

Samarium Cobalt Magnets, SmCo Magnets Datasheet



Samarium Cobalt magnets (SmCo) is the sister Rare Earth Magnet to NdFeB. SmCo is sometimes called a Rare Earth Cobalt magnet. SmCo magnets exist in two alloy varieties.

Sm1Co5 (SmCo1:5) is the original SmCo alloy. Sm2Co17 (SmCo2:17) is the more common used and stronger SmCo alloy with SmCo26 being the most popular variety.

Sm1Co5 contains mainly Sm and Co and contains no iron (Fe) so it has excellent corrosion resistance -it should never corrode with water.

Sm2Co17 is mainly Sm and Co but also contains Cu, Hf &/or Zr, sometimes Pr, and Fe. The low free iron content in Sm2Co17 means it is technically prone to a little surface corrosion when in water.

Sm2Co17 is regarded as having good to very good corrosion resistance (far superior to NdFeB) in most applications. A simple coating of NiCuNi will very likely solve any risk of corrosion.

Samarium Cobalt magnets (SmCo) may be weaker than NdFeB magnets at room temperature but SmCo will often outperform NdFeB above +150 to +180 deg C (subject to the application and grade).

SmCo magnets are ideal for aerospace, automotive, sensor, loudspeaker, motor and military applications. In mission critical applications they are an ideal first choice.

SmCo magnets offer minimal change in magnetic output over a small temperature change (with far less variation than NdFeB or ferrite; only Alnico is better).

The Low Temperature Coefficient (LTC) versions have less variation in magnetic output with temperature change (due to added Gd and Er).

SmCo magnets performance over a massive range of temperatures (from near to -273 deg C up to +350 deg C).

The H versions Sm2Co17 have higher Hci and operate up to +350°C rather than +300°C.

SmCo and NdFeB could be interchangeable e.g. SmCo30 should perform very similarly to N30 at ambient temperature.

Product Information

Sm1Co5 (1:5 alloy)

Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|---------------|-----------|----------|----------|---------|-----------|-------|-------------------|-------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m ³ | MGOe |
| SmCo16 (1:5) | 0.81-0.85 | 8.1-8.5 | 620-660 | 7.8-8.3 | 1194-1830 | 15-23 | 110-127 | 14-16 |
| SmCo18 (1:5) | 0.85-0.90 | 8.5-9.0 | 660-700 | 8.3-8.8 | 1194-1830 | 15-23 | 127-143 | 16-18 |
| SmCo20 (1:5) | 0.90-0.94 | 9.0-9.4 | 680-725 | 8.5-9.1 | 1194-1830 | 15-23 | 150-167 | 19-21 |
| SmCo22 (1:5) | 0.92-0.96 | 9.2-9.6 | 710-750 | 8.9-9.4 | 1194-1830 | 15-23 | 160-175 | 20-22 |
| SmCo24 (1:5) | 0.96-1.00 | 9.6-10.0 | 730-770 | 9.2-9.7 | 1194-1830 | 15-23 | 175-190 | 22-24 |
| SmCo18S (1:5) | 0.85-0.90 | 8.5-9.0 | 660-700 | 8.3-8.8 | 1433-2000 | 18-25 | 135-151 | 17-19 |
| SmCo20S (1:5) | 0.90-0.94 | 9.0-9.4 | 680-725 | 8.5-9.1 | 1433-2000 | 18-25 | 143-160 | 18-20 |
| SmCo22S (1:5) | 0.92-0.96 | 9.2-9.6 | 710-750 | 8.9-9.4 | 1433-2000 | 18-25 | 160-175 | 20-22 |

Low Temperature Coefficient Sm1Co5 (1:5 alloy)

Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|-----------------|-----------|---------|----------|---------|-----------|-------|-------------------|--------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m ³ | MGOe |
| SmCo10LTC (1:5) | 0.59-0.63 | 5.9-6.3 | 460-493 | 5.8-6.2 | 1430-1830 | 18-23 | 68-80 | 8.5-10 |

Rev.Temp.Coef. of Induction (Br), α , %/°C :-

(+20 to +100°C) = -0.004, (+100 to +200°C) = -0.021, (+200 to +300°C) = -0.041.

