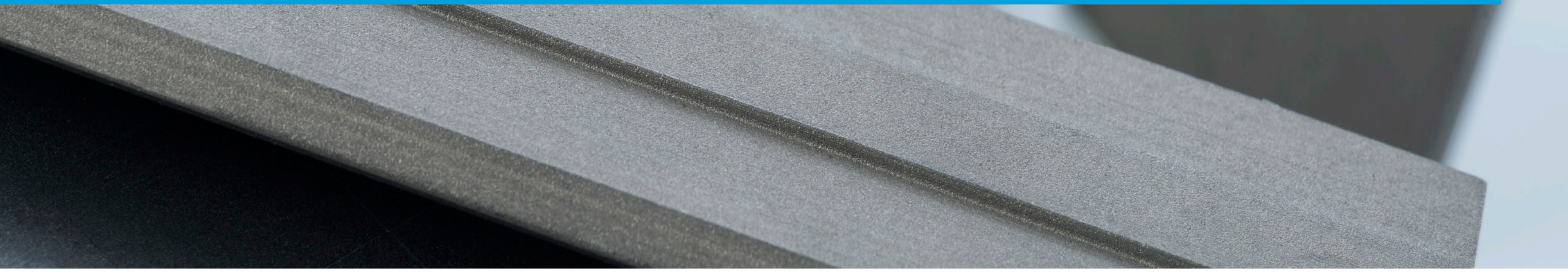
Materials Services | Materials Germany

Samarium-Cobalt magnets

Product information

thyssenkrupp



SmCo magnets are strong permanent magnets made of an alloy of the rare earth material samarium (Sm) and cobalt (Co). Additionally, they can contain the elements iron (Fe), copper (Cu) and zirconium (Zr). They are anisotropic and produced by a sintering process. These magnets are available in the two alloy compositions Sm_1Co_5 and Sm_2Co_{17}, also known as 1/5 alloy or 2/17 alloy.

Due to their very high coercive field strength SmCo magnets are extremely resistant to demagnetization and electromagnetic counter fields. In comparison to NdFeB magnets they provide better temperature stability due to the higher Curie temperature.

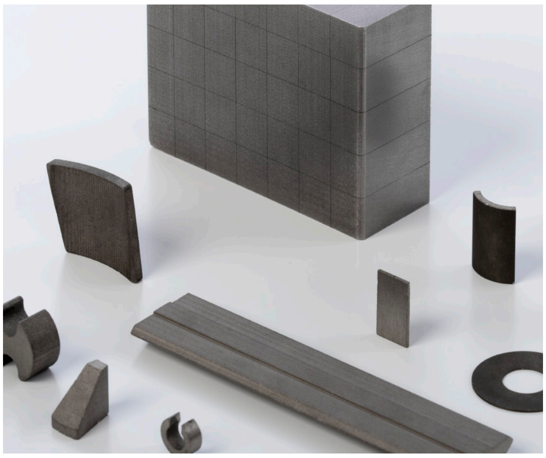
SmCo magnets are very hard and brittle, therefore careful machining and handling is advisable to avoid fractures and cracks.

Content

Magnet shapes

Compression-mold - block, ring, segment, cylinder and other shapes can be produced. Small and micro magnets can be cut from larger blocks.

Grooves, drill holes, indents, etc. can be pressed into the magnets as long as they are parallel to the direction of pressing.



Delivery program

Our range comprises a wide selection of various SmCo materials with differing magnetic properties. They permit material selection tailored to individual application requirements. We look forward to advising you in detail.

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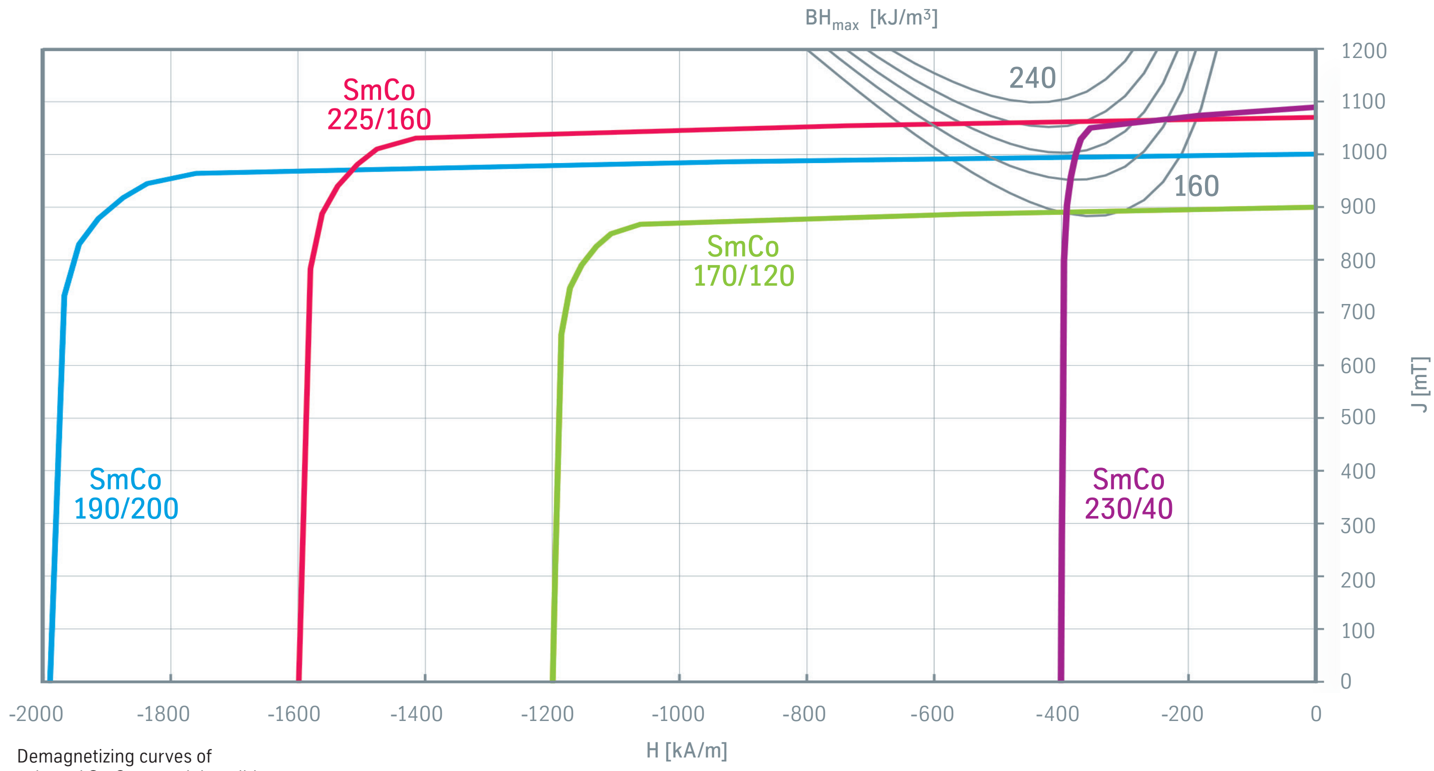
Magnetic properties

