KOEROX™ I

Injection Molded Ferrite

Koerox I magnets are made by injection molding. The manufacturing methods used eliminate the need for machining and permit the production of close-toleranced ready-to-install parts. In addition, injection molding makes it possible to connect the magnets directly to shafts or other components. Diverse shaping possibilities combined with insert and composite techniques and the typical toughness of plastics allow the production of complex magnets offering new and cost-effective solutions in design and manufacture.

Hard ferrite-based, plastic-bonded, isotropic and anisotropic permanent magnets from KOLEKTOR MAGNET TECHNOLOGY GmbH are made by injection molding and supplied under the names Koerox I PA and PS. As well as the low cost and wide availability of the magnet raw material, they offer good mechanical properties, high edge strength and the advantage that they can be molded to almost any shape with close tolerances. Through the use of appropriate binders, magnets can be used at high operating temperatures.

PLASTIC-BONDED HARD FERRITE MATERIALS, INJECTION MOULDED

Thermoplastic-bonded hard ferrite is an almost ideal engineering material combining many desirable properties. Magnetic components made of this material are finding significant use in electric motors and generators, and in magnetic sensors, particularly involving the development of improved sensing elements. Diverse examples of the material's use are found in the automotive area, and the number of applications is set to grow still further.

Over the years demands have become more complex and more sophisticated manufacturing methods have been developed to meet them. Figs 1 to 4 show typical products incorporating Koerox I magnets.

The ability to orient and magnetize the ferrite particles in the plastic matrix in almost any desired way during the manufacturing process makes this material far superior to isotropic, sintered, hard ferrite from a magnetic point of view, opening up many new applications as well as opportunities for cost-effective substitution.

From the mechanical point of view Koerox I magnets offer even more advantages over sintered magnets. Insert technology makes it possible to integrate shafts, bushings and many other elements to perform secondary mechanical functions; interference fits and centered fits are possible. Many processes in the further processing of the magnets can be automated through collaboration between manufacturer and user. Because hard ferrite is available in abundance, magnets can frequently be used to perform secondary bearing and rive functions (pinions) using cost-effective joining techniques.

An increasingly important area of use is in automotive engineering. Components based on Koerox I can be used at operating temperatures up to 200°C (e.g. in engines and transmissions) through the use of PPS binders. The trend towards non-contacting sensors in the automotive field is opening up more and more applications. Important parameters, which directly affect the accuracy of the overall

sensor unit, are signal intensity and homogeneity, pole steepness and close-toleranced pole angles.

High Pole numbers are often desired for resolution reasons. Here it must be noted that with pole widths of around 1.5 to 2.0 mm there is a technical limit to direct lateral orientation, and in addition the extreme dependence on distance when dealing with small pole widths is sometimes underestimated.

The Koerox Data Table presents the range of material variants obtained using different magnet powders, binder materials, fill factors and orientation methods. For applications involving temperatures greater than 150°C, Koerox I PS (with PPS as plastic matrix) commends itself, while for critical sheer loads in combination with low temperature high-coercivity variants are available. For all Koerox I grades the reversible temperature coefficients are: Tc(Js) = -0.2%/K, Tc(HcJ) = + 0.35%/K.

For borderline applications KOLEKTOR MAGNET TECHNOLOGY GmbH offers targeted support in component design, magnetic calculation and specification testing.

As a general rule, users are recommended to liaise closely with the manufacturer at an early stage of product design to arrive at competitive solutions that meet the technical requirements of the application. "Quality by design" is of particular importance in the manufacture of thermoplastic-bonded oriented hard ferrite magnets.

