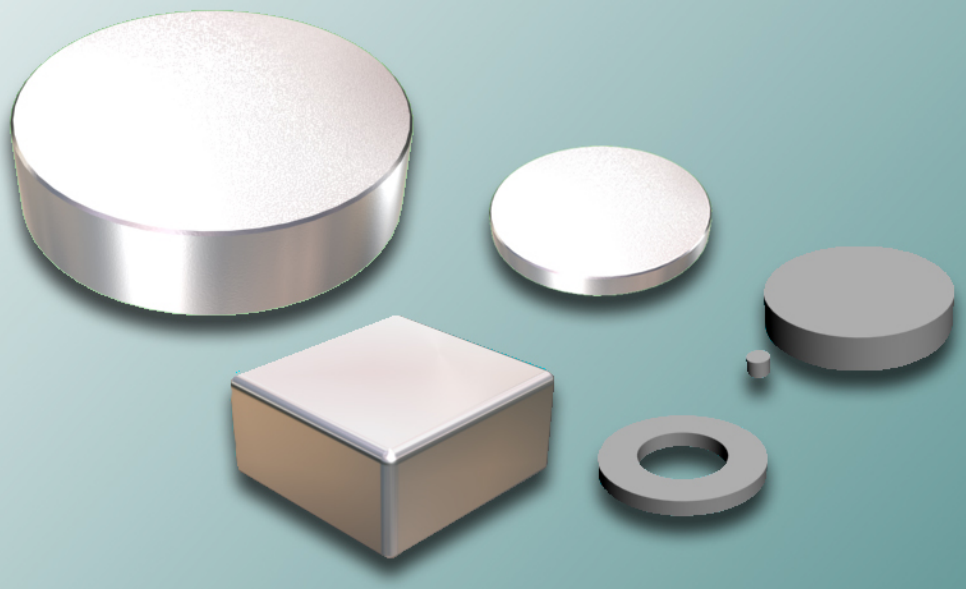
Integrated Magnetics

Rare Earth Permanent Magnets Technical Data Book



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Samarium Cobalt

Overview

Table of Magnetic Properties

Table of Physical Properties

BH Curves by Grade

Grade	BHmax	Hci
S2809	24 ~ 28	9,000
S2909	25 ~ 29	9,000
S3007	24 ~ 30	7,000
S3018	24 ~ 30	18,000
S3120	25 ~ 31	20,000
S3310	28 ~ 33	10,000
S3320	28 ~ 33	20,000
S3410	29 ~ 34	10,000

Rare Earth Magnets

(Introduction)

Collectively known as the Rare Earths (because they are alloys of the Lanthanide group of elements), Neodymium Iron Boron ($Nd_2Fe_{14}B$) and Samarium Cobalt (Sm_1Co_5 and Sm_2Co_{17}) magnets are the most advanced commercialized permanent magnet materials available today. Within each of these classes of Rare Earth Magnets are a wide variety of grades, spanning a range of properties and potential applications.

Both NdFeB and SmCo magnets are available in sintered and bonded forms. The bonded form of the material can be produced with close tolerances off-tool, with little or no finishing required. However the energy products of bonded Rare Earths are much lower than that of the sintered form. Sintered magnets usually require finishing in order to hold required mechanical tolerances.

Rare Earth magnets are brittle and machining operations should be performed before magnetization, using diamond grinding tools. SmCo magnets are much more brittle than NdFeB materials.

Sintered Rare Earth magnets are anisotropic and can only be magnetized in the direction of orientation. Bonded forms are available in isotropic forms which can be magnetized in any direction, including with multiple poles, though special magnetizing fixtures are required for this.

Quick Comparison of NdFeB and SmCo magnets

Material	Energy Products	Mechanical Strength	Density (Lbs/in^3)	Corrosion Resistance	Temperature Stability	Cost
NdFeB	32 to 53	Medium	0.275	Low	Low to Medium	Lower
SmCo	18 to 33	Low	0.300	High	High	Higher

Neodymium Iron Boron Overview

Neodymium Iron Boron magnets were commercially introduced in the early 1980s. They are widely used today in many different applications. The cost of this magnet material (on a dollars per energy product basis) is comparable to that of Ferrite magnets. On a dollars per pound basis, the cost of Neo magnets is about 10 to 20 times that of Ferrite magnets.

Note that NdFeB magnets are covered by various patents (held by Neomax) and only licensed materials are allowed into the USA. There are a number of sources that do sell unlicensed products to those willing to purchase them. ITG does not sell unlicensed materials.

Key Benefits

- **Very high strength**
- **Relatively low cost (by weight about 20 time Ferrite magnets, by "Dollars per BHmax" about 1.5 times Ferrite magnets).**
- **Relatively easy to machine, compared to Alnico and SmCo magnets.**

Key Challenges

- **Properties deteriorate rapidly at temperatures in excess of about 150°C (depending on grade and permeance coefficient magnet is operating at).**
- **Most grades of NdFeB magnets need to be protected against oxidation - by coating or pla ing the magnets.**

Quick Facts

- **Density - 0.275 lbs per cubic inch**
- **Saturation magnetizing field required - about 35kOe**
- **Manufacturing methods - sintering (most common), injection molding, compression bonding, or calendaring.**
- **Shapes available - blocks, bars, discs, rings, arc segments, etc.**
- **Grades available - from about 3330 to 5311. (First 2 digits represent BHmax, and second two digits represent Intrinsic Coercivity, Hci.)**
- **Sizes - off tool the largest die pressed blocks are about 4" cube, while isostatically pressed blocks can be much longer in the orientation direction (up to 9 feet).**
- **Machining - Neodymium magnets should be machined by grinding using diamond wheels, However, of the hard magnet materials, Neo magnets are the least difficult to machine. We have successfully machined very small magnets - down to 0.012" diameter with a center hole of 0.003" diameter, 0.040" long.**

Surface Treatment

Painting, coating, or plating is generally recommended for NdFeB, although recently certain grades have been made that exhibit higher resistance to oxidation. Plating NdFeB is a difficult process, and commercial plating houses unfamiliar with the specialized plating techniques required are unlikely to be able to achieve plating with good adhesion on Neo magnets. Nickel, Zinc, or Tin plating, plating provides good corrosion resistance for NdFeB magnets, though longer lead times or higher volumes may be required for these. We are also able to cadmium chromate or aluminum chromate plate NdFeB using vacuum deposition (IVD) techniques. A variety of organic coatings have also been successfully developed for NdFeB, exhibiting good corrosion resistance characteristics. For especially harsh environments, it may be advisable to use a combination of coating techniques, or to encapsulate the material in a sealed housing.

CAUTION!!!

- **NdFeB powder is very fine and when dry can ignite spontaneously - care must be taken in handling NdFeB powder.**
- **NdFeB magnets are very powerful - care must be taken in handling these magnets to avoid injuries.**
- **NdFeB magnets are susceptible to corrosion.**

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Magnetic Properties Table

Material: Neodymium Iron Boron Magnet

Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N5311	D	14,200 ~ 14,700	10,300	11,000	48 ~ 53	-0.11	-0.65	~ 80	~ 170
N5014	I	13,900 ~ 14,400	13,100	14,000	46 ~ 51	-0.11	-0.61	~ 130	~ 260
N5011	D	13,900 ~ 14,400	10,300	11,000	46 ~ 51	-0.11	-0.61	~ 110	~ 230
N4916	D	13,500 ~ 14,100	12,700	16,000	44 ~ 49	-0.11	-0.61	~ 140	~ 280
N4914	D	13,600 ~ 14,100	12,800	14,000	45 ~ 49	-0.11	-0.61	~ 130	~ 260
N4616	D	13,200 ~ 13,700	12,550	16,000	41 ~ 46	-0.11	-0.61	~ 140	~ 280
N4614	D	13,300 ~ 13,800	12,200	14,000	42 ~ 46	-0.11	-0.61	~ 130	~ 260
N4518	D	13,200 ~ 13,700	12,500	18,000	41 ~ 45	-0.11	-0.55	~ 150	~ 300
N4321	D	12,700 ~ 13,200	12,000	21,000	39 ~ 43	-0.10	-0.54	~ 160	~ 320
N4316	D	12,800 ~ 13,300	12,000	16,000	39 ~ 43	-0.10	-0.59	~ 150	~ 300
N4025	D	12,200 ~ 12,800	11,500	25,000	36 ~ 40	-0.10	-0.50	~ 200	~ 390
N4021	D	12,300 ~ 12,900	11,600	21,000	36 ~ 40	-0.10	-0.55	~ 160	~ 320
N3917	D	12,300 ~ 12,700	11,700	17,000	36 ~ 39	-0.10	-0.59	~ 150	~ 300
N3730	D	11,600 ~ 12,200	11,000	30,000	33 ~ 37	-0.10	-0.45	~ 230	~ 440
N3725	D	11,400 ~ 12,000	11,200	25,000	32 ~ 37	-0.08	-0.51	~ 230	~ 440
N3621	D	11,900 ~ 12,500	11,700	21,000	34 ~ 39	-0.09	-0.53	~ 160	~ 320
N3530	D	11,300 ~ 11,900	10,700	30,000	31 ~ 35	-0.10	-0.46	~ 230	~ 440
N3428	I	11,200 ~ 11,800	11,100	28,000	30 ~ 34	-0.08	-0.51	~ 240	~ 460
N3412	D	11,700 ~ 11,900	10,900	12,000	33 ~ 34	-0.11	-0.61	~ 110	~ 230
N3335	D	11,000 ~ 11,600	10,400	35,000	29 ~ 33	-0.10	-0.42	~ 250	~ 480
N3330	D	11,100 ~ 11,700	10,500	30,000	29 ~ 33	-0.08	-0.44	~ 230	~ 440

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

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Physical Properties Table

Material: Neodymium Iron Boron Magnet

Neodymium Iron Boron / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC)	(ºF)
N5311	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.7×10^{-6}	340	640
N5014	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.7×10^{-6}	340	640
N5011	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.7×10^{-6}	340	640
N4916	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.8×10^{-6}	340	640
N4914	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.8×10^{-6}	340	640
N4616	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.3×10^{-6}	-1.1×10^{-6}	360	680
N4614	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.4×10^{-6}	-1.1×10^{-6}	340	640
N4518	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.3×10^{-6}	-2.3×10^{-6}	340	640
N4321	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.1×10^{-6}	-2.1×10^{-6}	340	640
N4316	7.5×10^3	0.271	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.4×10^{-6}	-1.1×10^{-6}	350	660
N4025	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.1×10^{-6}	-2.1×10^{-6}	340	640
N4021	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.1×10^{-6}	-2.1×10^{-6}	350	660
N3917	7.7×10^3	0.278	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.7×10^{-6}	340	640
N3730	7.7×10^3	0.278	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.3×10^{-6}	-2.1×10^{-6}	360	680
N3725	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.7×10^{-6}	-2.1×10^{-6}	340	640
N3621	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.2×10^{-6}	-1.1×10^{-6}	360	680
N3530	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.4×10^{-6}	-1.4×10^{-6}	350	660
N3428	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.7×10^{-6}	340	640
N3412	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	8.9×10^{-6}	-1.7×10^{-6}	340	640
N3335	7.7×10^3	0.278	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.3×10^{-6}	-2.1×10^{-6}	340	640
N3330	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.7×10^{-6}	-1.1×10^{-6}	360	680

[3]// M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

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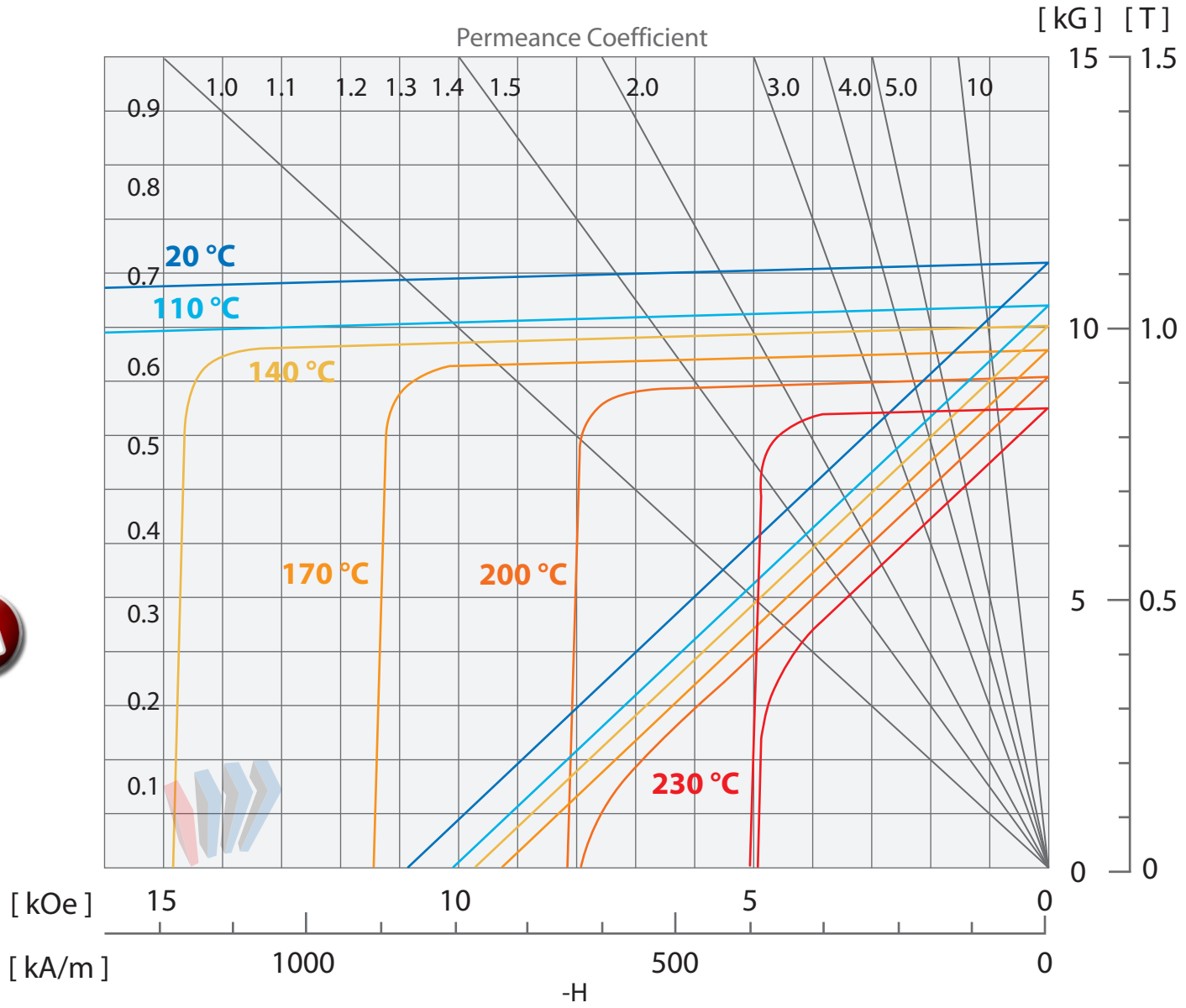
Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3330



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [2]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3330	D	11,100 ~ 11,700	10,500	30,000	29 ~ 33	-0.08	-0.44	~ 230	~ 440

