SmCo Samarium Cobalt Magnet Material

Sintered Samarium Cobalt (SmCo) was the first of the Rare Earth family of permanent magnet materials. Developed in the 1960's, it revolutionised magnetic design by offering substantial improvements in energy product to that of other materials at the time, such as Alnico and Ceramic Ferrite.

There are two main groups of grades available in SmCo; 1:5 and 2:17. The 2:17 group of SmCo grades offer the highest energy product (BHmax), ranging from 22 MGOe to 32 MGOe. SmCo not only offers grades that can rival Neodymium-Iron-Boron (NdFeB) in performance but has the added advantage of excellent temperature and corrosion resistance. Its maximum working temperature is up to 350^0C and displays low levels of losses during its temperature climb.

SmCo is considered to be the magnet material of choice for many engineers looking for a material that offers high energy in harsh or challenging environments. It is often used in high temperature motors and drives, marine application, Oil and Gas, Aerospace, Medical and Vacuum industries.

Magnet Sales and Service offers a wide range of standard sizes from stock and offers rapid prototyping for bespoke components and assembly work.

Design Considerations

The working environment is often the determining reason for choosing SmCo. Although it is more costly than other high energy materials such as NdFeB, it is able to work in some very difficult environments.

SmCo 2:17 has excellent resistance to corrosion, which allows it to work in areas of high humidity, often without coating. SmCo 2:17 ability to withstand the influences of temperature is its greatest strength and the level of temperature losses compared to NdFeB is far less, therefore SmCo can operate continuously and at a greater range of temperatures.

SmCo downfall is it its brittleness, it is very prone to chipping and must not be used as a structural component. SmCo also requires extremely high fields to magnetise it, which can influence size and shape of component.

Summary

- Excellent resistance to corrosion
- High temperature performance
- High resistance to demagnetisation
- Standard stock sizes available
- Rapid Prototyping and assembly available

Grade and Magnetic Characteristics SmCo 2:17

2:17 Grade	Br kGs	Hcb kOe (min)	Hci kOe (min)	(BH)max MGOe (min)	Density g/cm^3	Max working Temp ^{0}C
22/25 22/30 22/35	9.7 +/-0.3	9.0	25 28 32	22	8.4	350
24/25 24/30 24/35	10.3+/-0.3	9.2	25 28 32	24	8.4	350
26/16 26/20 26/25 26/30	10.8+/-0.3	8.5 9.5 9.5 9.5	14 18 22 26	25	8.4	300
28/16 *28/20 28/25 28/30	11.0 +/-0.3	9.8 9.6 9.6 9.6	13 17 22 26	27	8.4	300
30/12 30/15 30/20 30/25	11.3 +/-0.3	8.0 9.0 9.5 9.5	10 13 18 22	29	8.4	300
32/12 32/15 32/20	11.5+/-0.3	8.0 9.0 9.6	10 13 18	31	8.4	300

* = MSS Standard 2:17 grade for raw material

SmCo 1:5

1:5 Grade	Br kGs	Hcb kOe (min)	Hci kOe (min)	(BH)max MGOe (min)	Density g/cm^3	Max working Temp ^{0}C
18/18 18/20 18/25	8.6 +/-0.3	8.2	16 18 22	17	8.3	250
20/18 20/20 20/25	9.0+/-0.3	8.5	16 18 22	19	8.3	250
22/15 22/18 22/20	9.5+/-0.3	8.8	14 16 18	21	8.3	250
24/15 24/18	10.0 +/-0.3	9.2	14 16	23	8.3	250

Physical and Mechanical Characteristics

Composition			SmCo 2:17 32 30 28 26 24 22	SmCo 1:5 24 22 20 18
Physical characteristics				
Curie temperature	^{0}C		800 to 850	700 to 750
	(K)		(1073 to 1123)	(973 to 1023)
Thermal expansion coefficient	C//	1^0C	8×10^{-6}	6×10^{-6}
		(1K)	(8×10^{-6})	(6×10^{-6})
	C⊥	1^0C	11×10^{-6}	13×10^{-6}
		(1K)	(11×10^{-6})	(13×10^{-6})
Thermal conductivity	Kcal/mhr^{0}C		10	11
	(W/mK)		(12)	(13)
Specific heat	Cal/g^{0}C		8×10^{-2}	9×10^{-2}
	(J/kgK)		(335)	(377)
Specific resistivity	Ω-cm		8.6×10^{-5}	5.3×10^{-5}
Mechanical characteristics				
Deflection strength	Kg/mm^2		15	18
	(N/m^2)		(1.5×10^8)	(1.8×10^8)
Compressive strength	Kg/mm^2		82	102
	(N/m^2)		(8×10^8)	(10×10^8)
Tensile strength	Kg/mm^2		3.6	4.1
	(N/m^2)		(3.5×10^7)	(4×10^7)
Young's modulus	Kg/mm^2		1.2×10^4	1.6×10^4
	(N/m^2)		(1.2×10^{11})	(1.6×10^{11})
Vickers hardness	Hv		500 to 600	450 to 500