Raw material		Remanent magnetization		Coercivity				Energy product		Operating temperature	Temperature coefficient	
		B_r		H_{cJ}		H_{cB}		$(BH)_{max}$		T_{max}	TK(B_r)	TK(H_{cJ})
		mT	kG	kA/m	kOe	kA/m	kOe	kJ/m³	MGOe	°C	%/K	%/K
Sm_1Co_5 170/160	min	900	9.0	1600	20	660	8.3	170	21	250	-0.045	-0.25
Sm_2Co_{17} 180/40	min	920	9.2	400	5	320	4.0	180	22	250	-0.033	-0.20
Sm_2Co_{17} 190/200	min	1000	10.0	1990	25	675	8.5	190	24	350	-0.033	-0.20
Sm_2Co_{17} 225/160	min	1070	10.7	1600	20	700	8.8	225	28	350	-0.033	-0.20
Sm_2Co_{17} 230/40	min	1090	10.9	400	5	320	4.0	230	29	250	-0.033	-0.20
Sm_2Co_{17} 225/200	min	1070	10.7	1990	25	700	8.8	225	28	350	-0.033	-0.20
Sm_2Co_{17} 160/120*	min	900	9.0	1200	15	670	8.5	160	20	350	-0.015	-0.20
Sm_2Co_{17} 180/120*	min	930	9.3	1200	15	685	8.6	180	22	350	-0.015	-0.20

* = Reduced temperature coefficient of B_r
The relative permeability (μ_p) is between 1.04–1.15.

Selected material qualities (according EN 60404-8-1:2015). Further qualities on request.

Demagnetizing curves



Demagnetizing curves of selected SmCo material qualities

Physical properties

Raw material	Density	Young's modulus	Flexural strength	Com-pressive strength	Vickers hardness	Electrical resistivity	Heat capacity	Thermal conductivity	Coefficient of linear thermal expansion in magnetizing direction	normal to mag. direction
	ρ g/cm³	E kN/mm²	F_B N/mm²	F_P N/mm²	H_v	ρ Ω mm²/m	C J/kg K	λ W/m K	Δdl_0 10^{-6}/K	Δdl_0 10^{-6}/K
Sm_1Co_5 150/120	8.4	160	120	1000	550	0.55	360	13	6	13
Sm_2Co_{17} 180/120	8.3	120	120	800	640	0.85	320	12	8	11

Curie temperature
Tc = 720–800 °C

Chemical resistance

SmCo magnets are largely resistant to organic acids, but not resistant to inorganic acids and alkaline solutions.

Permanent contact with water should be avoided.

Due to the strong affinity of samarium to oxygen, SmCo magnets tend to oxidize at higher temperatures.

Production

The alloy preparation is done by melting the alloy and grinding the raw materials to a nanocrystalline powder with a grain size of below 5 µm. The magnetic alignment is achieved by pressing under the influence of a magnetic field. Depending on the orientation and direction of pressing compared with the magnetic field, the alignment and thus the magnetic values will vary considerably. During the so called cross field pressing, the magnetic field and the direction of pressing should be at right angles.

This results in high energy density and optimum remanence. Axial pressing (press direction and magnetic field are parallel) results in lower values (approximately 10 % lower B_r and 20 % lower $(BH)_{max}$ value). However, this should meet customer requirements in most cases and result in more cost effective production of big volume quantities.

Magnet sintering is carried out in an inert gas atmosphere or in a vacuum at temperatures between 1100–1200 °C. Sintering density is between 8.2–8.5 g/cm³. Finally the magnets are heat treated between 500–900 °C.

Further production stages are machining, grinding, system assembly, etc.

Temperature behavior

Due to the effects of higher temperatures SmCo magnets can suffer losses of remanence, $(BH)_{max}$ value and coercivity. However, these losses are for the most part reversible as a reduction in temperature re-establishes the original values.

Losses caused by counterfields are also reversible by renewed magnetizing.

Stabilization methods can adjust the magnets to certain values. This excludes possible changes in the form of magnetic losses during application. It should be noted that this process is linked to lower induction values.

Contact

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