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

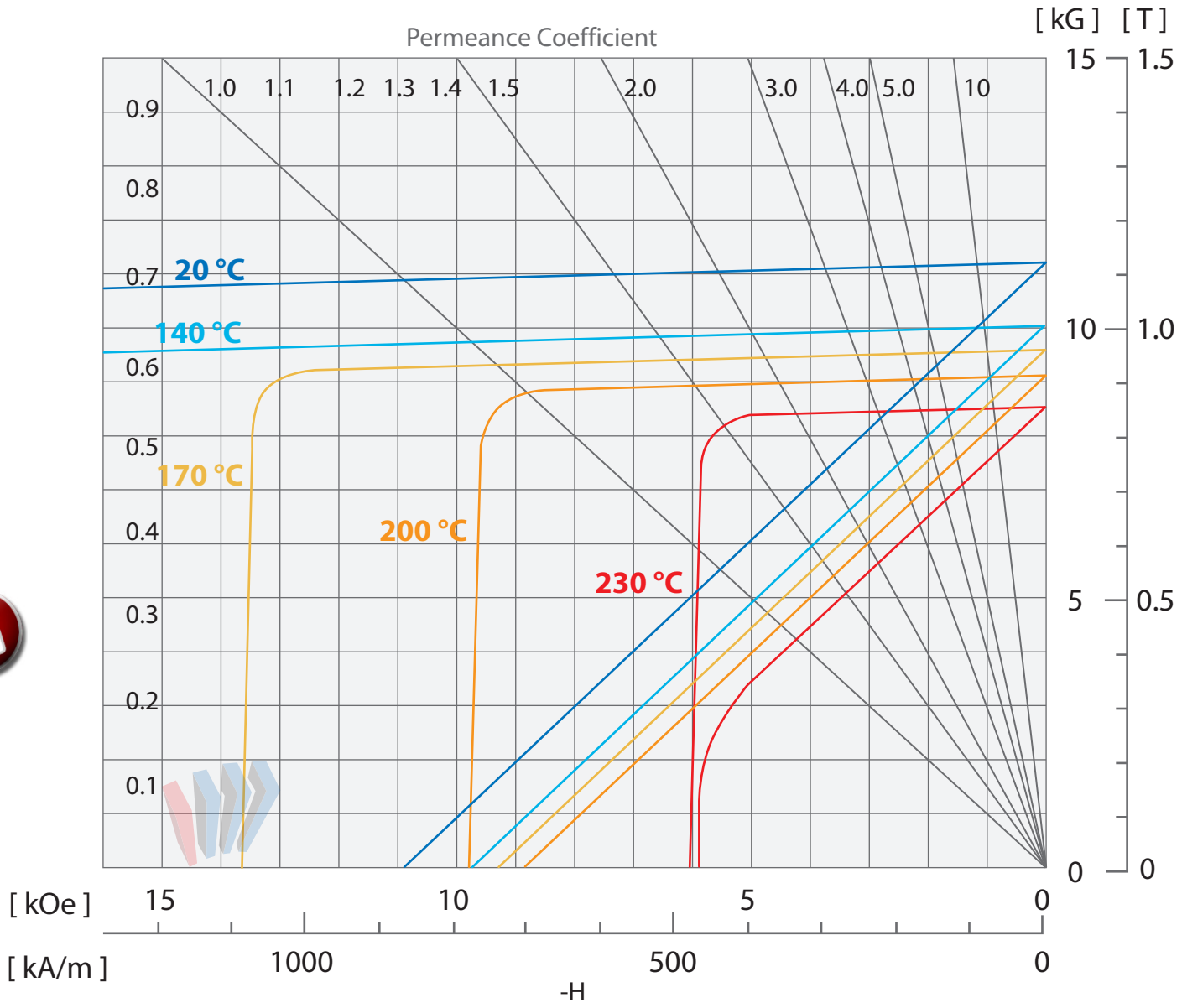
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N3330	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.7 x 10^{-6}	-1.1 x 10^{-6}	360	680

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3335



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [2]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3335	D	11,000 ~ 11,600	10,400	35,000	29 ~ 33	-0.10	-0.42	~ 250	~ 480

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

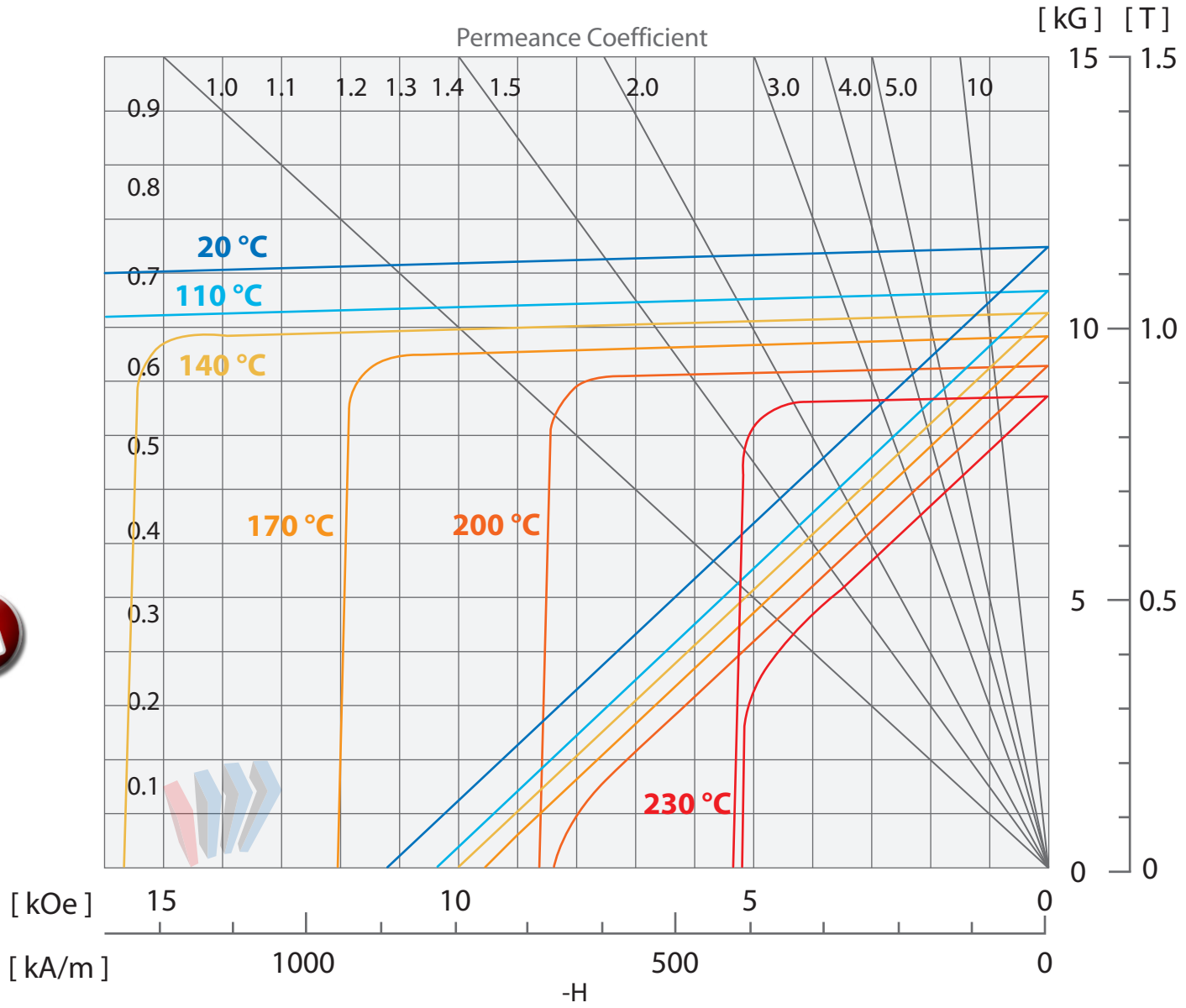
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N3335	7.7 x 10^3	0.278	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.3 x 10^{-6}	-2.1 x 10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3530



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3530	D	11,300 ~ 11,900	10,700	30,000	31 ~ 35	-0.10	-0.46	~ 230	~ 440

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC)	(ºF)
N3530	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.4 x 10^{-6}	-1.4 x 10^{-6}	350	660

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

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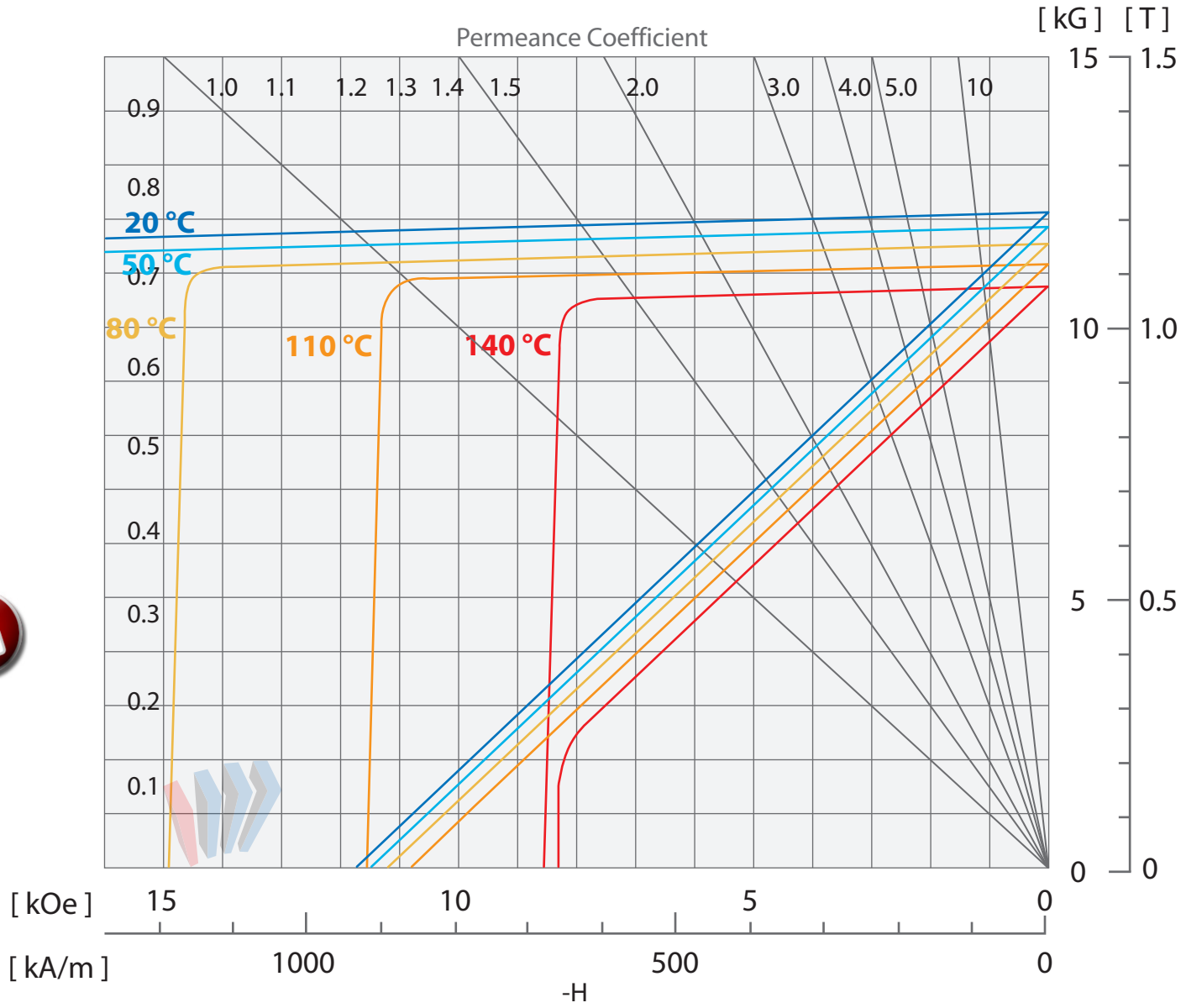
Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3621



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3621	D	11,900 ~ 12,500	11,700	21,000	34 ~ 39	-0.09	-0.53	~ 160	~ 320

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N3621	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.2 x 10^{-6}	-1.1 x 10^{-6}	360	680

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

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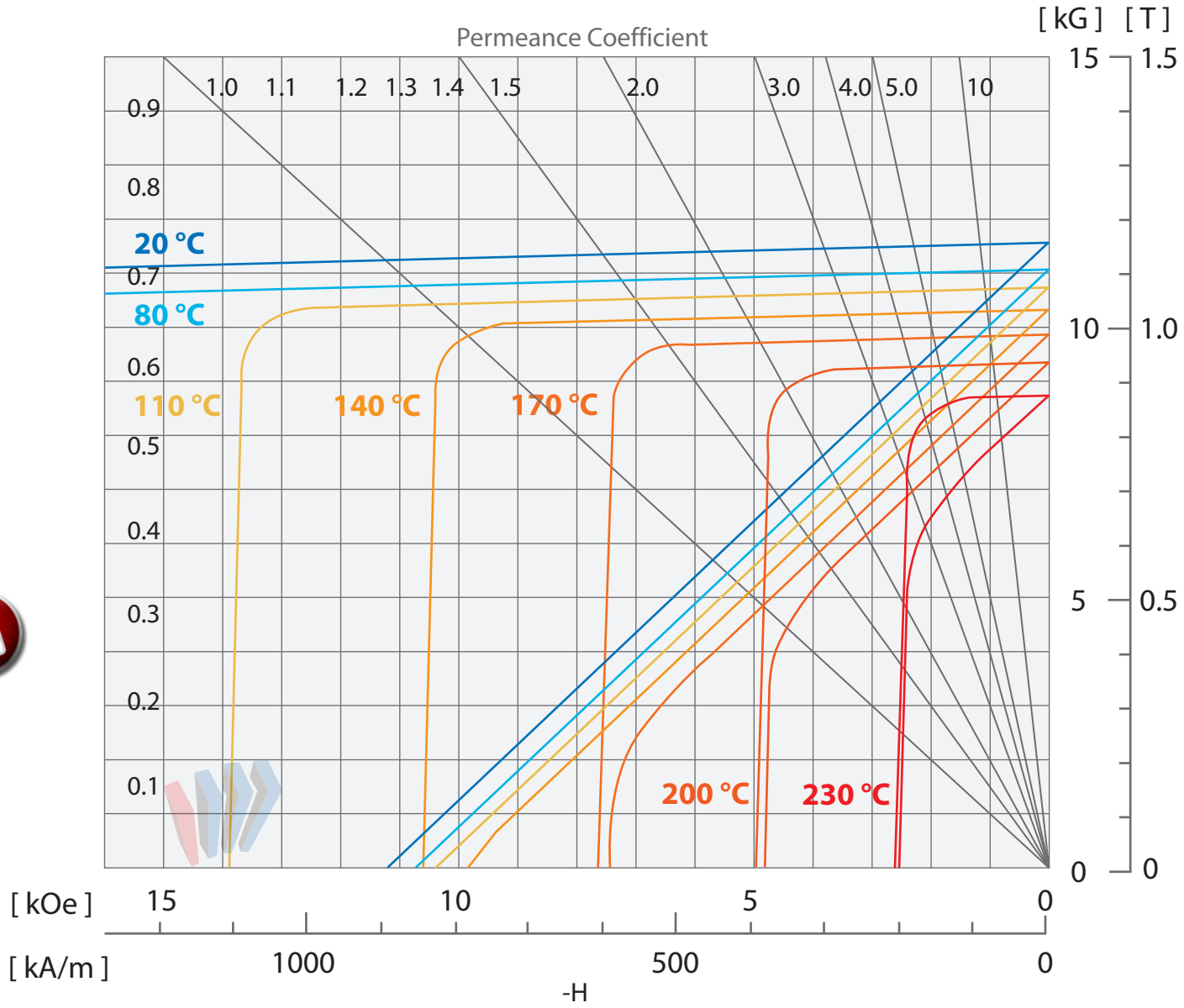
Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3725



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3725	D	11,400 ~ 12,000	11,200	25,000	32 ~ 37	-0.08	-0.51	~ 230	~ 440

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

Neodymium Iron Boron / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N3725	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.7×10^{-6}	-2.1×10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