FIGURE 1: COMPOSITE PARTS

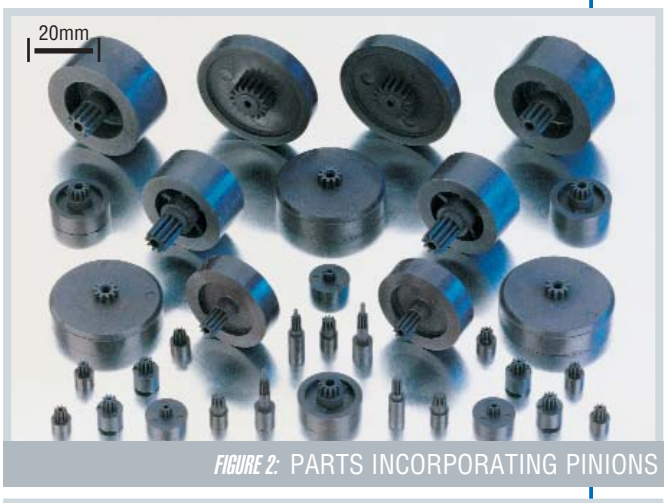

FIGURE 2: PARTS INCORPORATING PINIONS

FIGURE 3: MEDIUM & LARGE PARTS

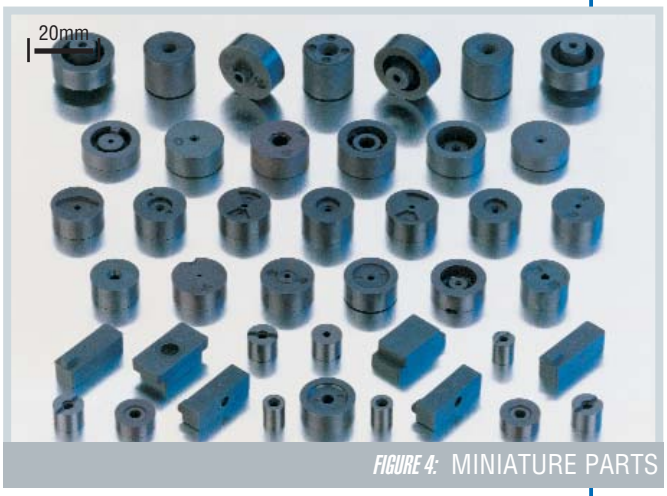

FIGURE 4: MINIATURE PARTS

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Product	1)	$(BH)_{max}$ kJ/m³ typ.	$(BH)_{max}$ kJ/m³ min	$(BH)_{max}$ MGOe typ.	$(BH)_{max}$ MGOe min.	Br mT typ.	Br mT min.	Br G typ.	Br G min.	H_{cB} kA/m typ.	H_{cB} kA/m min.	H_{cB} Oe typ.	H_{cB} Oe min.	Intrinsic Coercivity H_{cJ} kA/m typ.	Intrinsic Coercivity H_{cJ} kA/m min.	Intrinsic Coercivity H_{cJ} Oe typ.	Intrinsic Coercivity H_{cJ} Oe min.	Relative Permeability typ.	Density g/cm³ typ.	Temperature Coefficient of Br, α (20-100 °C) %/K typ.	Temperature Coefficient of H_{cJ}, β (20-100 °C) %/K typ.
Koerox I 1/20 PA	i	1.7	1.4	0.21	0.18	103	96	1030	960	70	65	880	817	220	205	2765	2576	1.20	2.9	–0.20	+0.35
Koerox I 2/20 PA	i	2.7	2.4	0.34	0.30	128	123	1280	1230	86	81	1081	1018	220	205	2765	2576	1.20	3.3	–0.20	+0.35
Koerox I 5/22 PA	a	5.2	5.0	0.65	0.63	170	163	1700	1600	120	114	1508	1433	220	205	2765	2576	1.06	2.6	–0.20	+0.35
Koerox I 6/22 PA	a	6.7	6.5	0.84	0.82	190	183	1900	1780	131	122	1646	1533	220	205	2765	2576	1.06	2.8	–0.20	+0.35
Koerox I 9/22 PA	a	8.9	8.7	1.12	1.09	219	211	2190	2150	151	143	1898	1797	220	205	2765	2576	1.06	3.1	–0.20	+0.35
Koerox I 10/22 PA	a	10.3	10.0	1.29	1.26	236	227	2360	2300	157	150	1973	1885	220	205	2765	2576	1.06	3.3	–0.20	+0.35
Koerox I 12/23 PA	a	11.5	11.2	1.45	1.41	250	242	2500	2540	161	153	2023	1923	230	215	2890	2702	1.06	3.4	–0.20	+0.35
Koerox I 13/24 PA	a	13.0	12.8	1.63	1.61	265	257	2650	2670	173	165	2174	2073	235	220	2953	2765	1.06	3.5	–0.20	+0.35
Koerox I 14/24 PA	a	14.3	14.0	1.80	1.76	276	268	2760	2720	175	168	2199	2111	230	215	2840	2702	1.06	3.6	–0.20	+0.35
Koerox I 9/30 PA	a	8.9	8.7	1.12	1.09	220	212	2200	2200	151	143	1898	1797	300	280	3770	3519	1.06	3.3	–0.20	+0.35
Koerox I 11/18 PS	a	11.7	11.4	1.47	1.43	250	242	2500	2450	138	128	1734	1608	167	153	2099	1923	1.07	3.5	–0.20	+0.35
Koerox I 9/18 PS	a	10.2	9.8	1.28	1.23	235	227	2350	2220	180	164	2262	2061	147	140	1847	1759	1.08	3.4	–0.20	+0.35
Koerox I 8/20 PS	a	7.5	7.1	0.94	0.89	200	192	2000	1990	134	129	1684	1621	195	179	2450	2249	1.07	3.1	–0.20	+0.35
Koerox I 8/29 PS	a	7.4	7.0	0.93	0.88	205	198	2050	2000	136	130	1709	1634	300	285	3770	3581	1.08	3.4	–0.20	+0.35

