p>The displacement force corresponds to the frictional force and depends on the coefficient of friction between the magnet and the work piece, as well as the adhesive force of the magnet.</p> <p>Due to their higher coefficient of friction, rubberized magnet systems have greater displacement forces.</p>																													

The nominal adhesive forces stated in the tables in the standards are minimum values, which are achieved at room temperature, vertical „pull-off“ and full contact of the magnets with low carbon steel work pieces and a minimum thickness of 10 mm.