Saturation Magnetisation

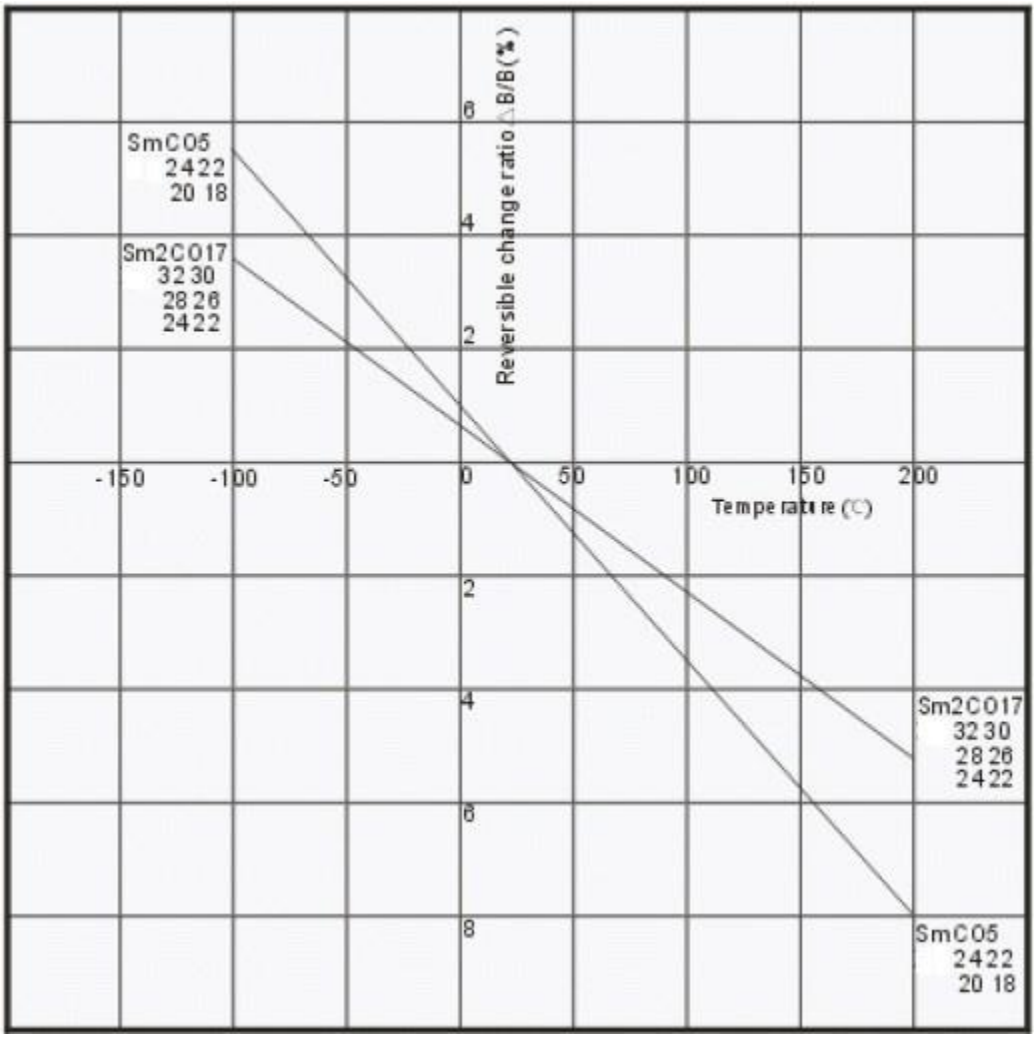
Material	Magnetic Field Strength H(min) KA/m	
SmCo 1:5	2400 (Hcj<1600)	4000 (Hcj>1600)
SmCo 2:17	4000 (Hcj<1000)	8000 (Hcj>1000)