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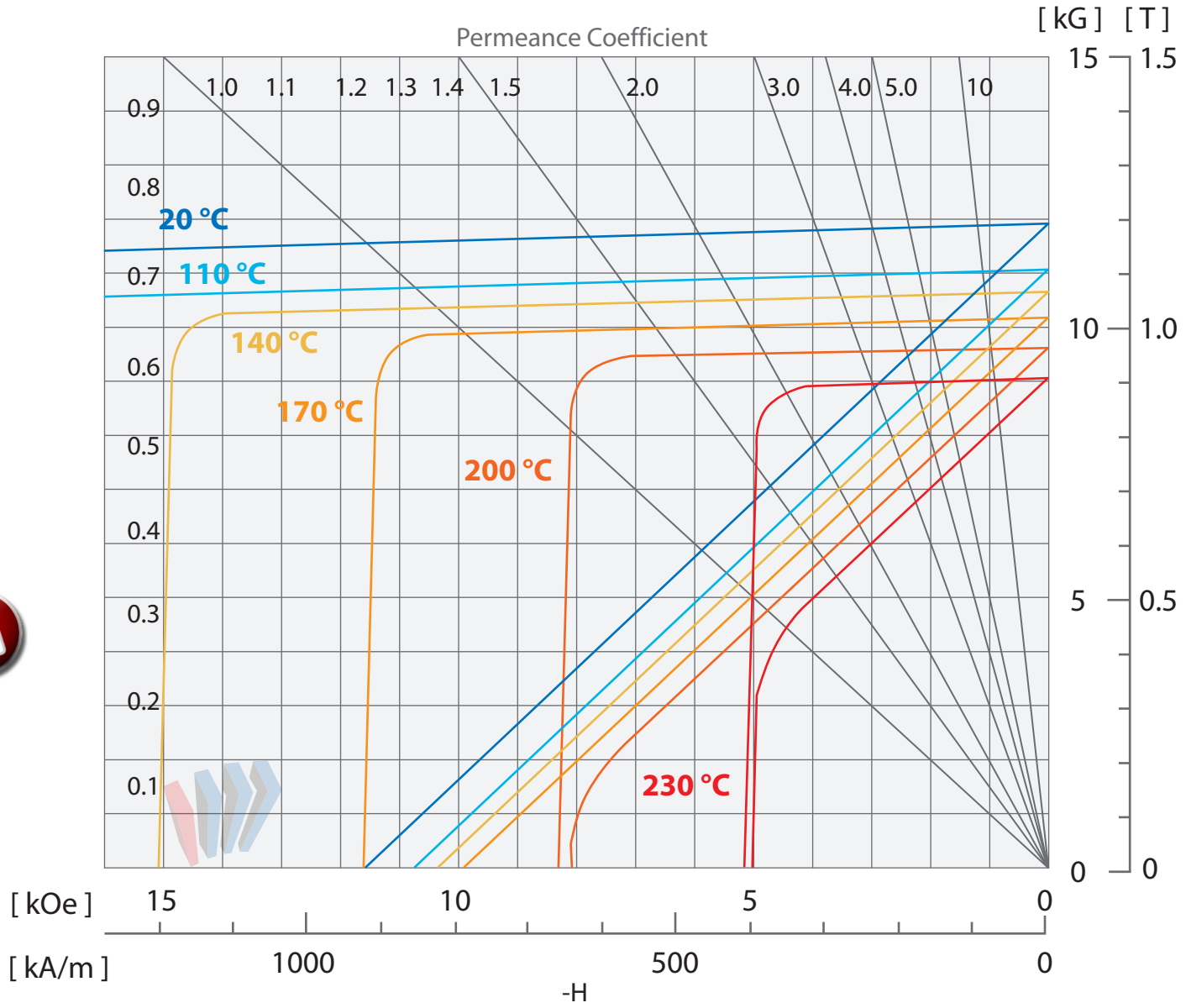
Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3730



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [2]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3730	D	11,600 ~ 12,200	11,000	30,000	33 ~ 37	-0.10	-0.45	~ 230	~ 440

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

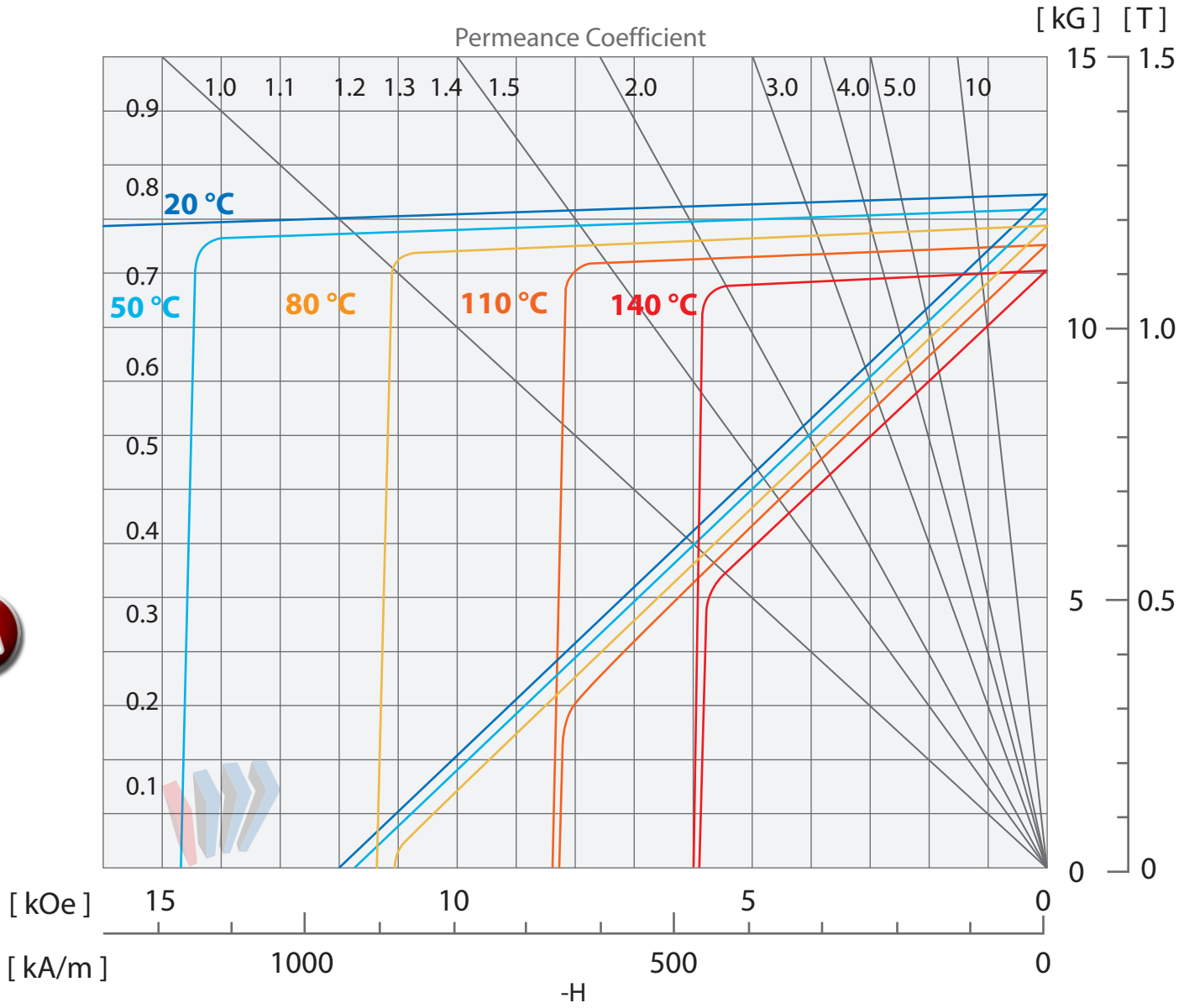
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC) (ºF)
N3730	7.7 x 10^3	0.278	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.3 x 10^{-6}	-2.1 x 10^{-6}	360 680

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N3917



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N3917	D	12,400 ~ 13,000	11,900	17,000	36 ~ 41	-0.09	-0.59	~ 140	~ 280

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

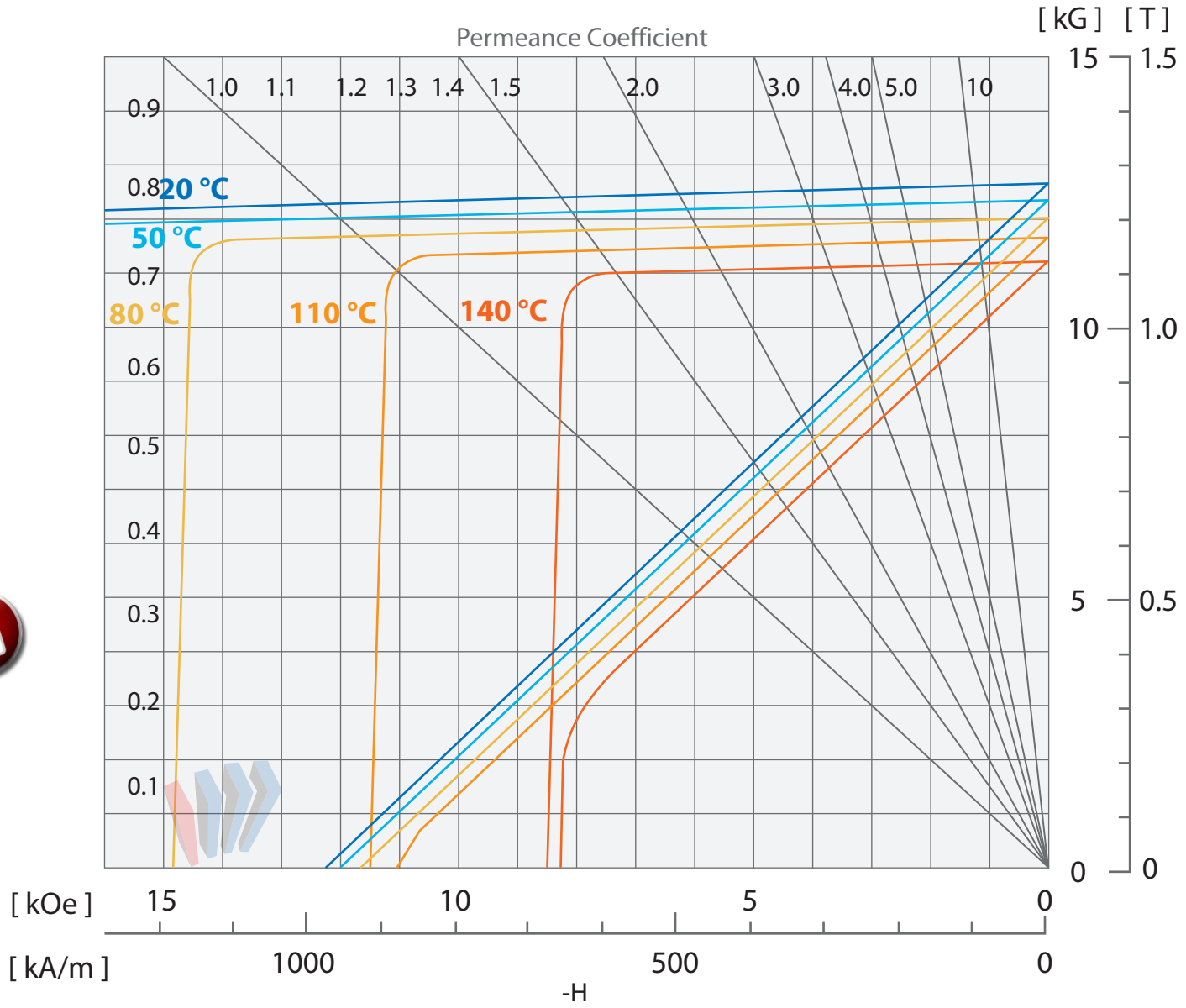
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC) / (ºF)
N3917	7.55×10^3	0.278	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.3×10^{-6}	-0.9×10^{-6}	355 / 670

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4021



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [2]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4021	D	12,300 ~ 12,900	11,600	21,000	36 ~ 40	-0.10	-0.55	~ 160	~ 320

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

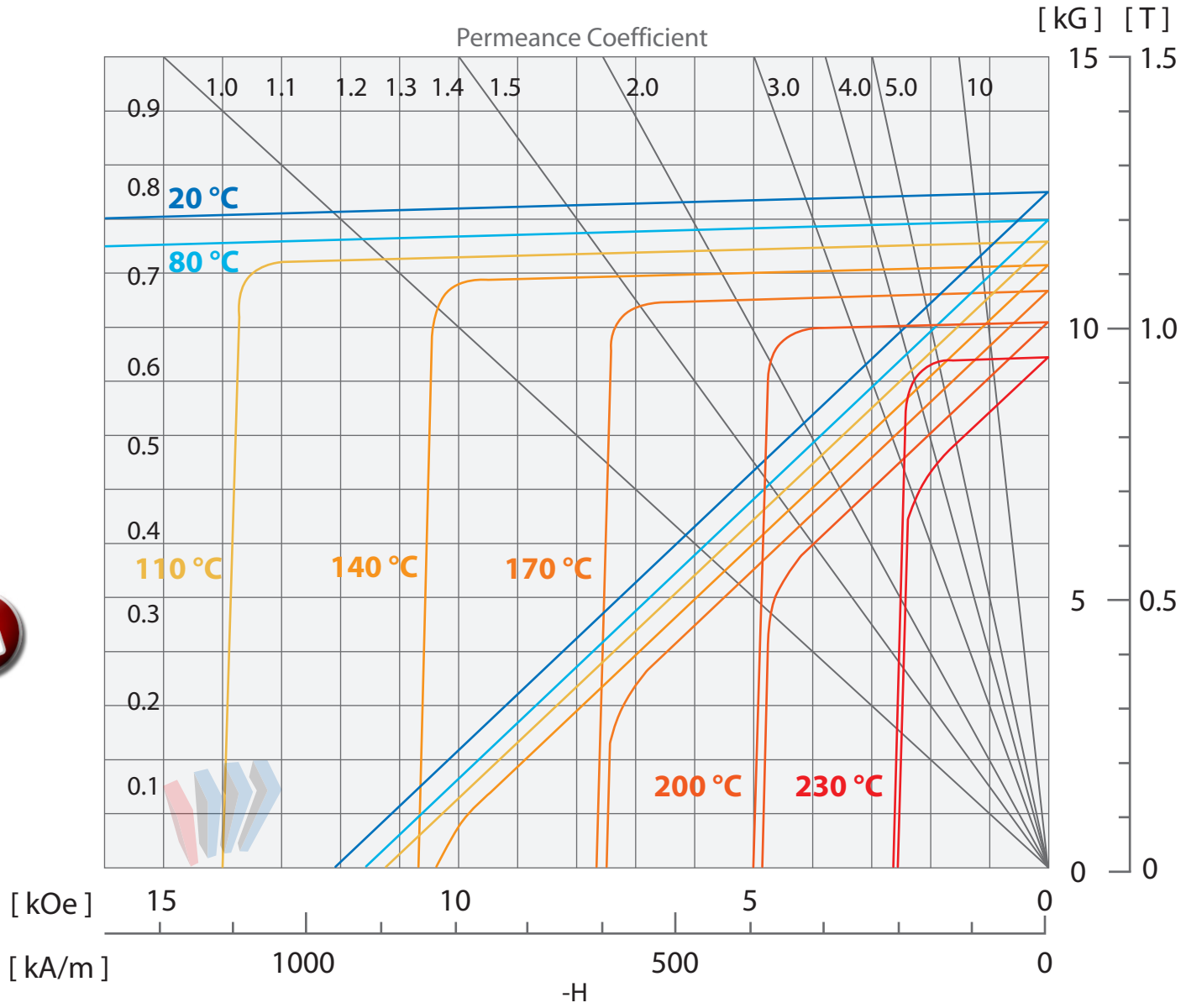
Neodymium Iron Boron / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N4021	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.1×10^{-6}	-2.1×10^{-6}	350	660

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4025



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4025	D	12,200 ~ 12,800	11,500	25,000	36 ~ 40	-0.10	-0.50	~ 200	~ 390