Sm2Co17 (2:17 alloy) Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|----------|-----------|-----------|----------|-----------|-----------|-------|---------|-------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m3 | MGOe |
| SmCo24L | 0.95-1.02 | 9.5-10.2 | 557-716 | 7.0-9.0 | 636-955 | 8-12 | 175-191 | 22-24 |
| SmCo26L | 1.02-1.05 | 10.2-10.5 | 557-748 | 7.0-9.4 | 636-955 | 8-12 | 191-207 | 24-26 |
| SmCo28L | 1.03-1.08 | 10.3-10.8 | 557-765 | 7.0-9.9 | 636-955 | 8-12 | 207-220 | 26-28 |
| SmCo30L | 1.08-1.15 | 10.8-11.5 | 557-795 | 7.0-10.0 | 636-955 | 8-12 | 220-240 | 28-30 |
| SmCo32L | 1.10-1.15 | 11.0-11.5 | 557-810 | 7.0-10.2 | 636-955 | 8-12 | 230-255 | 29-32 |
| SmCo26M | 1.02-1.05 | 10.2-10.5 | 716-780 | 9.0-9.8 | 955-1273 | 12-16 | 191-207 | 24-26 |
| SmCo28M | 1.03-1.08 | 10.3-10.8 | 716-796 | 9.0-10.0 | 955-1273 | 12-16 | 207-220 | 26-28 |
| SmCo30M | 1.08-1.10 | 10.8-11.0 | 716-835 | 9.0-10.5 | 955-1273 | 12-16 | 220-240 | 28-30 |
| SmCo32M | 1.10-1.13 | 11.0-11.3 | 716-845 | 9.0-10.6 | 955-1273 | 12-16 | 230-255 | 29-32 |
| SmCo22 | 0.93-0.97 | 9.3-9.7 | 676-740 | 8.5-9.3 | >1433 | >18 | 160-183 | 20-23 |
| SmCo24 | 0.95-1.02 | 9.5-10.2 | 700-750 | 8.7-9.4 | >1433 | >18 | 175-191 | 22-24 |
| SmCo26 | 1.02-1.05 | 10.2-10.5 | 750-780 | 9.4-9.8 | >1434 | >19 | 191-207 | 24-26 |
| SmCo28 | 1.03-1.08 | 10.3-10.8 | 756-796 | 9.5-10.0 | >1435 | >20 | 207-220 | 26-28 |
| SmCo30 | 1.08-1.10 | 10.8-11.0 | 788-835 | 9.9-10.5 | >1436 | >21 | 220-240 | 28-30 |
| SmCo32 | 1.10-1.13 | 11.0-11.3 | 811-845 | 10.2-10.6 | >1194 | >15 | 230-255 | 29-32 |
| SmCo24H | 0.95-1.02 | 9.5-10.2 | 700-750 | 8.7-9.4 | >1990 | >25 | 175-191 | 22-24 |
| SmCo26H | 1.02-1.05 | 10.2-10.5 | 750-780 | 9.4-9.8 | >1990 | >25 | 191-207 | 24-26 |
| SmCo28H | 1.03-1.08 | 10.3-10.8 | 756-796 | 9.5-10.0 | >1990 | >25 | 207-220 | 26-28 |
| SmCo30H | 1.08-1.10 | 10.8-11.0 | 788-835 | 9.9-10.5 | >1990 | >25 | 220-240 | 28-30 |

Low Temperature Coefficient Sm2Co17 (2:17 alloy) Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|-----------|-----------|---------|----------|---------|-----------|-------|---------|-------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m3 | MGOe |
| SmCo22LTC | 0.94-0.98 | 9.4-9.8 | 668-715 | 8.4-9.0 | 1194-1591 | 15-20 | 161-183 | 21-23 |

Rev.Temp.Coef. of Induction (Br), a, %/°C :-

(-50 to +20°C) = +0.005, (+20 to +100°C) = +0.012, (+100 to +200°C) = +0.006, (+200 to +300°C) = -0.025.