Temperature Characteristics

Reversible Temperature Coefficient at -100^{0}C to 200^{0}C

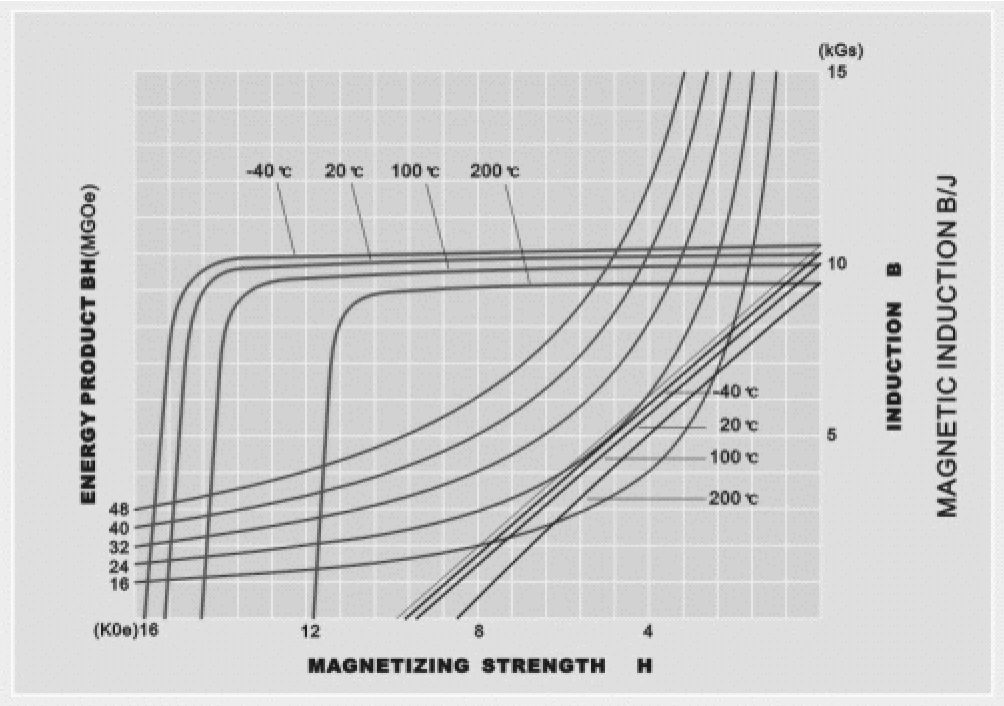
Temperature	-100^{0}C to 20^{0}C	20^{0}C to 100^{0}C	100^{0}C to 200^{0}C
SmCo 1:5	-0.045 % / ^{0}C	-0.045 % / ^{0}C	-0.050 % / ^{0}C
SmCo 2:17	-0.030% / ^{0}C	-0.030% / ^{0}C	-0.035% / ^{0}C