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

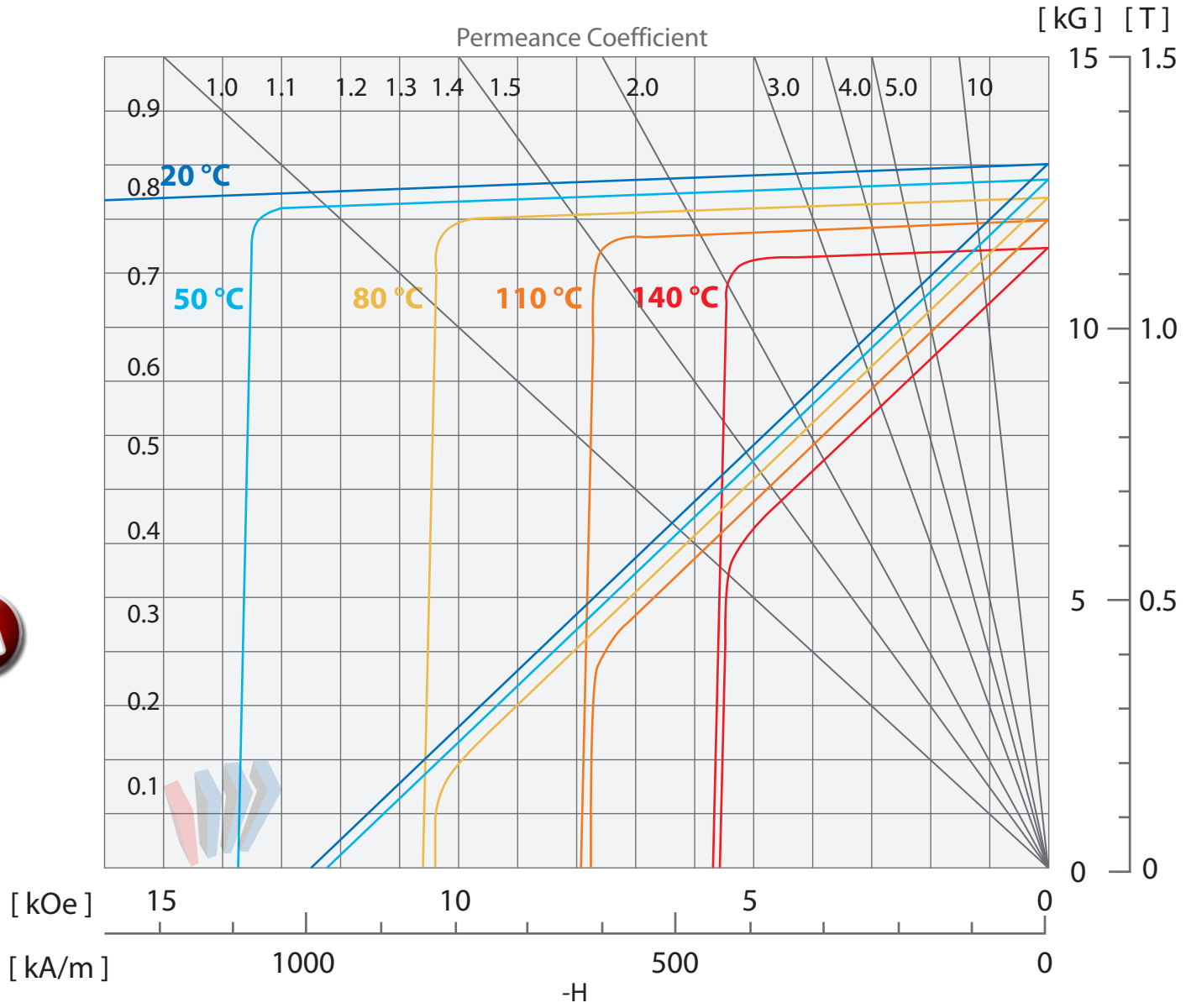
Neodymium Iron Boron / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N4025	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.1 x 10^{-6}	-2.1 x 10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4316



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4316	D	12,800 ~ 13,300	12,000	16,000	39 ~ 43	-0.10	-0.59	~ 150	~ 300

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

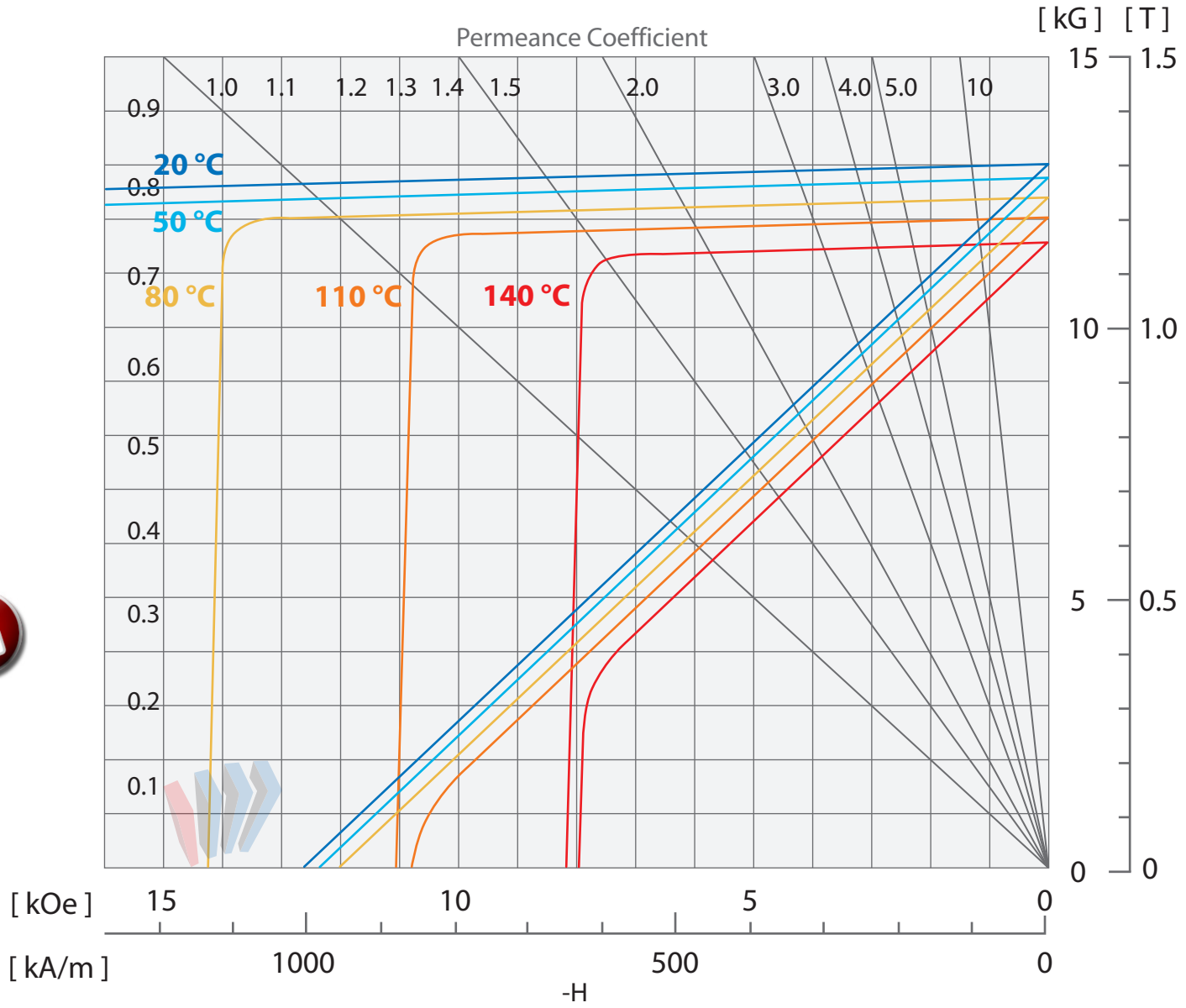
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N4316	7.5 x 10^3	0.271	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.4 x 10^{-6}	-1.1 x 10^{-6}	350	660

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4321



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4321	D	12,700 ~ 13,200	12,000	21,000	39 ~ 43	-0.10	-0.54	~ 160	~ 320

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

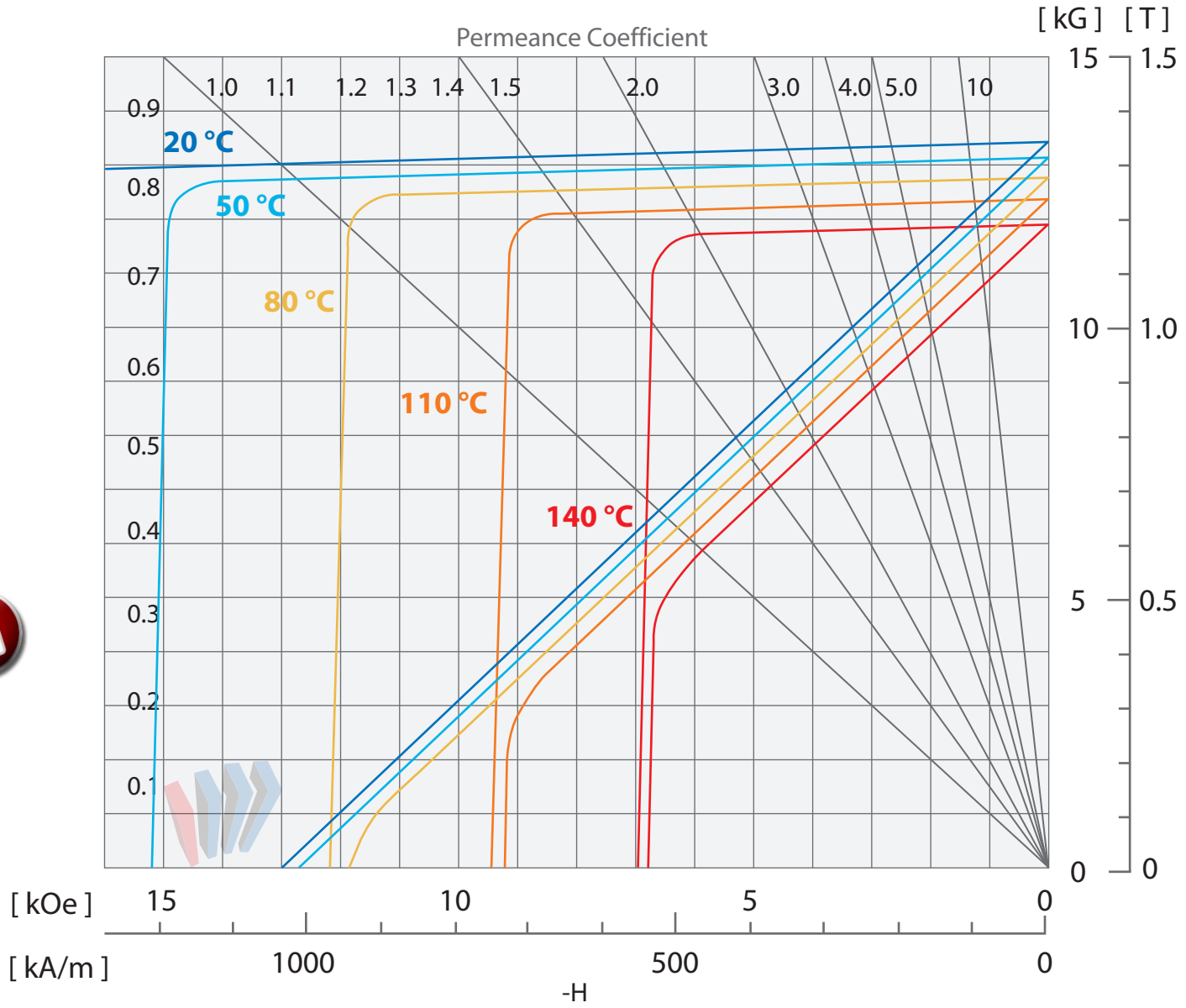
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC)	(ºF)
N4321	7.6×10^3	0.275	2.95×10^3	4.2×10^4	9.6×10^3	1.3×10^5	1.4×10^{-6}	7.1×10^{-6}	-2.1×10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4518



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4518	D	13,200 ~ 13,700	12,500	18,000	41 ~ 45	-0.11	-0.55	~ 150	~ 300

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

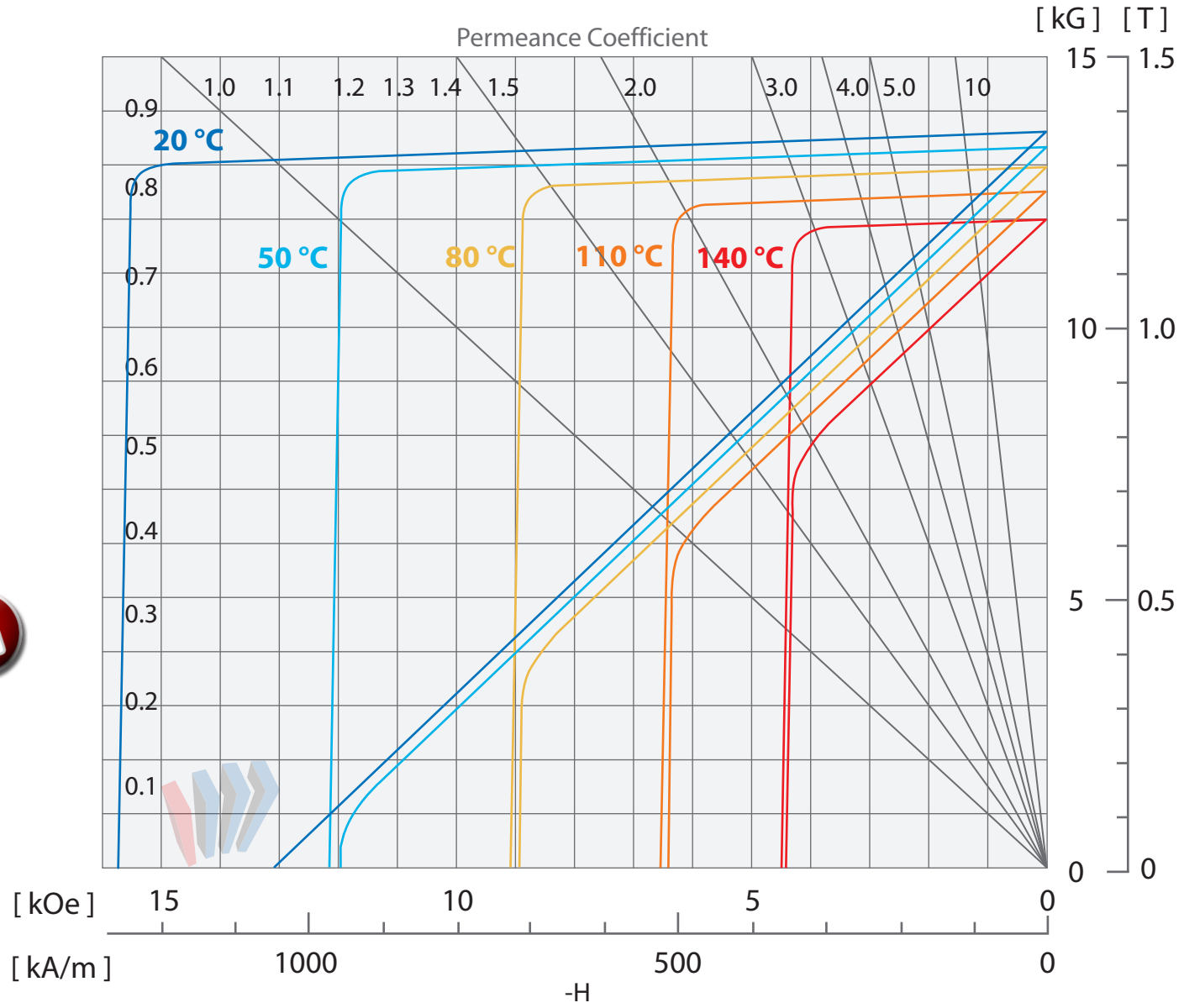
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC)	(ºF)
N4518	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.3 x 10^{-6}	-2.3 x 10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4614