1) i = Isotropic
a = Anisotropic

PA = Polyamide (Nylon)
PS = Polyphenylene Sulfide (PPS)

2) Maximum Operating Temperature is contingent upon the entire magnetic circuit. Consult your KOLEKTOR MAGNET TECHNOLOGY GmbH representative for application specific recommendations.

Chart 1: Demagnetization curves B(H)

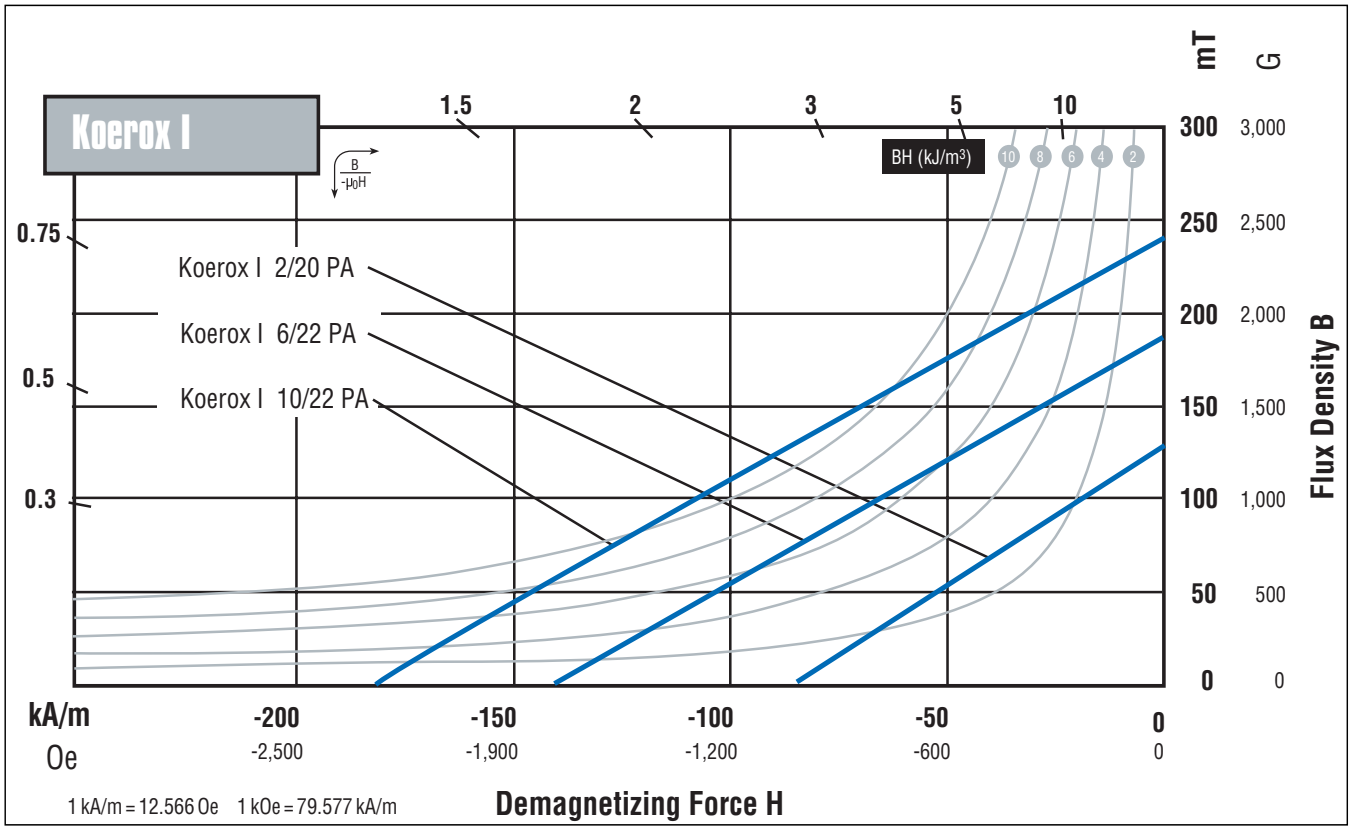

Chart 2: Demagnetization curves B(H)

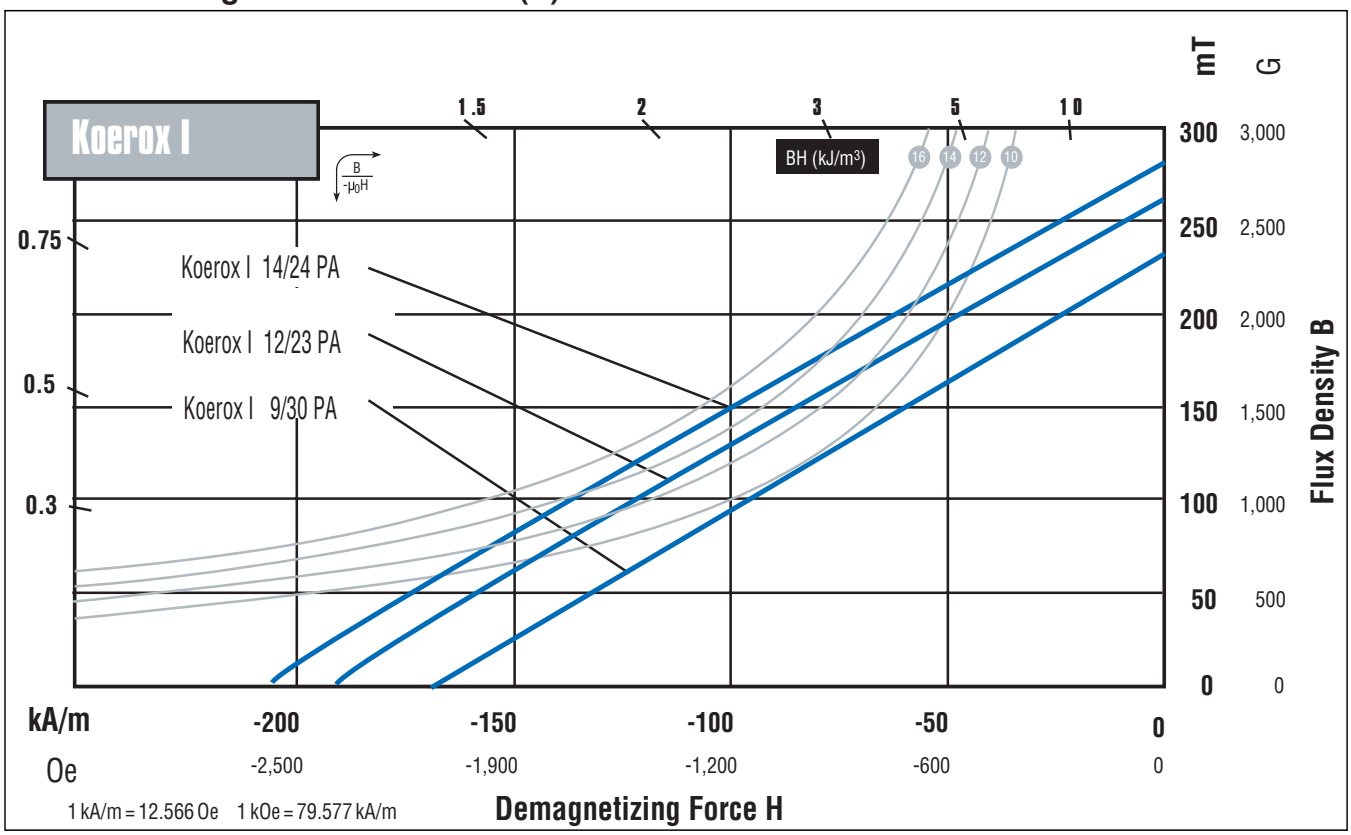

Chart 3: Demagnetization curves J(H) and B(H) at -40°C, room temperature (RT) and 150°C