Bonded Samarium Cobalt Magnets

These magnets are specially made to customer specified dimensions. There may be a tooling fee and also a magnetising coil fee (depends on magnetic pattern required). They are usually most cost efficient when ordered in high quantities (e.g. thousands). The binder limits the maximum operating temperature to +120°C as heat affects this first.

Bonded Sm1Co5 (1:5 alloy)

Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|----------|-----|-----|----------|-----|-----------|-----|-------------------|---------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m ³ | MGOe |
| SmCoB6 | 0.4 | 4.0 | 280 | 3.5 | 800 | 10 | 30-50 | 3.8-6.3 |
| SmCoB10 | 0.5 | 5.0 | 320 | 4.0 | 800 | 10 | 50-65 | 6.3-8.2 |

Bonded Sm2Co17 (2:17 alloy)

Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|----------|-----|-----|----------|-----|-----------|-----|-------------------|-----------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m ³ | MGOe |
| SmCoB10 | 0.6 | 6.0 | 360 | 4.5 | 800 | 10 | 65-80 | 8.2-10.0 |
| SmCoB12 | 0.7 | 7.0 | 400 | 5.0 | 800 | 10 | 80-95 | 10.0-12.0 |

Plastic Bonded SmCo

Typical Range of Values

| Material | Br | | Hc (Hcb) | | Hci (Hcj) | | BHmax | |
|----------|-----------|---------|----------|---------|-----------|----------|-------------------|---------|
| | T | kG | kA/m | kOe | kA/m | kOe | kJ/m ³ | MGOe |
| SmCoP3 | 0.3-0.4 | 3.0-4.0 | 199-279 | 2.5-3.5 | 716-1194 | 9.0-15.0 | 20-28 | 2.5-3.5 |
| SmCoP5 | 0.35-0.55 | 3.5-5.5 | 247-358 | 3.1-4.5 | 716-1194 | 9.0-15.0 | 32-52 | 4.0-6.5 |
| SmCoP8 | 0.55-0.68 | 5.5-6.8 | 334-462 | 4.2-5.8 | 716-1194 | 9.0-15.0 | 48-64 | 6.0-8.0 |

Max Working Temperature

(Please note - your application will affect the performance available)

| Material | Maximum recommended |
|-----------------------|--------------------------------------|
| Sm1Co5 (1:5) | +250 degrees C |
| Sm2Co17 (2:17) | +250 (L) / +300 / +350 (H) degrees C |
| Bonded Sm1Co5 (1:5) | +120 degrees C (binder fails) |
| Bonded Sm2Co17 (2:17) | +120 degrees C (binder fails) |
| Plastic bonded SmCo | +120 degrees C (binder fails) |

Temperature coefficients (values given for 20-100 deg C)

| Rev.Temp.Coef. of Induction (Br), a, %/°C | Rev.Temp.Coef. of Intrinsic Coercivity (Hci), b, %/°C |
|---|---|
| -0.050 (Sm1Co5) | -0.30 (Sm1Co5) |
| -0.045 (Sm1Co5 S) | -0.28 (Sm1Co5 S) |
| -0.035 (Sm2Co17) | -0.20 (Sm2Co17) |
| -0.050 (Bonded Sm1Co5) | -0.25 (Bonded Sm1Co5) |
| -0.030 (Bonded Sm2Co17) | -0.20 (Bonded Sm2Co17) |
| -0.040 (Plastic Bonded SmCo) | -0.20 (Plastic Bonded SmCo) |

Corrosion Resistance

Corrosion resistance:- SmCo(1:5) Excellent (has no iron); SmCo(2:17) Good to Very Good (has some free iron). SmCo magnets can usually be used in humid applications without any need for a protective coating. In wet environments, coating of SmCo(2:17) in NiCuNi is recommended to avoid surface corrosion issues. NiCuNi plated SmCo is claimed by some to limit chipping and allows for soldering as well but is rarely done.