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [2]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4614	D	13,300 ~ 13,800	12,200	14,000	42 ~ 46	-0.11	-0.61	~ 130	~ 260

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

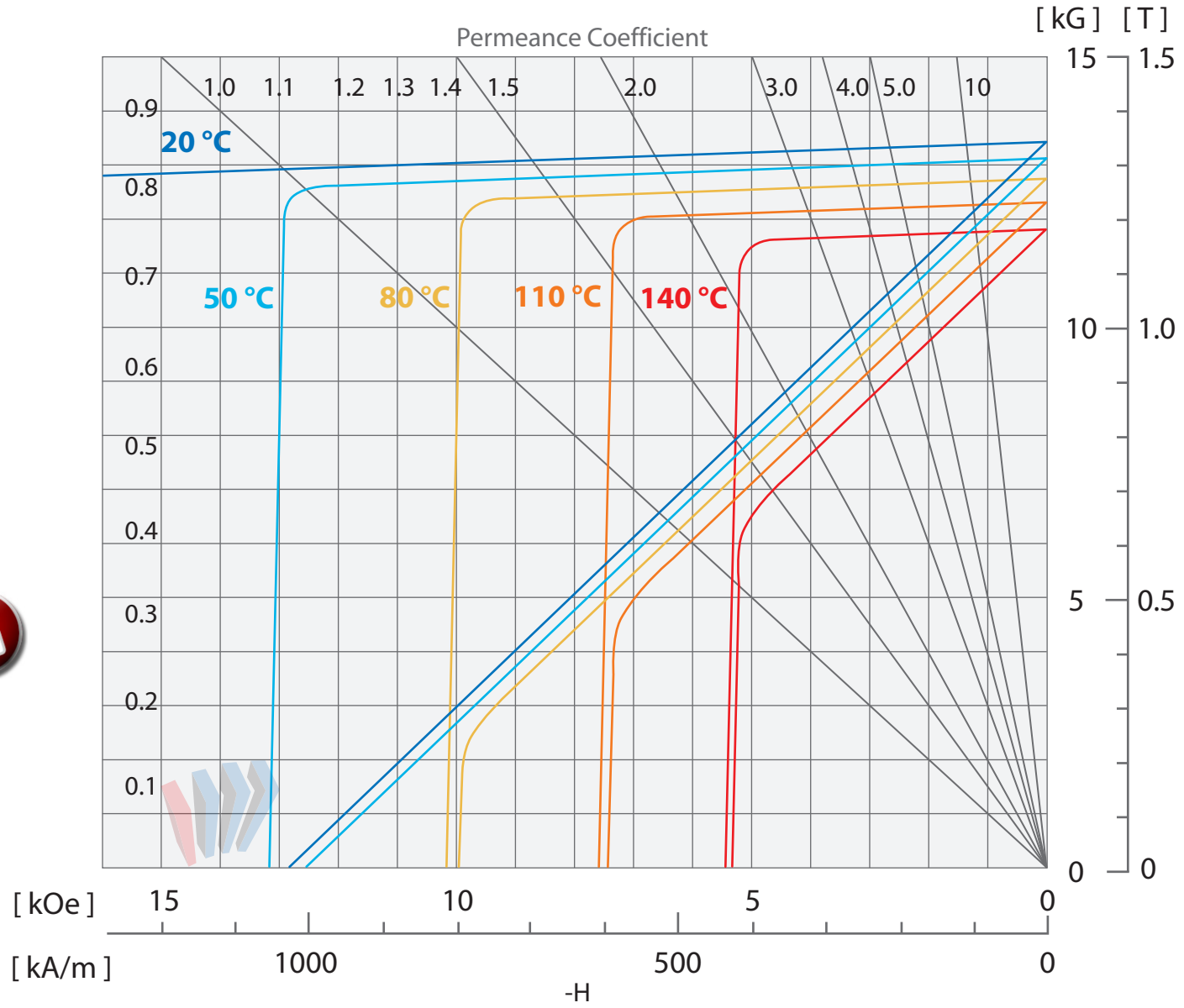
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C) / (°F)
N4614	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.4 x 10^{-6}	-1.1 x 10^{-6}	340 / 640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4616



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4616	D	13,200 ~ 13,700	12,550	16,000	41 ~ 46	-0.11	-0.61	~ 140	~ 280

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

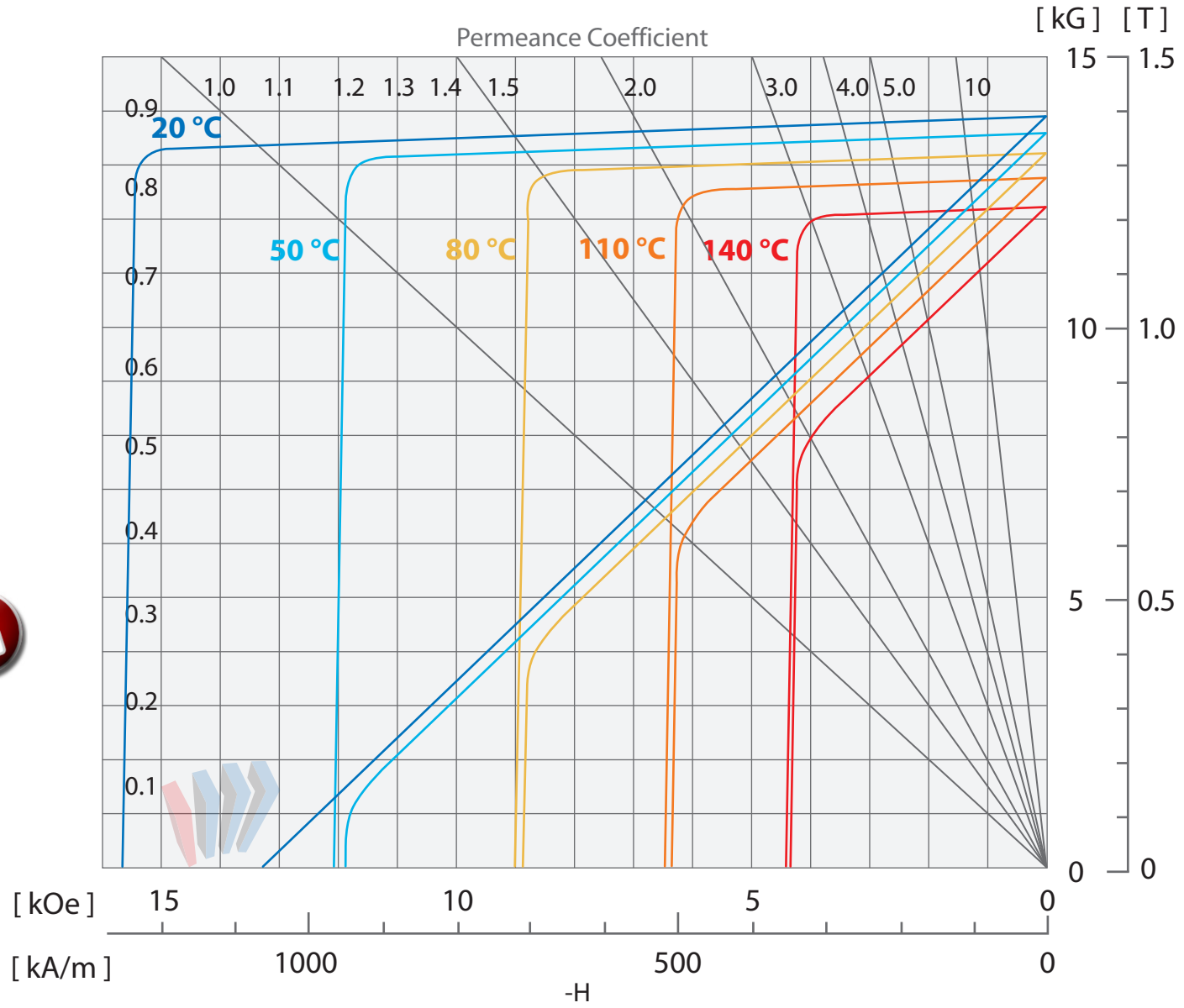
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC)	(ºF)
N4616	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	7.3 x 10^{-6}	-1.1 x 10^{-6}	360	680

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4914



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4914	D	13,600 ~ 14,100	12,800	14,000	45 ~ 49	-0.11	-0.61	~ 130	~ 260

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

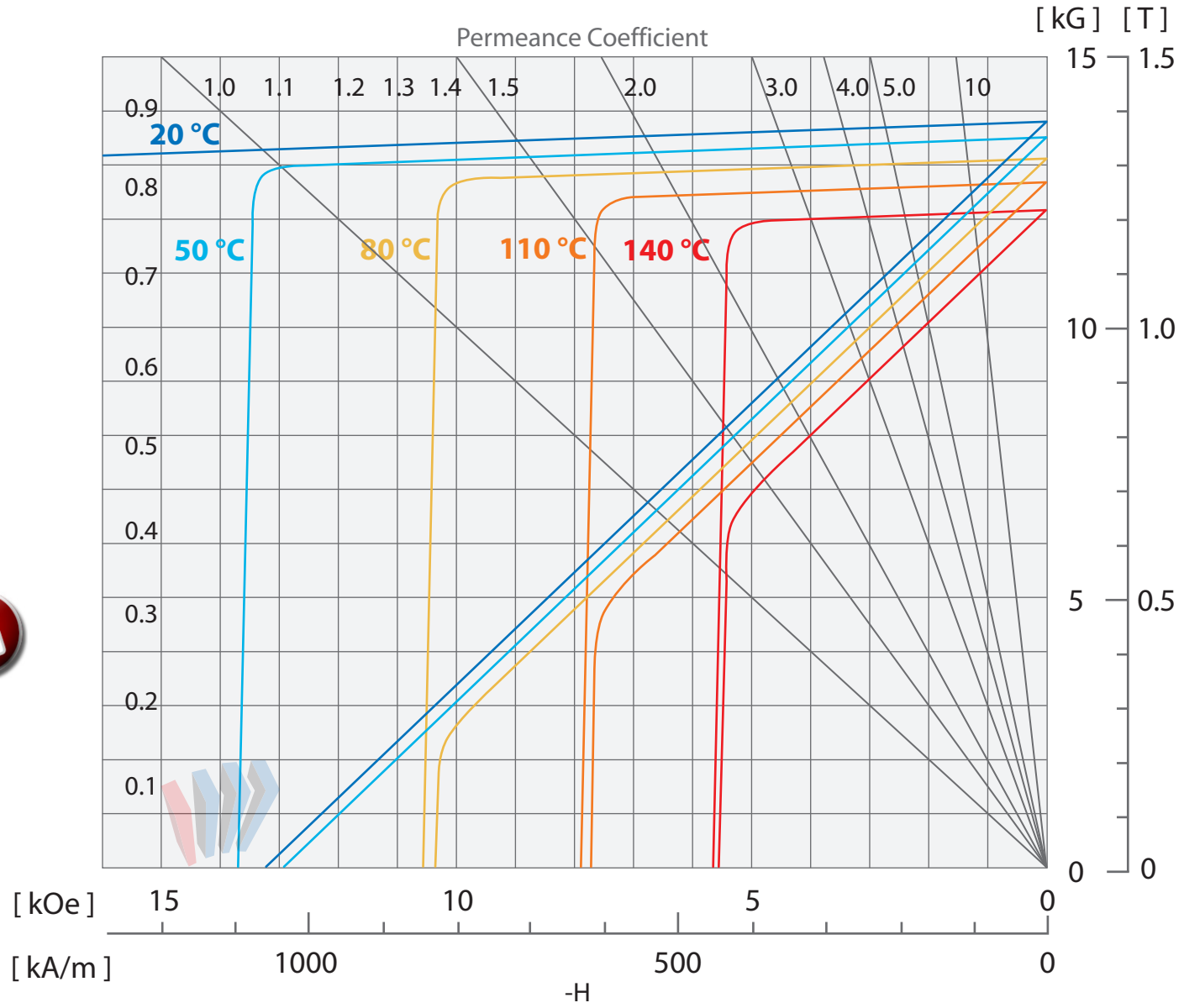
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N4914	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	8.9 x 10^{-6}	-1.8 x 10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N4916



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N4916	D	13,500 ~ 14,100	12,700	16,000	44 ~ 49	-0.11	-0.61	~ 140	~ 280

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

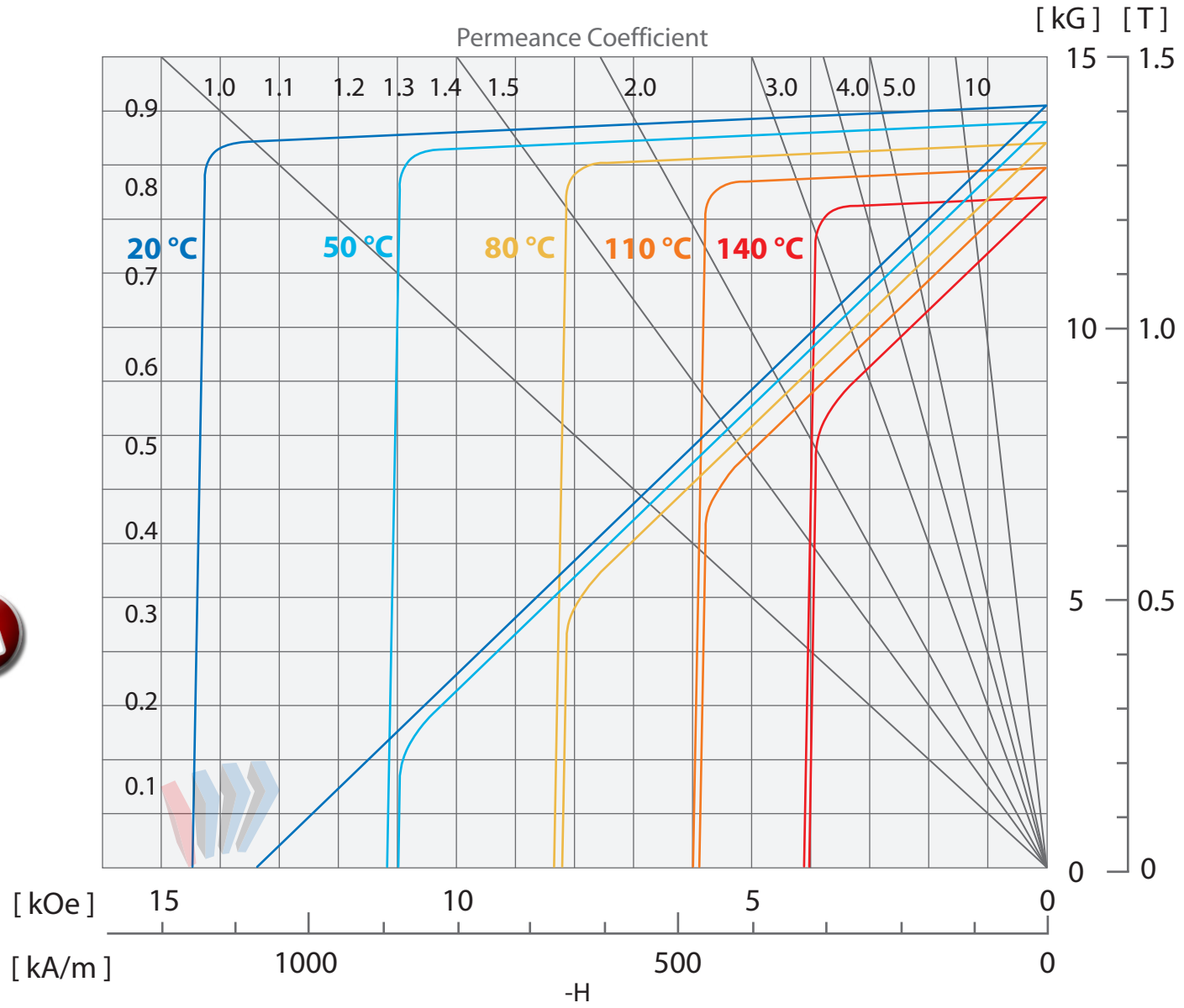
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC) / (ºF)
N4916	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	8.9 x 10^{-6}	-1.8 x 10^{-6}	340 / 640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N5011