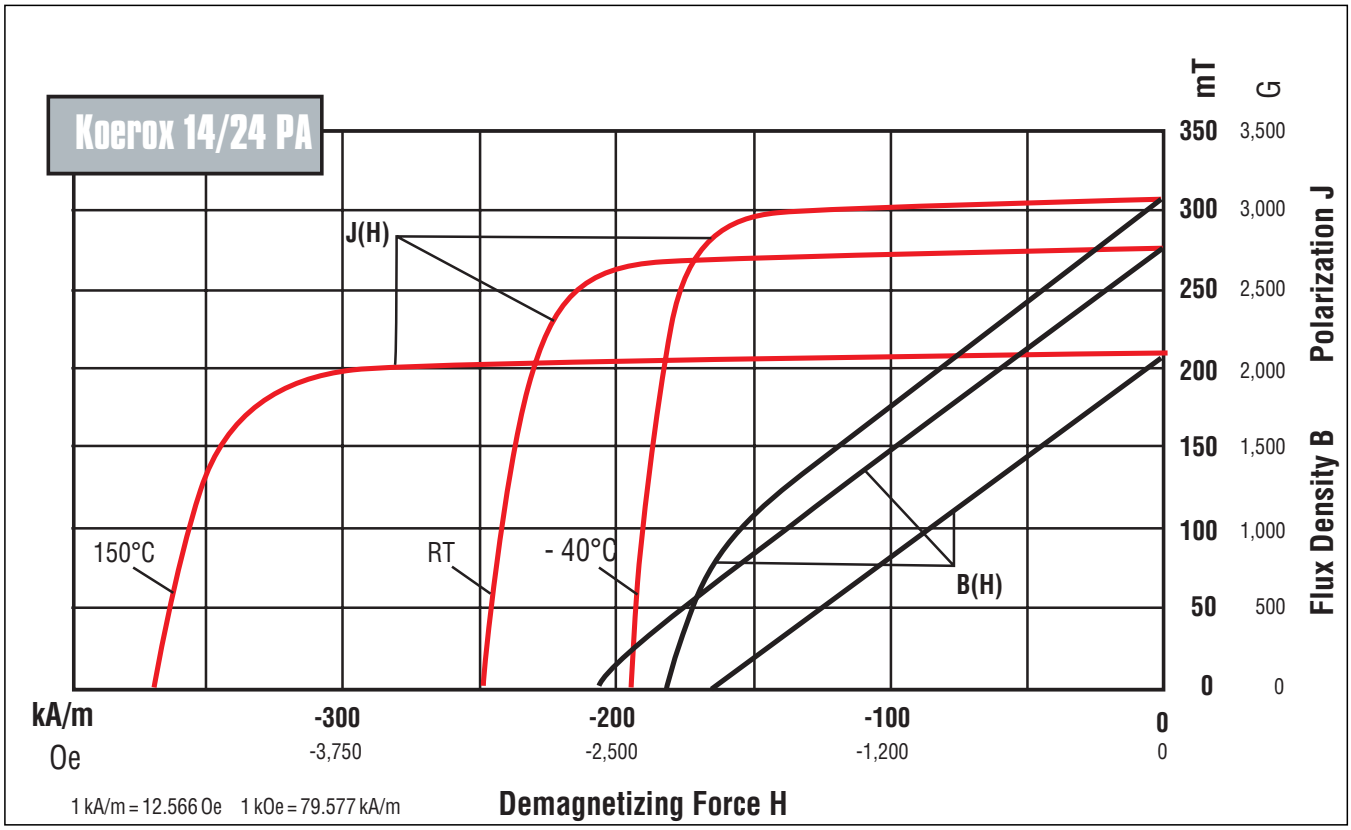

Chart 4: Demagnetization curves J(H) and B(H) at -40°C, room temperature (RT) and 150°C