Physical Characteristics (excluding bonded variants)

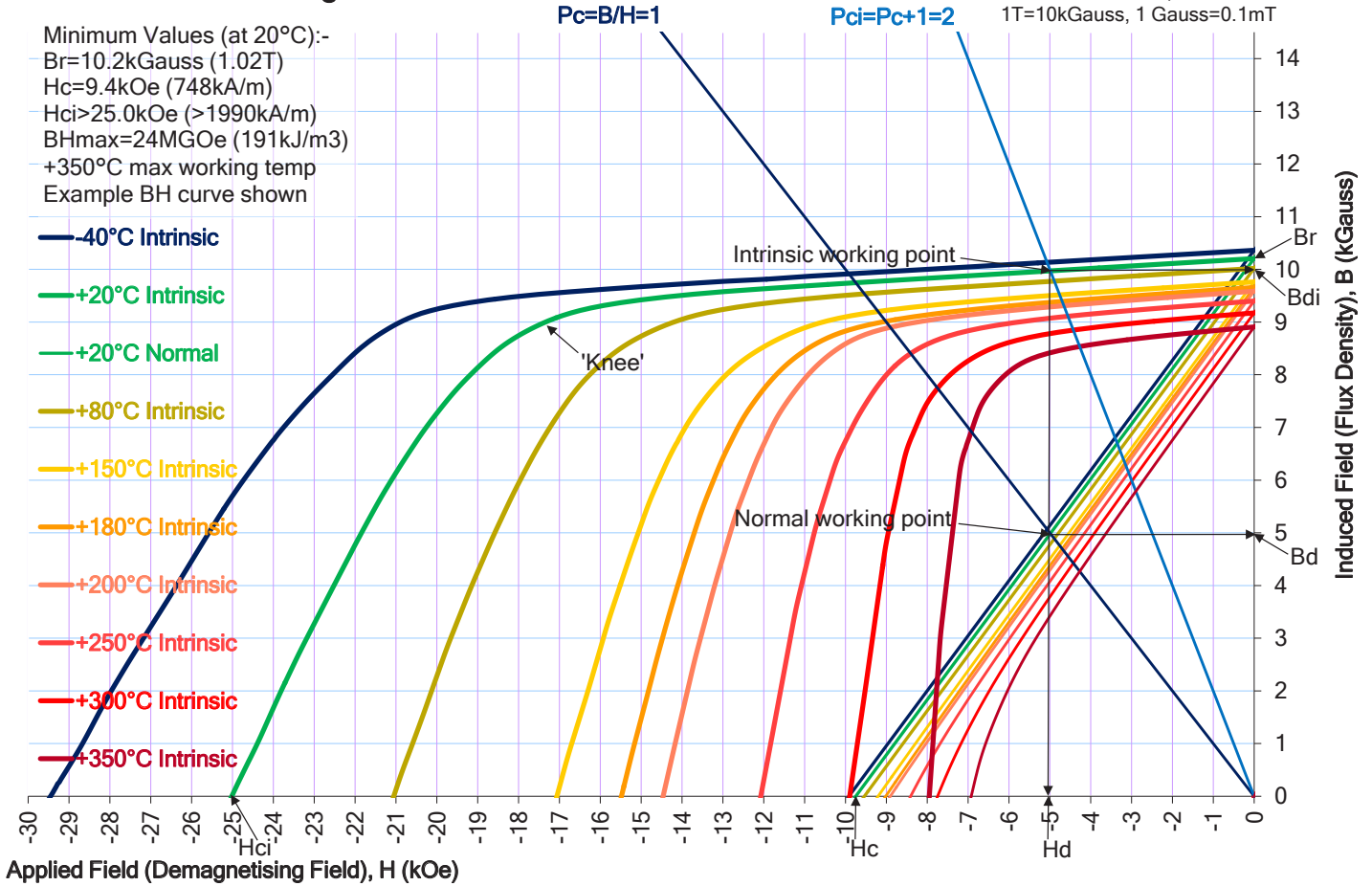
| Characteristic | Symbol | Unit | Value |
|--|------------------------------------|-----------------------------------|-----------|
| Density Sm1Co5 | D | g/cm ³ | 8.2-8.4 |
| Density Sm2Co17 | D | g/cm ³ | 8.3-8.5 |
| Vickers Hardness Sm1Co5 | Hv | D.P.N. | 500-600 |
| Vickers Hardness Sm2Co17 | Hv | D.P.N. | 450-500 |
| Compression Strength Sm1Co5 | C.S. | N/mm ² | 900-1000 |
| Compression Strength Sm2Co17 | C.S. | N/mm ² | 650-800 |
| Coefficient of Thermal Expansion Sm1Co5 | C// | 10 ⁻⁶ /°C | 6 |
| | C ⊥ | 10 ⁻⁶ /°C | 13 |
| Coefficient of Thermal Expansion Sm2Co17 | C// | 10 ⁻⁶ /°C | 8-10 |
| | C ⊥ | 10 ⁻⁶ /°C | 11 |
| Electrical Resistivity Sm1Co5 | r | μ Ω.cm | 5-6 |
| Electrical Resistivity Sm2Co17 | r | μ Ω.cm | 80-90 |
| Electrical Conductivity Sm1Co5 | s | 10 ⁶ S/m | 16.6-20 |
| Electrical Conductivity Sm2Co17 | s | 10 ⁶ S/m | 1.11-1.25 |
| Thermal Conductivity Sm1Co5 | k | kCal/(m.h.°C) | 11 |
| Thermal Conductivity Sm2Co17 | k | kCal/(m.h.°C) | 10 |
| Specific Heat Capacity Sm1Co5 | c | kCal/(kg.°C) | 0.08 |
| Specific Heat Capacity Sm2Co17 | c | kCal/(kg.°C) | 0.09 |
| Tensile Strength Sm1Co5 | σ _{UTS} or S _U | kg/mm ² | 4.1 |
| Tensile Strength Sm2Co17 | σ _{UTS} or S _U | kg/mm ² | 3.6 |
| Young's Modulus Sm1Co5 | λ / E | 10 ¹¹ N/m ² | 1.6 |
| Young's Modulus Sm2Co17 | λ / E | 10 ¹¹ N/m ² | 1.2 |
| Flexural Strength Sm1Co5 | σ | N/mm ² | 120 |
| Flexural Strength Sm2Co17 | σ | N/mm ² | 110 |