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N5011	D	13,900 ~ 14,400	10,300	11,000	46 ~ 51	-0.11	-0.61	~ 110	~ 230

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

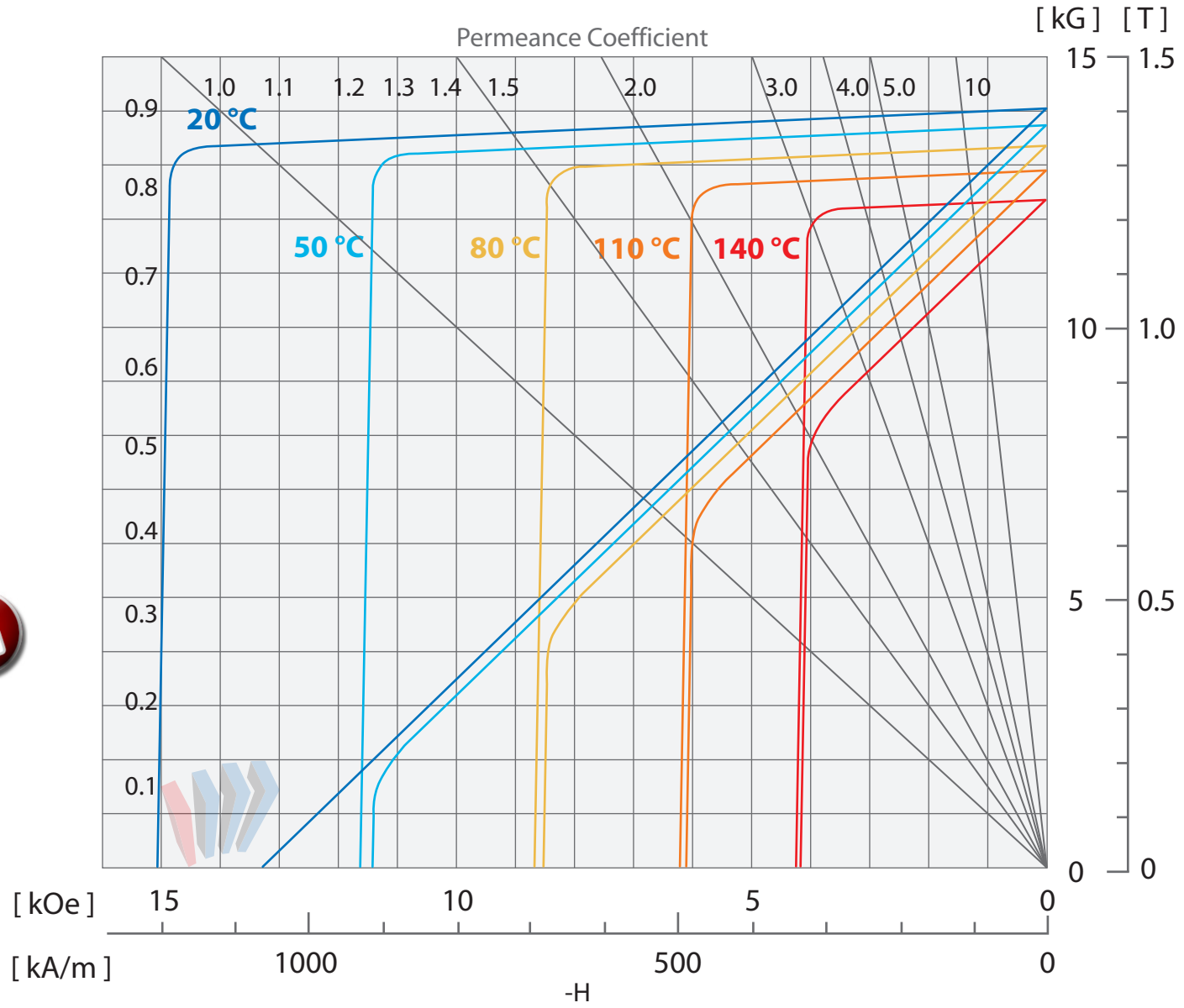
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(ºC)	(ºF)
N5011	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	8.9 x 10^{-6}	-1.7 x 10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N5014



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [2]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N5014	I	13,900 ~ 14,400	13,100	14,000	46 ~ 51	-0.11	-0.61	~ 130	~ 260

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

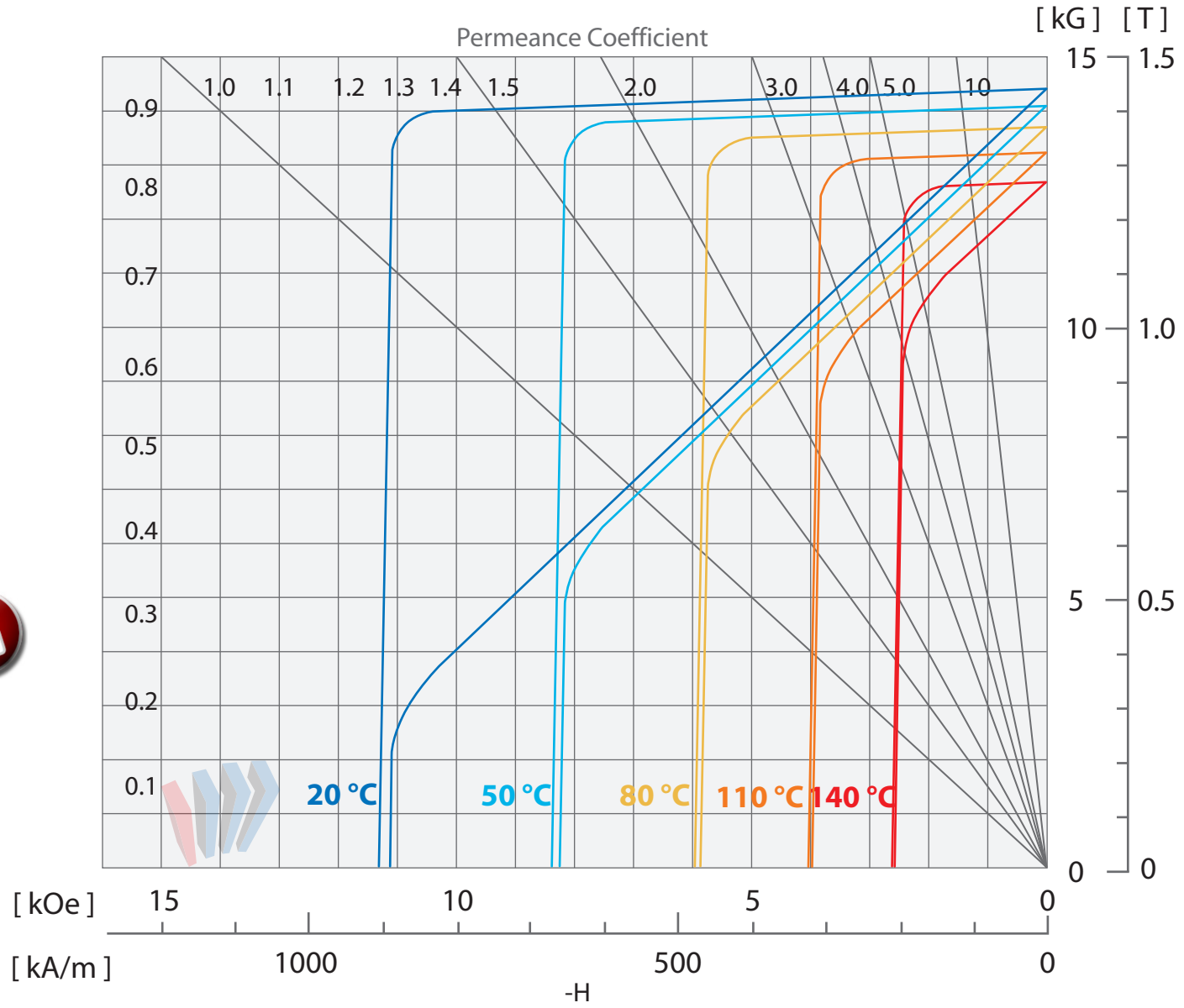
Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature	
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
N5014	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	8.9 x 10^{-6}	-1.7 x 10^{-6}	340	640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Neodymium Iron Boron Magnet — Grade: N5311



Neodymium Iron Boron / Magnetic Properties									
Grade	Press[1]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc=2 [(2)]	
		Range	Typical	Minimum	Range	of BR	of Hci	(°C)	(°F)
N5311	D	14,200 ~ 14,700	10,300	11,000	48 ~ 53	-0.11	-0.65	~ 80	~ 170

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

Neodymium Iron Boron / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[3]		Curie Temperature
	(Kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C) / (°F)
N5311	7.6 x 10^3	0.275	2.95 x 10^3	4.2 x 10^4	9.6 x 10^3	1.3 x 10^5	1.4 x 10^{-6}	8.9 x 10^{-6}	-1.7 x 10^{-6}	340 / 640

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Samarium Cobalt Overview

Samarium Cobalt magnets - the first commercialized "Rare Earth" magnets - were introduced in the early 1970s. They are used today most often in applications which involve elevated temperatures and the need for high magnetic properties. On a dollars per pound basis, the cost of SmCo magnets is about 25 to 50 times that of Ferrite magnets.

Key Benefits

- **High magnetic strength - up to about 32MGOe**
- **May be operated up to about 300°C**
- **Does not need to be protected against oxidation**

Key Challenges

- **Very brittle, and hard to machine**
- **Because this material contains Cobalt, the cost of SmCo is relatively high**

Quick Facts

- **Density - 0.300 lbs per cubic inch**
- **Saturation magnetizing field required - about 50kOe**
- **Manufacturing methods - sintering (most common), with some injection molding and compression bonding.**
- **Shapes available - blocks, bars, discs, rings, arc segments, etc.**
- **Grades available - from about 1410 to 3214. (First 2 digits represent BHmax, and second two digits represent Intrinsic Coercivity, Hci.)**
- **Sizes - off tool the largest die pressed blocks are about 3" cube, while isostatically pressed blocks can be much longer in the orientation direction (up to 9 feet).**

Surface Treatment

In general, no surface treatment is required for SmCo magnets since they are not subject to oxidation.

CAUTION!!!

- **SmCo magnets are very brittle and easily chip or break upon impact.**
- **All Rare Earth magnets are very powerful - care must be taken in handling these magnets to avoid injuries.**

Integrated Magnetics

Magnetic & Physical Properties Table

Material: Samarium Cobalt Magnet

Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3410	D	2:17	11,300 ~ 12,100	10,000	10,000	29 ~ 34	-0.03	-0.22	~ 300	~ 570
S3320	D	2:17	11,200 ~ 12,000	10,600	20,000	28 ~ 33	-0.04	-0.27	~ 325	~ 610
S3310	D	2:17	11,200 ~ 12,000	9,000	10,000	28 ~ 33	-0.04	-0.25	~ 300	~ 570
S3120	D	2:17	10,700 ~ 11,500	10,300	20,000	25 ~ 31	-0.04	-0.20	~ 350	~ 660
S3018	D	2:17	10,200 ~ 11,200	9,800	18,000	24 ~ 30	-0.04	-0.20	~ 400	~ 750
S3007	D	2:17	10,500 ~ 11,200	8,250	7,000	24 ~ 30	-0.04	-0.17	~ 250	~ 480
S2909	D	2:17	10,200 ~ 11,000	9,250	9,000	25 ~ 29	-0.03	-0.17	~ 300	~ 570
S2809	D	2:17	10,000 ~ 10,800	9,250	9,000	24 ~ 28	-0.03	-0.19	~ 300	~ 570

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

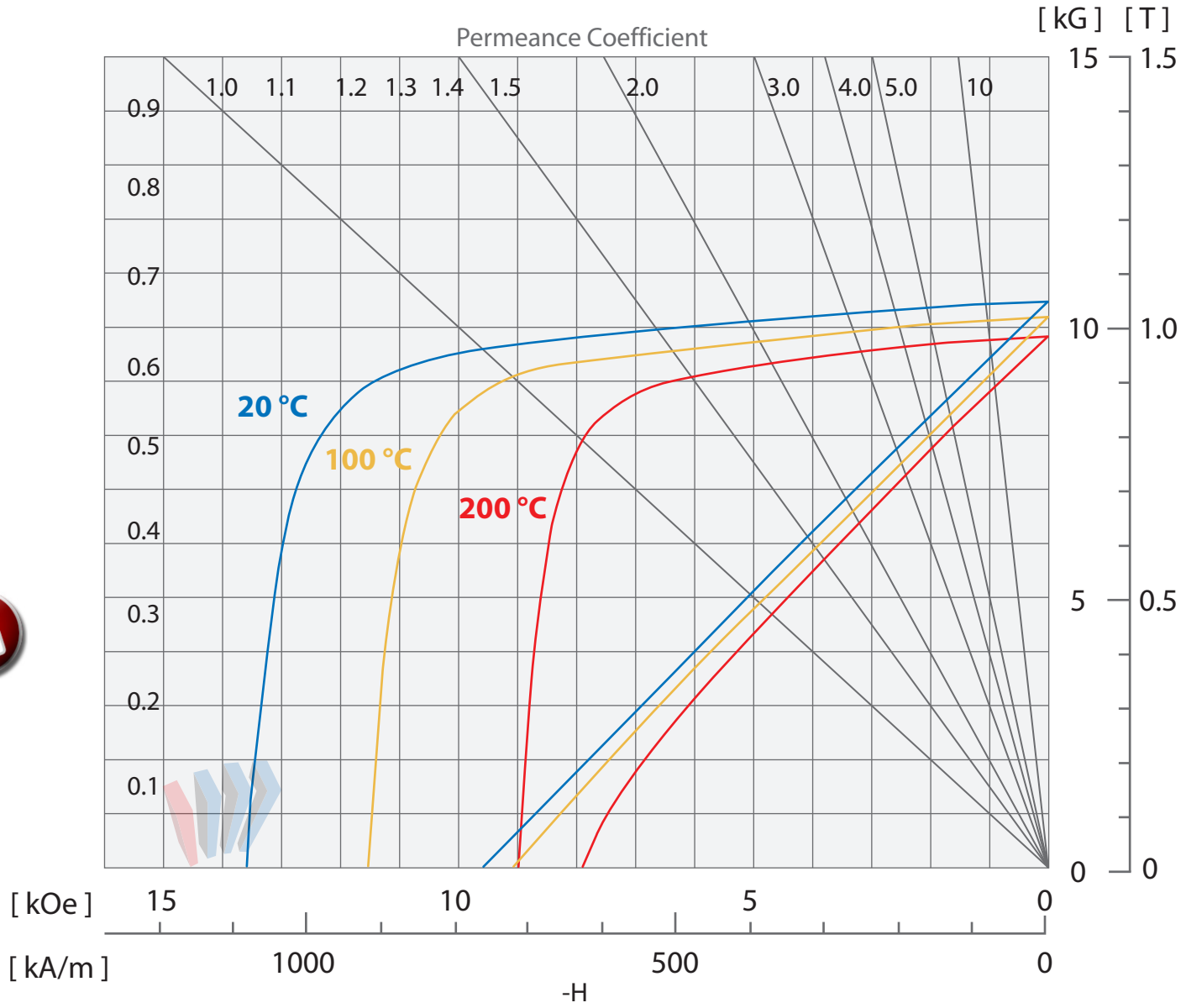
Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3410	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	8.9×10^{-6}	11.6×10^{-6}	825	1510
S3320	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	8.8×10^{-6}	11.5×10^{-6}	825	1510
S3310	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	8.9×10^{-6}	11.6×10^{-6}	825	1510
S3120	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	9.2×10^{-6}	11.7×10^{-6}	825	1510
S3018	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	9.6×10^{-6}	12.0×10^{-6}	825	1510
S3007	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	9.7×10^{-6}	12.2×10^{-6}	825	1510
S2909	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	8.9×10^{-6}	11.6×10^{-6}	825	1510
S2809	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	9.2×10^{-6}	12.2×10^{-6}	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S2809