Reversible Temperature Change

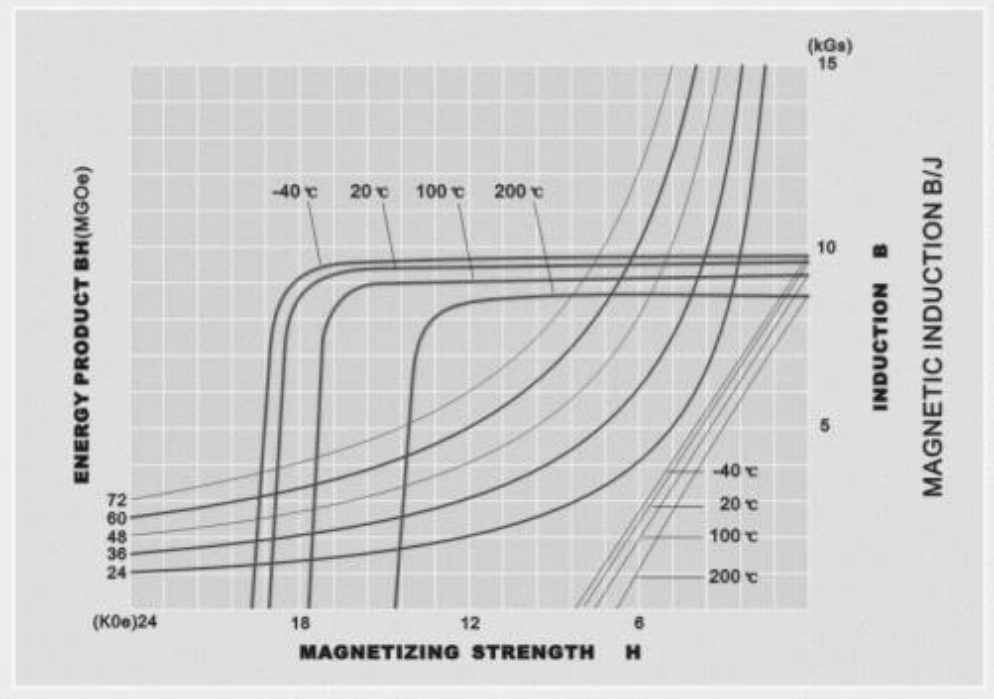


Demagnetisation Curve - SmCo 1:5 Grades

24/15



22/20



