



Sm2Co17 vs NdFeB: performance data at 20 °C and 180 °C

Two grades, two temperatures, the same block size. The numbers behind the question “can you replace a samarium magnet with a neodymium one?”

1. Grade data

Material	Temperature	Br (T)	Hcb (kA/m)	Hcj (kA/m)	(BH)max (kJ/m ³)	Source
NdFeB N45UH	20 °C	1.341	1038	2056	348	BH tester report
NdFeB N45UH	180 °C	1.108	638	760	212	From temperature coefficients
Sm2Co17 grade 30H	20 °C	1.090	826	1990	225	BH tester report
Sm2Co17 grade 30H	180 °C	1.029	780	1353	201	From temperature coefficients

Both 20 °C rows are measured on our own test bench. Vendors publish room-temperature data only, so the 180 °C columns are modelled from the coefficients below. Coefficients used: $\alpha(\text{Br}) = -0.1085 \text{ \%}/^\circ\text{C}$ for NdFeB (GB/T 13560), $\alpha(\text{Br}) = -0.035 \text{ \%}/^\circ\text{C}$ and $\beta(\text{Hcj}) = -0.20 \text{ \%}/^\circ\text{C}$ for Sm2Co17 2:17.

2. Working point in one identical block (FEMM field simulation, 20 °C)

Material in the model	H at the probe point	B at the probe point	B·H
Sm2Co17	420 kA/m	0.549 T	28.98 MGOe
NdFeB N45UH	518 kA/m	0.675 T	44.0 MGOe

Same block size, same mesh, same probe point. Only the material changed. |B| is the flux density a Hall sensor reads. |H| is the self-demagnetizing field inside the magnet. The pair (|H|, |B|) is the working point: put it on the demagnetization curve and you can see the margin to the knee. Two magnets of the same size still sit at different points, so the readouts do not scale with Br alone. Model blocks and curve data agree to within about one percent at this working point.

3. What this means for a swap

- At 20 °C the neodymium grade is **0.25 T higher in Br** and gives about **23 % more flux density** in the same block.
- Br falls about **three times faster** in neodymium with heat. At 180 °C the Br gap narrows to 0.08 T.
- Hcj is where the swap really bites: 2056 → **760 kA/m** for NdFeB, 1990 → **1353 kA/m** for Sm2Co17.
- Keep the working point **above the knee** at the highest temperature the magnet ever reaches, with margin.
- Only Br maps to the field at a fixed distance. (BH)max and Hcj are not field values.
- Neodymium needs a coating (Ni-Cu-Ni, zinc or epoxy); samarium cobalt is usually used bare. A coating changes the fit and the effective air gap.