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S2809	D	2:17	10,000 ~ 10,800	9,250	9,000	24 ~ 28	-0.03	-0.19	~ 300	~ 570

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S2809	8.4 x 10^3	0.304	1.2 x 10^3	1.7 x 10^4	9.1 x 10^3	1.3 x 10^5	0.8 x 10^{-6}	9.2 x 10^{-6}	12.2 x 10^{-6}	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

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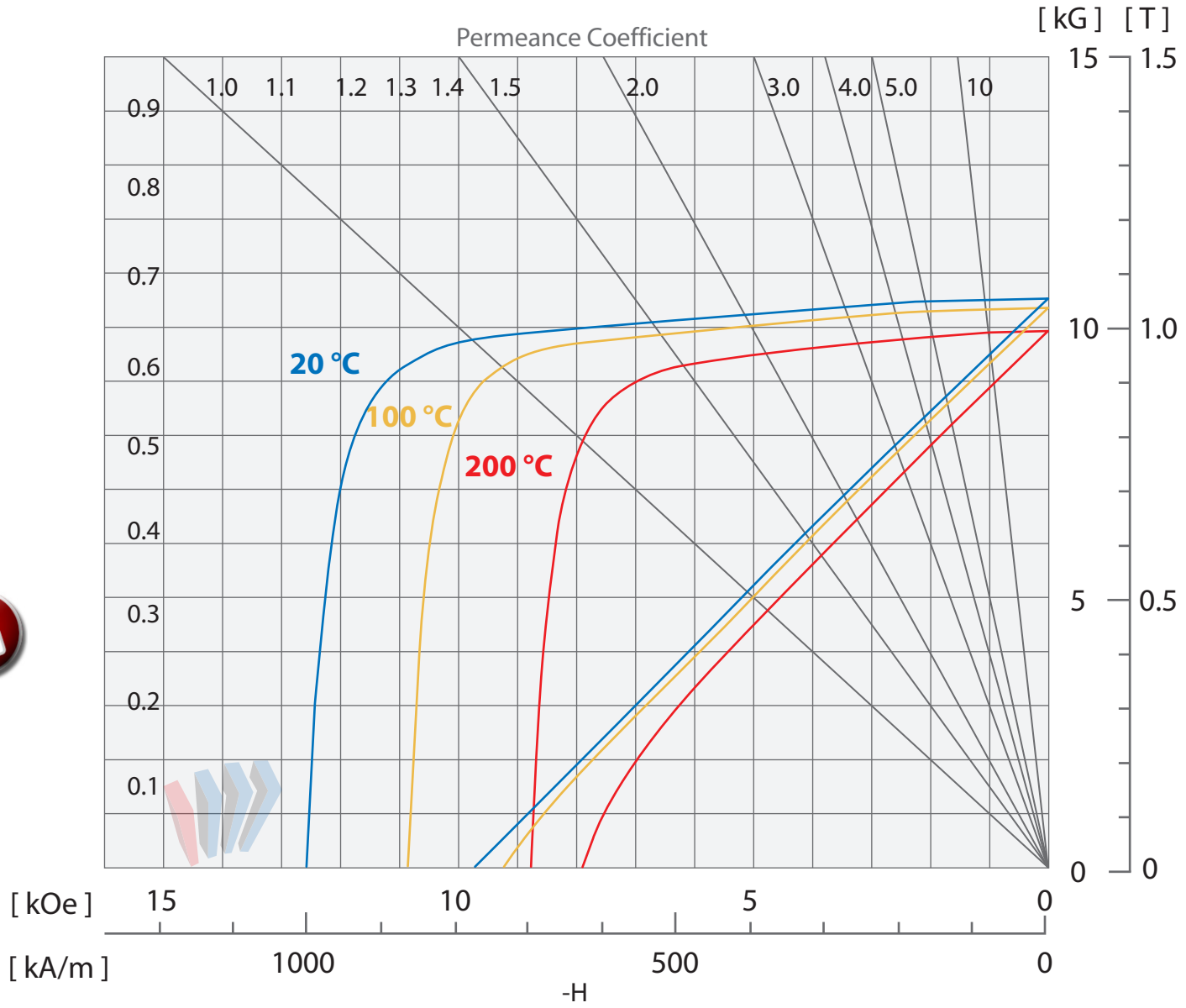
Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S2909



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S2909	D	2:17	10,200 ~ 11,000	9,250	9,000	25 ~ 29	-0.03	-0.17	~ 300	~ 570

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

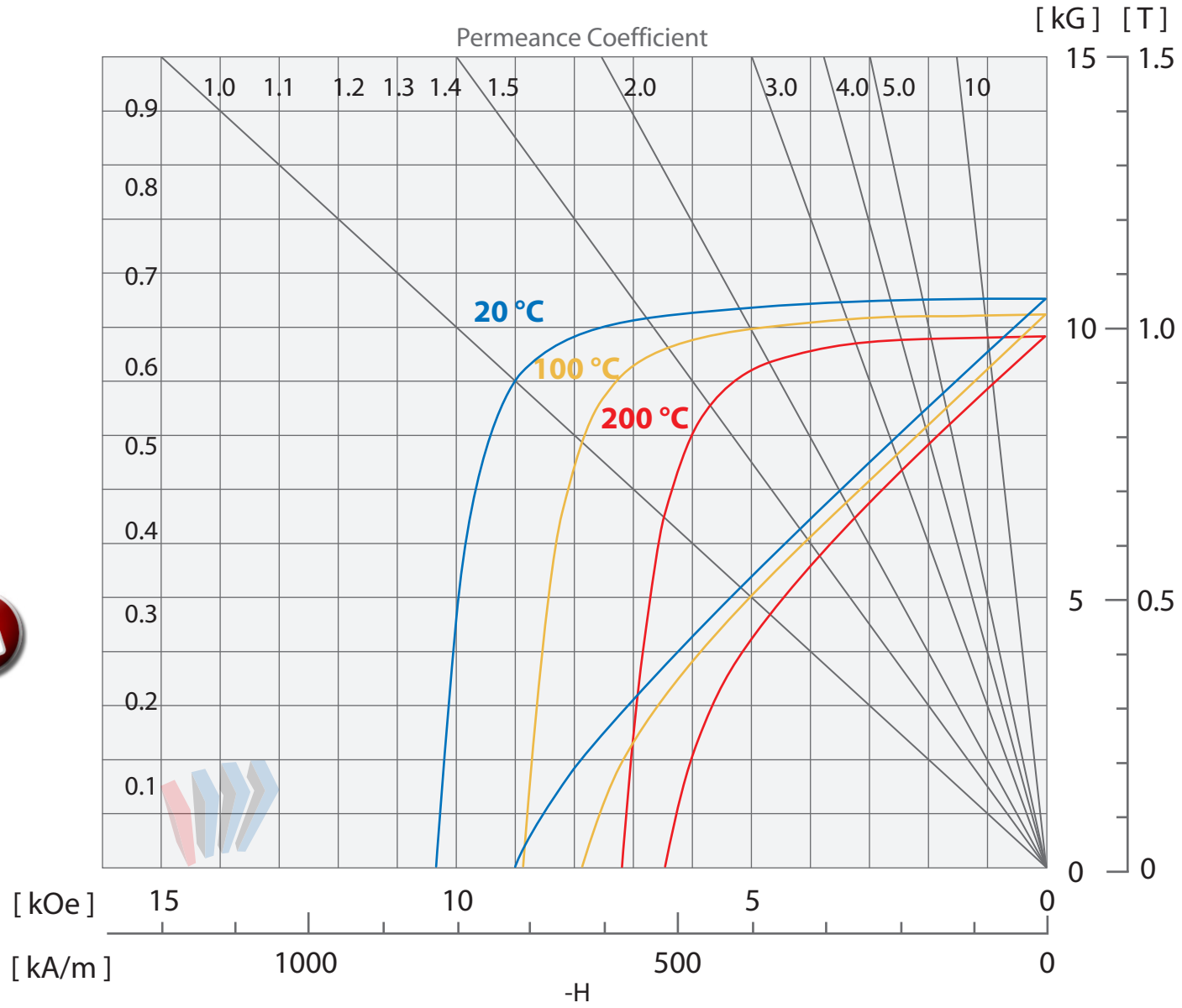
Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S2909	8.4 x 10³	0.304	1.2 x 10³	1.7 x 10⁴	9.1 x 10³	1.3 x 10⁵	0.8 x 10⁻⁶	8.9 x 10⁻⁶	11.6 x 10⁻⁶	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S3007



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3007	D	2:17	10,500 ~ 11,200	8,250	7,000	24 ~ 30	-0.04	-0.17	~ 250	~ 480

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

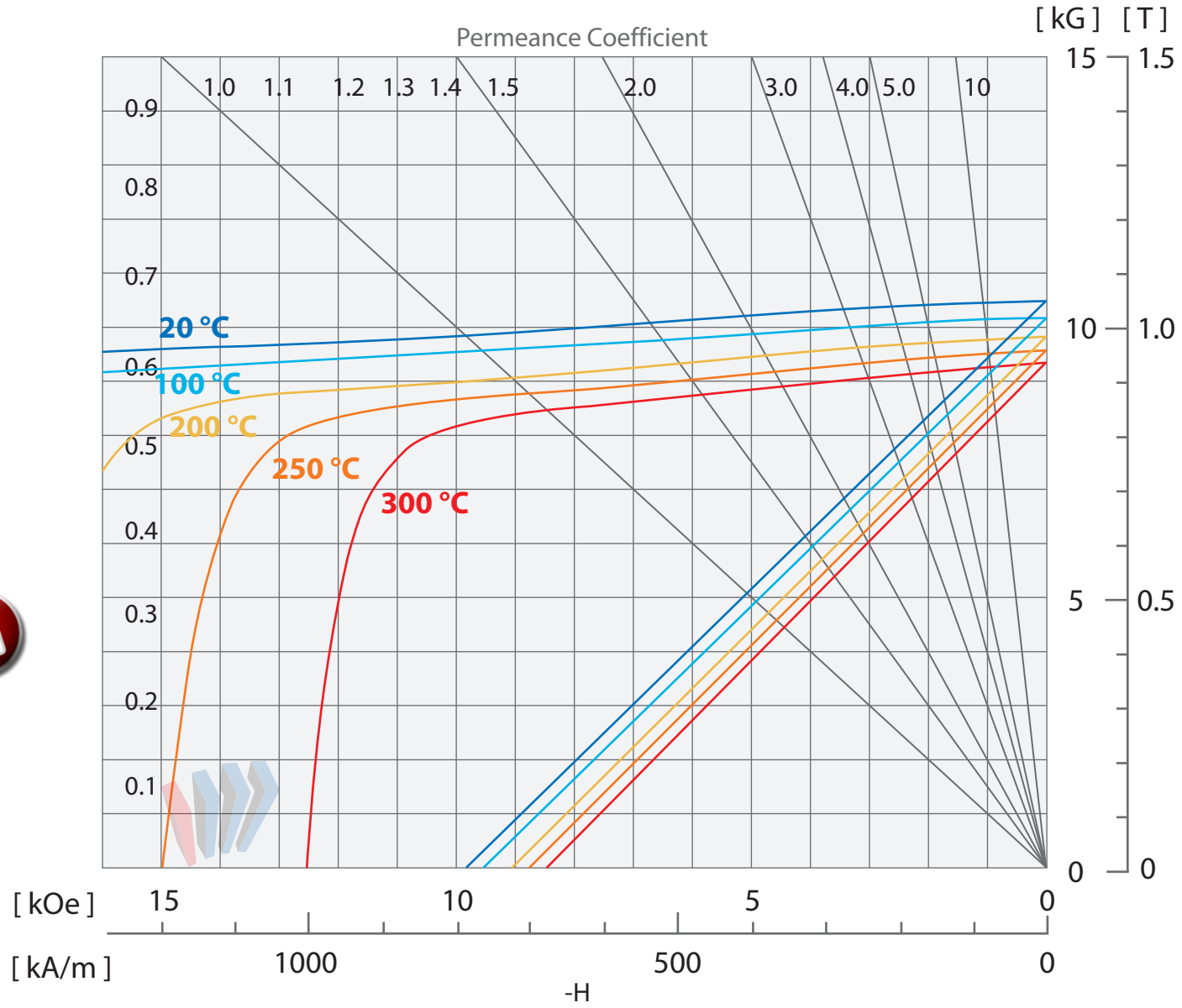
Samarium Cobalt / Physical Properties										
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3007	8.4 x 10^3	0.304	1.2 x 10^3	1.7 x 10^4	9.1 x 10^3	1.3 x 10^5	0.8 x 10^{-6}	9.7 x 10^{-6}	12.2 x 10^{-6}	825	1510

[4] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S3018



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3018	D	2:17	10,200 ~ 11,200	9,800	18,000	24 ~ 30	-0.04	-0.20	~ 400	~ 750

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

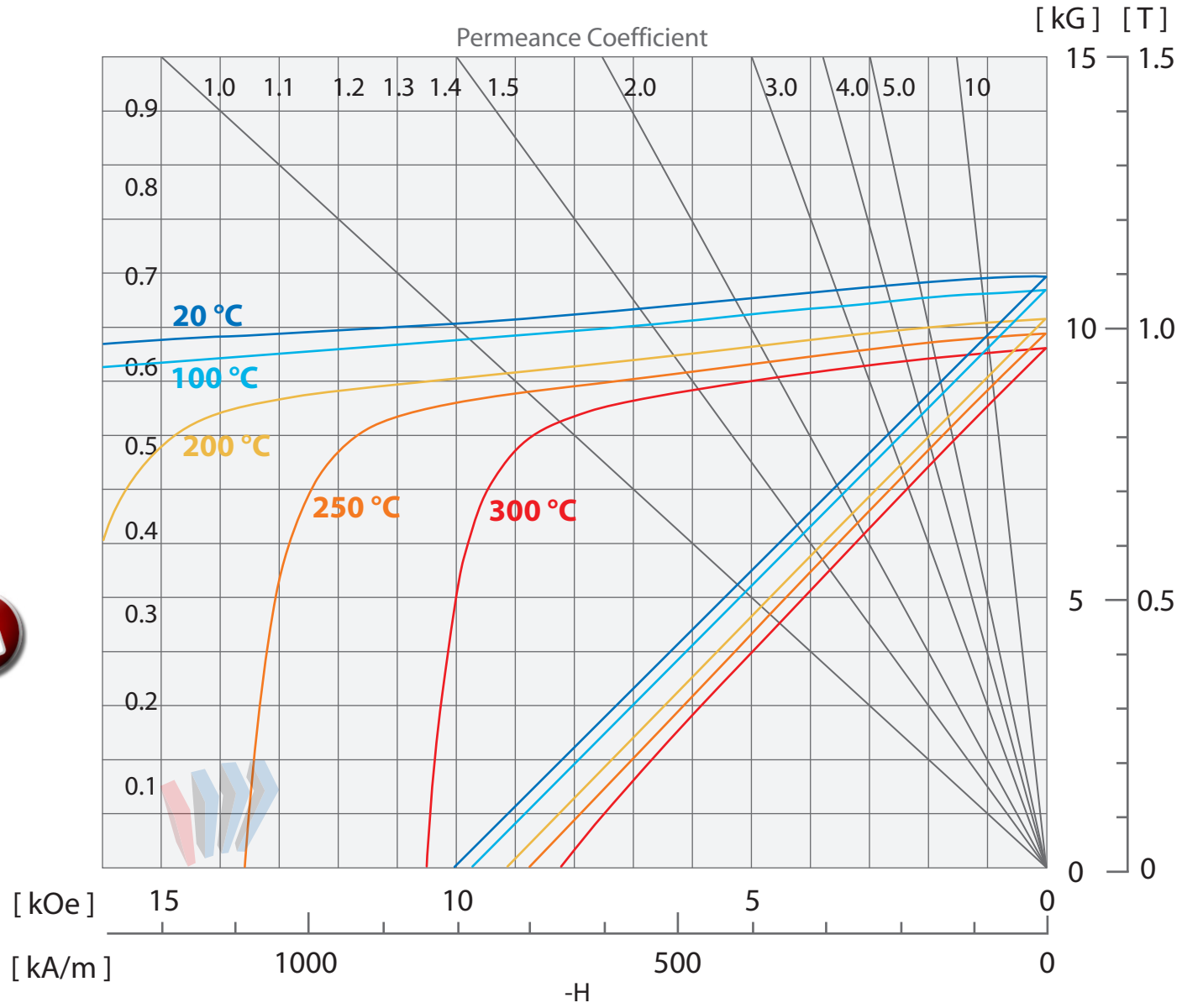
Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3018	8.4 x 10^3	0.304	1.2 x 10^3	1.7 x 10^4	9.1 x 10^3	1.3 x 10^5	0.8 x 10^{-6}	9.6 x 10^{-6}	12.0 x 10^{-6}	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S3120