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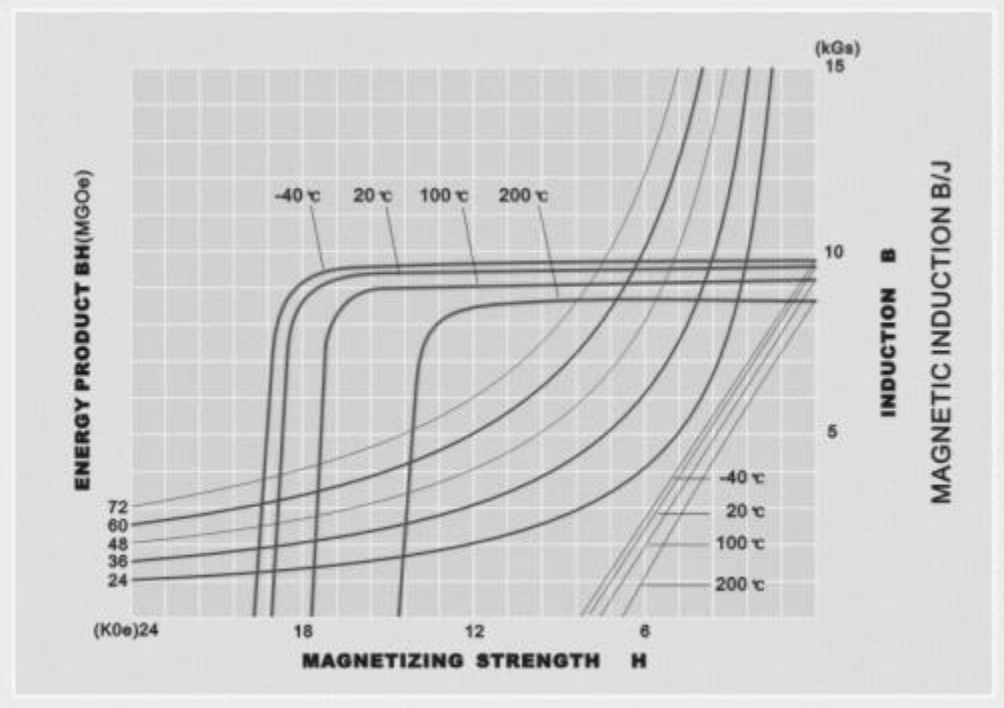
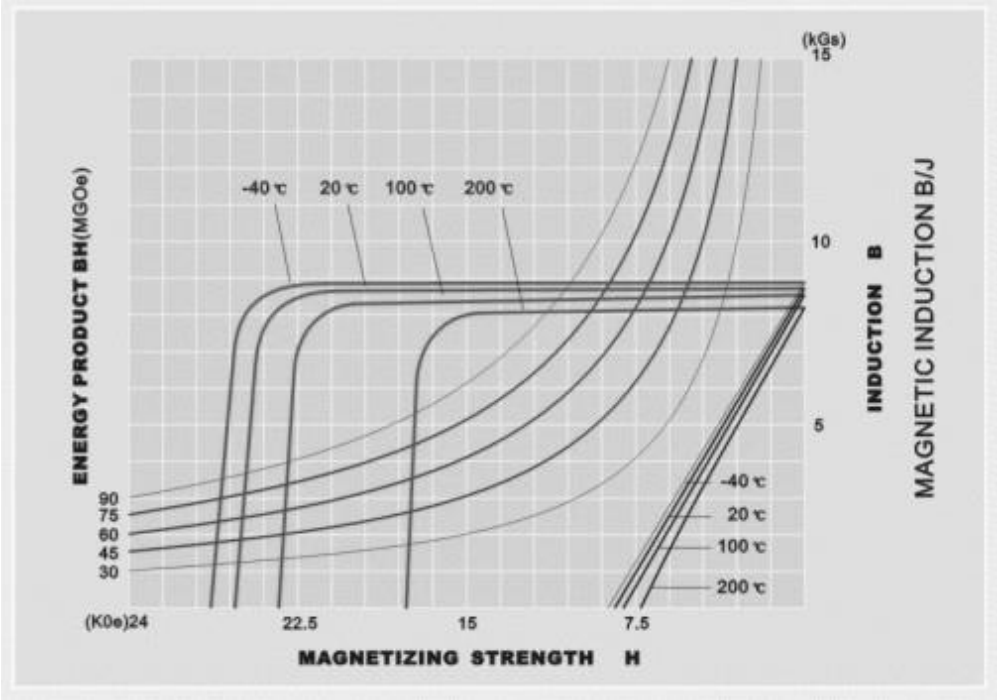
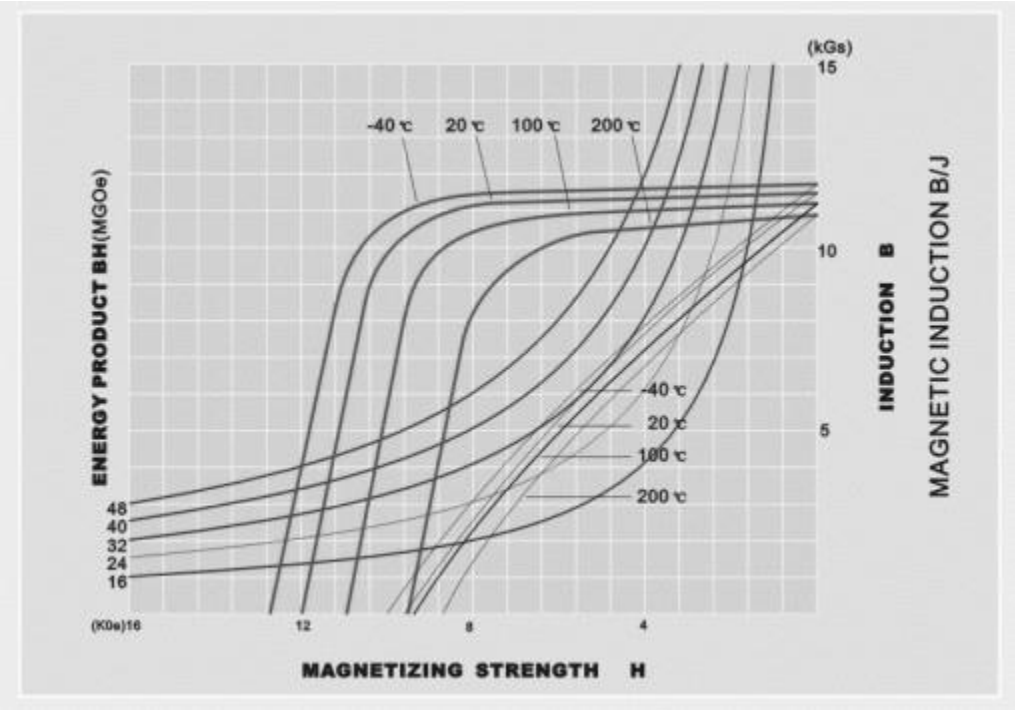