| Compressive strength Sm1Co5 | σ | N/mm ² | 650 |
| Compressive strength Sm2Co17 | σ | N/mm ² | 800 |
| Rigidity | E.I | N/m ² | 150 |
| Poisson's Ratio | ν | | 0.27 |
| Curie Temperature Sm1Co5 | T _c | °C | 700-750 |
| Curie Temperature Sm2Co17 | T _c | °C | 800-850 |

Example of a BH curve (second quadrant demagnetisation)

SmCo - SmCo26H grade

Conversions:-
 1kA/m=12.5665Oe, 1kOe=79.5775kA/m
 1T=10kGauss, 1 Gauss=0.1mT

Minimum Values (at 20°C):-
 Br=10.2kGauss (1.02T)
 Hc=9.4kOe (748kA/m)
 Hci>25.0kOe (>1990kA/m)
 BHmax=24MGOe (191kJ/m3)
 +350°C max working temp
 Example BH curve shown



Additional Notes

SmCo magnets will outperform NdFeB magnets at temperatures above +150 to +180 degrees C.

SmCo magnets can be used at cryogenic temperatures (i.e. towards absolute zero, -273 degrees C).

The magnet shape, its environment, and the actual application affect how the NdFeB magnet will perform. Temperature is important as well as damp or wet conditions.

When determining suitability, you should analyse the Intrinsic curve not the Normal curve.

By keeping the intrinsic working point above the 'knee' and ideally at the BHmax working point maximum performance is possible.

If you have any more questions, require technical assistance and would like a quotation, simply contact us.

Although we have made every attempt to provide accurate information, we do reserve the right to change any of the information in this document without notice.

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