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3120	D	2:17	10,700 ~ 11,500	10,300	20,000	25 ~ 31	-0.04	-0.20	~ 350	~ 660

[1] D: Die-Pressed, I: Isostatically-Pressed

[2] Type: Sm_1Co_5 or Sm_2Co_{17} types

[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

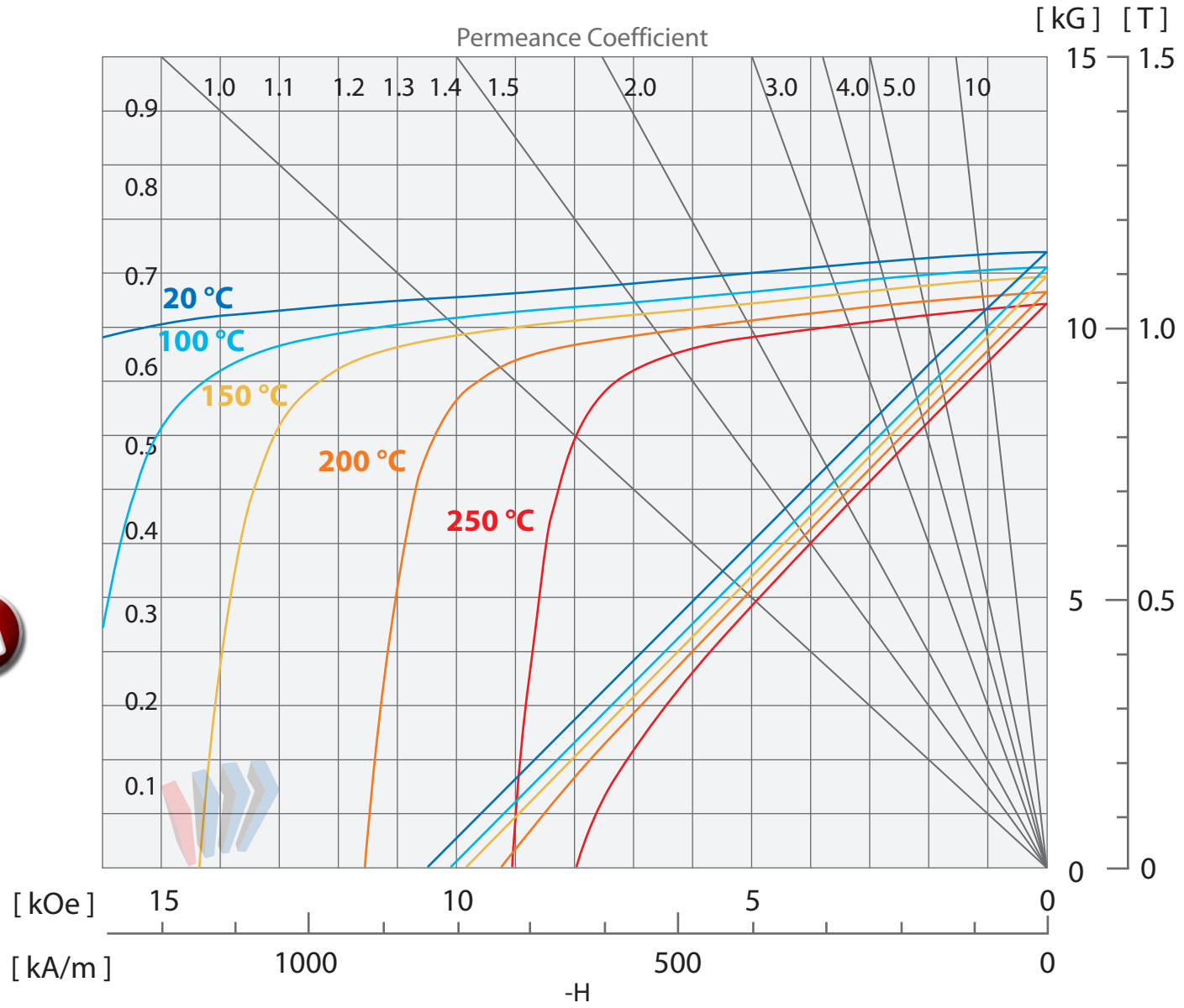
Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3120	8.4 x 10^3	0.304	1.2 x 10^3	1.7 x 10^4	9.1 x 10^3	1.3 x 10^5	0.8 x 10^{-6}	9.2 x 10^{-6}	11.7 x 10^{-6}	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S3310



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3310	D	2:17	11,200 ~ 12,000	9,000	10,000	28 ~ 33	-0.04	-0.25	~ 300	~ 570

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

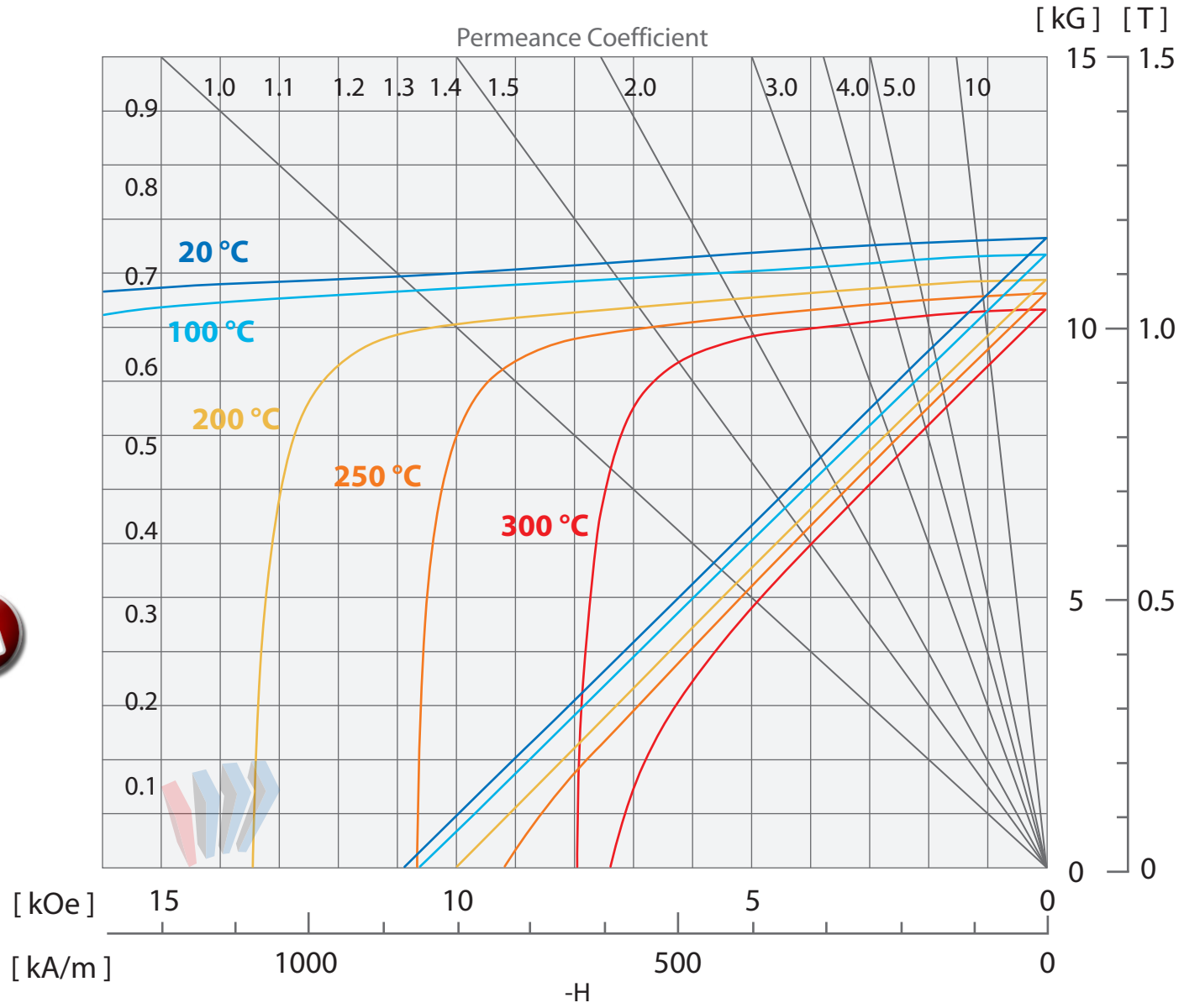
Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3310	8.4 x 10^3	0.304	1.2 x 10^3	1.7 x 10^4	9.1 x 10^3	1.3 x 10^5	0.8 x 10^{-6}	8.9 x 10^{-6}	11.6 x 10^{-6}	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S3320



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 ([3])	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3320	D	2:17	11,200 ~ 12,000	10,600	20,000	28 ~ 33	-0.04	-0.27	~ 325	~ 610

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

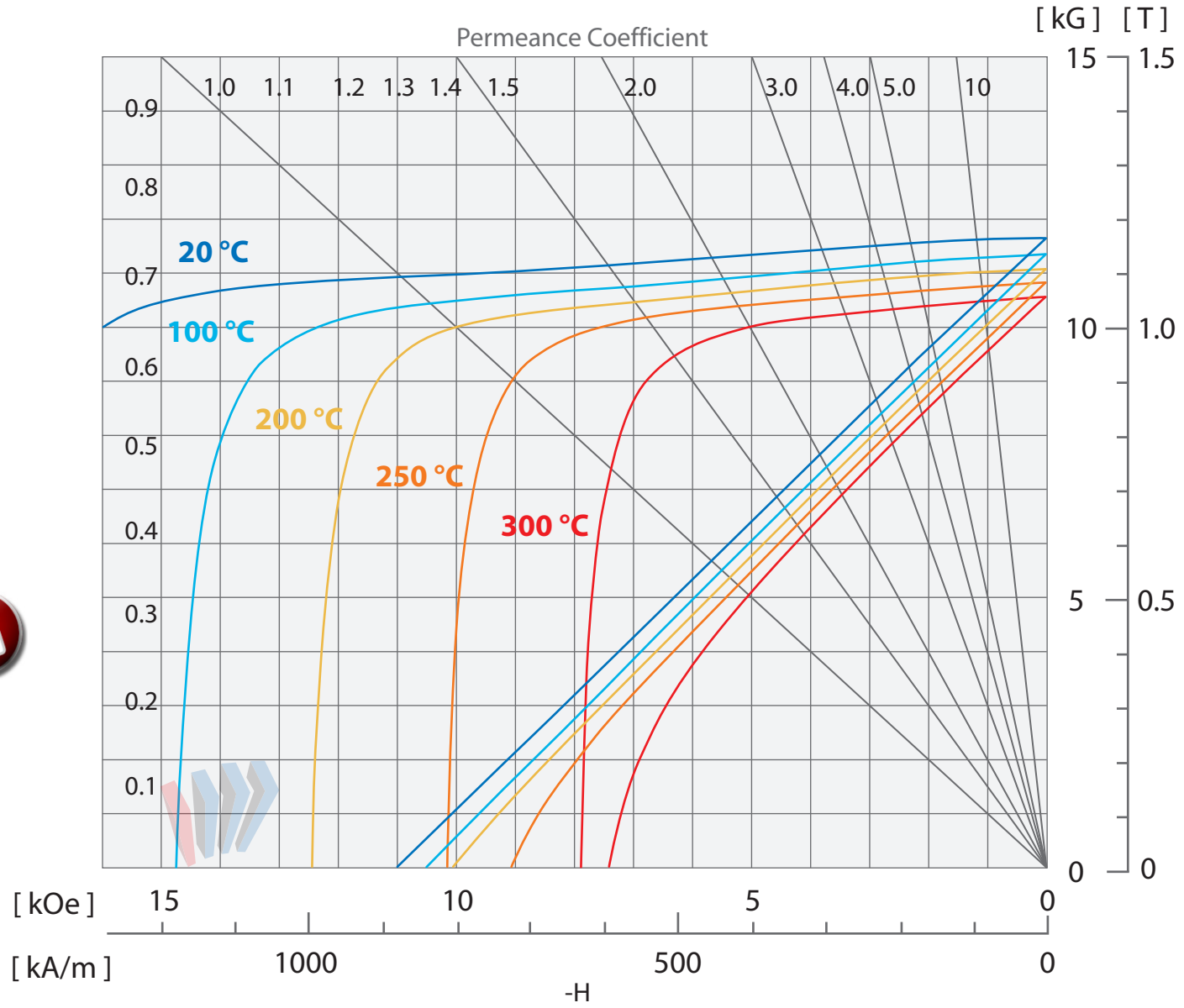
Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3320	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	8.8×10^{-6}	11.5×10^{-6}	825	1510

[3] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.

Integrated Magnetics

Technical Data Sheet

Material: Samarium Cobalt Magnet — Grade: S3410



Samarium Cobalt / Magnetic Properties										
Grade	Press[1]	Type[2]	Br (Gauss)	Hc (Oersteds)	Hci (Oersteds)	BHmax (MGOe)	Temperature Coefficients (%/°C)		Maximum Operating Temp @ Pc = 2 [3]	
			Range	Typical	Minimum	Range	of Br	of Hci	(°C)	(°F)
S3410	D	2:17	11,300 ~ 12,100	10,000	10,000	29 ~ 34	-0.03	-0.22	~ 300	~ 570

[1] D: Die-Pressed, I: Isostatically-Pressed
[2] Type: Sm_1Co_5 or Sm_2Co_{17} types
[3] The Maximum Operating Temperature shown here is for magnets operating at a Permeance Coefficient of 2. At the temperatures shown the operating point of the material is above the knee of the BH Curve.

Samarium Cobalt / Physical Properties											
Grade	Density		Bending Strength		Compressive Strength		Electrical Resistivity (Ωm)	Coeff. of Thermal Expansion[4]		Curie Temperature	
	(kg/m³)	(lbs/in³)	(kg/m²)	(lbs/in²)	(kg/m²)	(lbs/in²)		// M	⊥M	(°C)	(°F)
S3410	8.4×10^3	0.304	1.2×10^3	1.7×10^4	9.1×10^3	1.3×10^5	0.8×10^{-6}	8.9×10^{-6}	11.6×10^{-6}	825	1510

[4] // M Parallel to magnetic orientation, ⊥M Perpendicular to magnetic orientation.