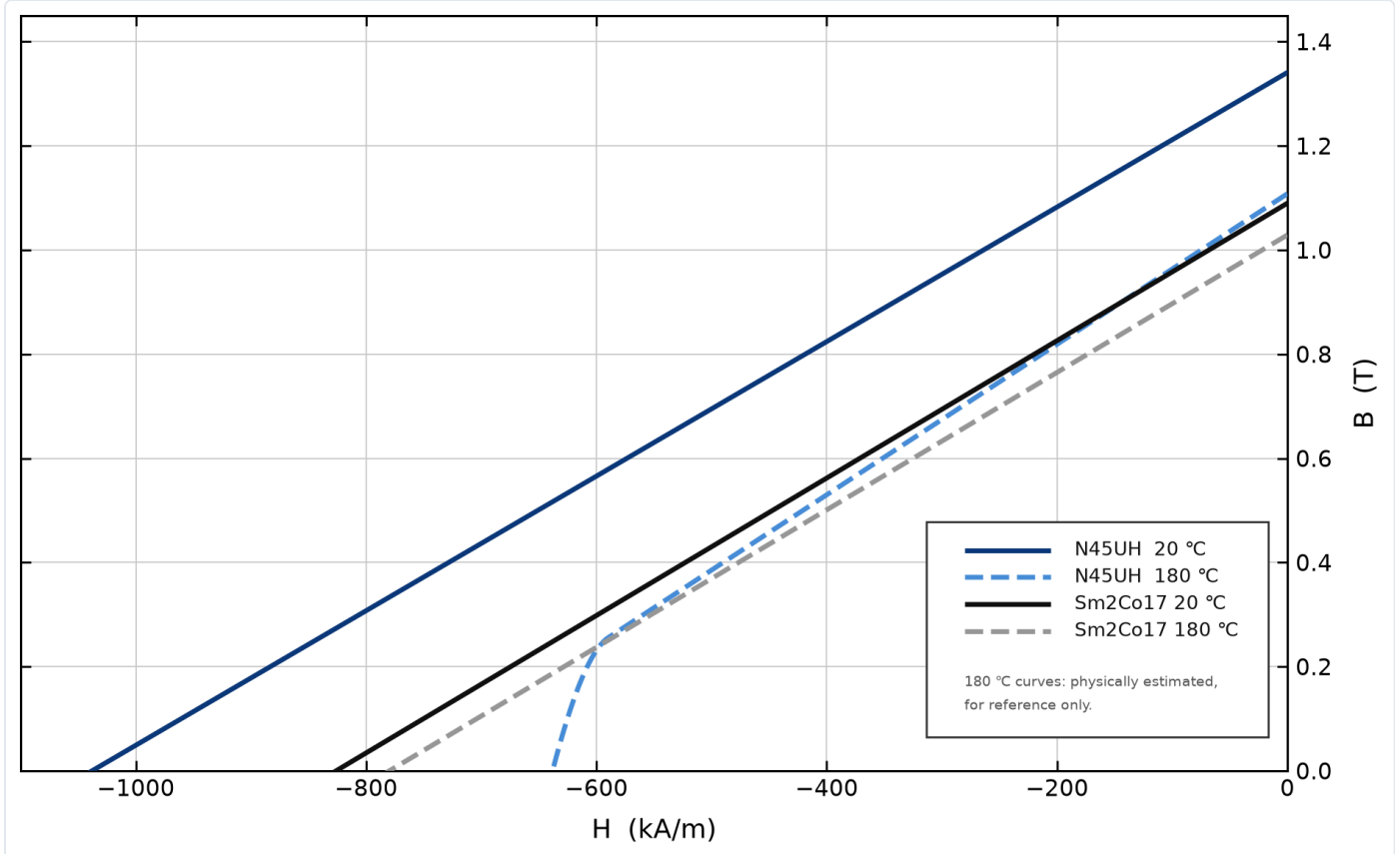
4. Commercial notes

- Price.** For the same part, samarium cobalt usually costs two to four times as much as neodymium.
- Lead time.** Neodymium normally ships five to fifteen days sooner. More plants run it and capacity is larger.
- Minimum order.** No fixed minimum for neodymium. Samarium cobalt is quoted per job and the minimum is negotiable.
- Where the gap closes.** Above 150 °C the price gap narrows, and above roughly 200 °C samarium cobalt often wins on total cost.

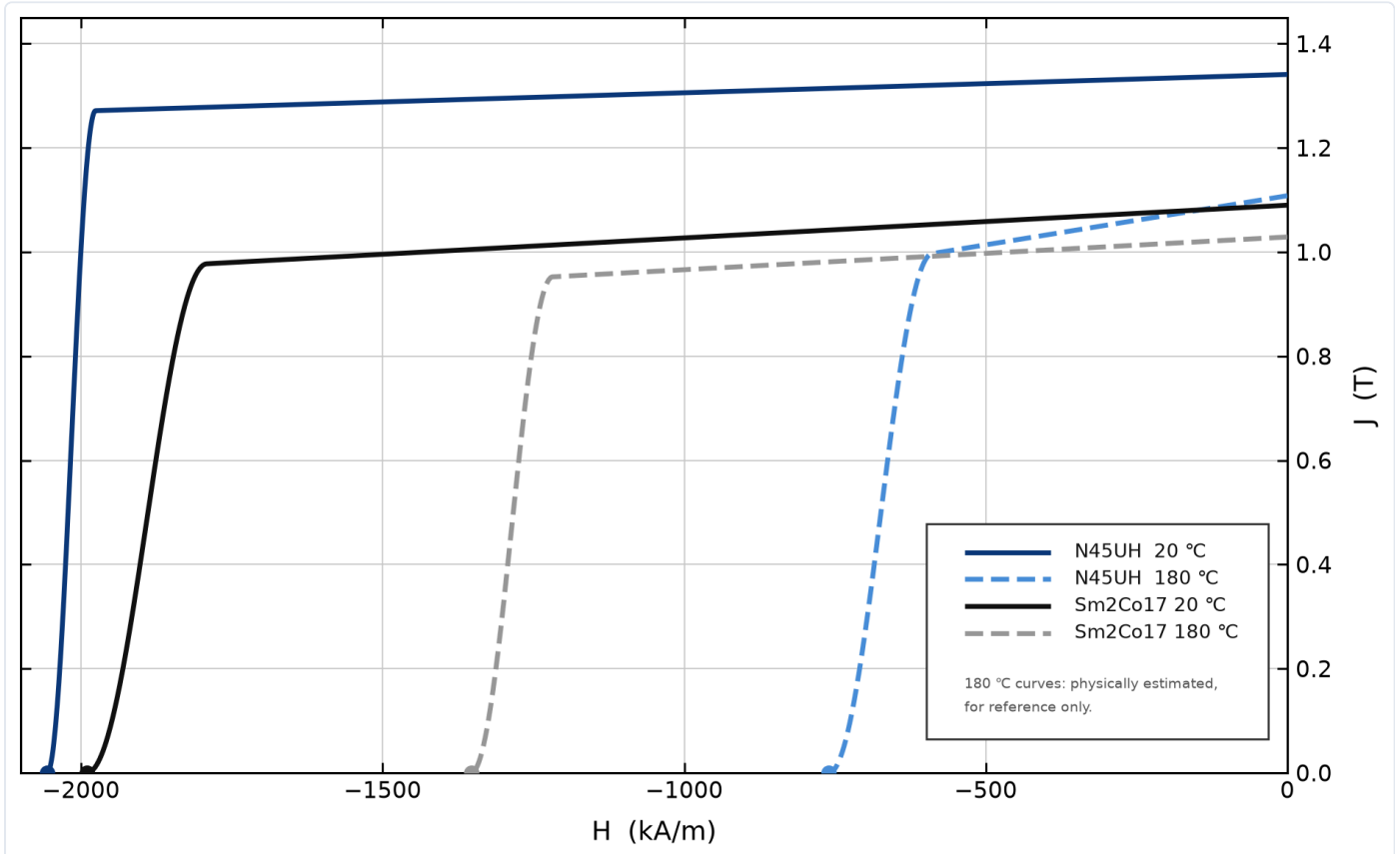
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Normal (B-H) demagnetization curves. The point where a curve meets the vertical axis is B_r . H_{cb} is where it meets the bottom axis. Note the bend in the 180 °C neodymium curve at about 588 kA/m.



Intrinsic (J-H) curves. The curve stays flat while the magnet is stable. The point where it starts to drop is the knee, and J reaches zero at H_{cj} . At 180 °C the neodymium grade loses most of its margin.