(kGs)
15
10
5
INDUCTION B
MAGNETIC INDUCTION B/J
ENERGY PRODUCT BH(MGOe)
-40 ℃
20 ℃
100 ℃
200 ℃
72
60
48
36
24
(K0e)24
18
12
6
MAGNETIZING STRENGTH H

18/25


(kGs)
15
10
5
INDUCTION B
MAGNETIC INDUCTION B/J
ENERGY PRODUCT BH(MGOe)
-40 ℃
20 ℃
100 ℃
200 ℃
90
75
60
45
30
(K0e)24
22.5
15
7.5
MAGNETIZING STRENGTH H

Demagnetisation Curve - SmCo 2:17 Grades

32/12



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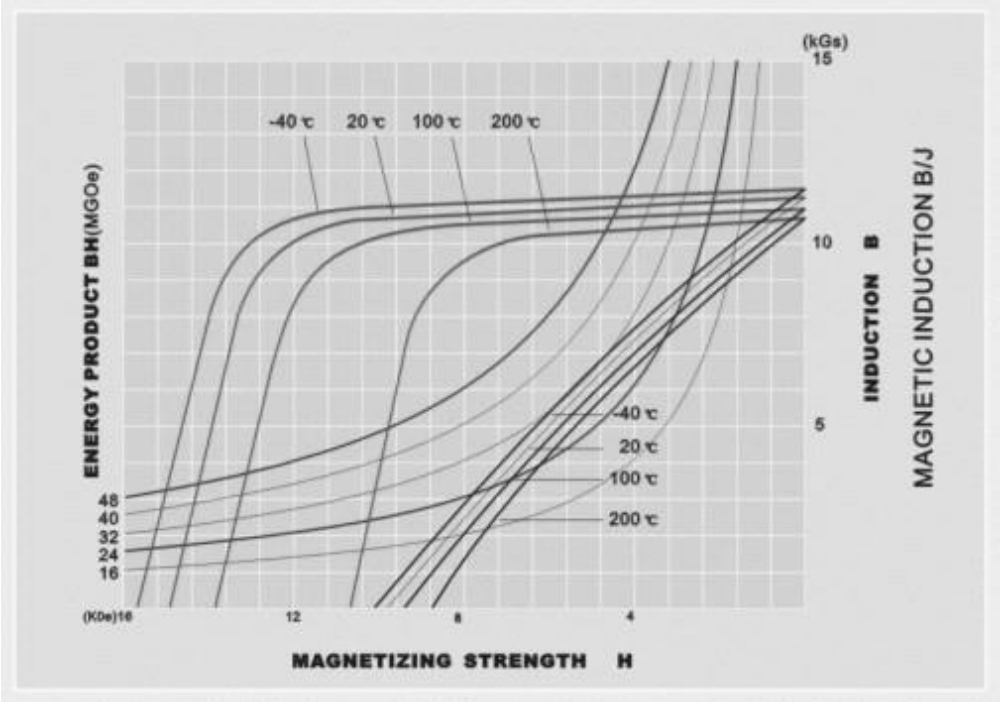

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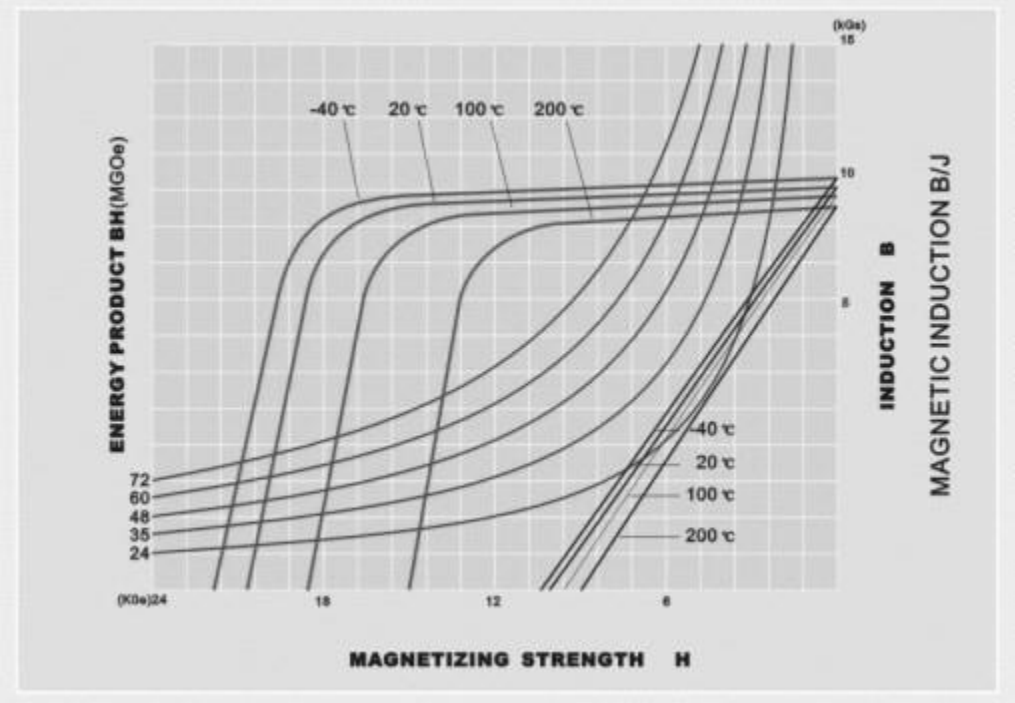
(kGs)
15
10
5
-40 ℃
20 ℃
100 ℃
200 ℃
ENERGY PRODUCT BH(MGOe)
72
60
48
35
24
(KOe)24
18
12
6
MAGNETIZING STRENGTH H
INDUCTION B
MAGNETIC INDUCTION B/J