TECHNICAL DESCRIPTION, PERMEDYN® MF1

Permedyn® MF1 and MF2 are isotropic soft magnetic composite materials with medium frequency performance, primarily intended for applications DC-50 kHz. It exhibits very high maximum permeability and saturation magnetization.
Permedyn® MF1 and MF2 are primarily tailored to replace thin, laminated transformer sheet in applications such as: fast responding electromagnetic valves, relays etc. and all sorts of magnetically powered actuators, shakers etc. It will also replace ferrites in applications where ferrites have too low saturation magnetization.
Permedyn® MF1 and MF2 can easily be machined with conventional cutting methods into every possible shape.
Permedyn® MF1 and MF2 can be surface treated with almost all conventional coating systems intended for alloys of iron.

MF1 is the choice when optimal performance both magnetically and mechanically is the major criteria. When the price is more important and very high production quantities are expected, MF2 is the choice.

Magnetic Components AB has the production capabilities of manufacturing ranging from prototypes, which has to be machined into the right shape, to regular mass-production of net-shape products.
We produce components of all sizes. Our smallest device produced with Permedyn® MF materials is a linear differential transformer used in position sensing device. It weighs under 0.3 g. The largest single device is an induction heating plate weighing over 80 kg.

Static magnetic parameters

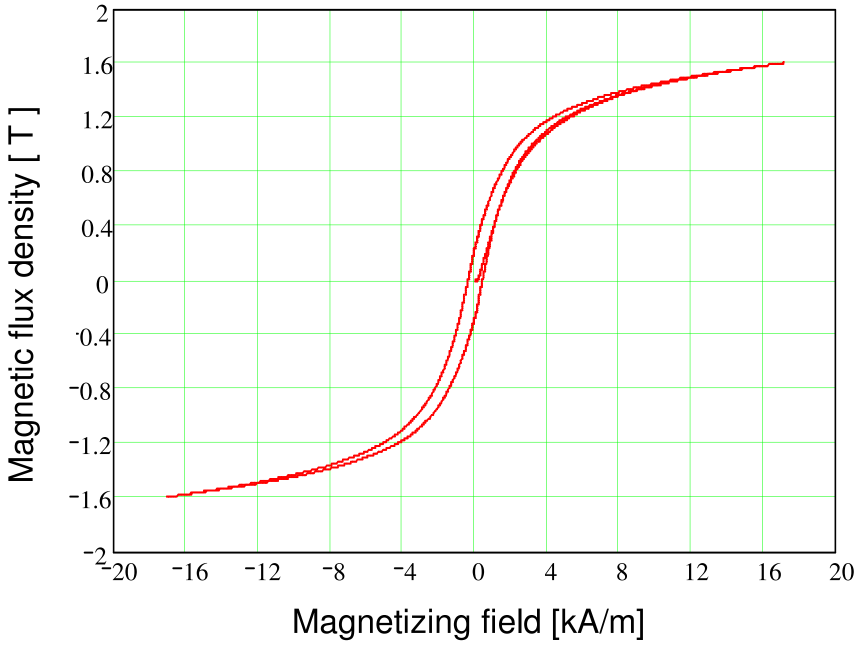

Figure 1. The magnetization loop with virginal magnetization curve.

The data in Table 1 are all calculated from the major magnetization loop with exception of the initial permeability, which is calculated at 60 mT on the virginal magnetization curve.

Table 1. Typical values of magnetic parameters deduced from the static magnetization curve Figure 1.

Description	Symbol	Typical value	Unit
Maximum relative permeability	μ_{max}	301	-
Maximum differential permeability	μ_{diff}	544	-
Initial permeability (60 mT)	μ_{init}	190	-
Saturation magnetization (16 kA/m)	B_{sat}	1.57	T
Coercive force	H_c	398	A/m
Magnetic remanence	B_r	0.26	T
Energy transformation ratio[1]	η	81	%
Absolute energy loss of one cycle[2]	W_{loss}	2330	J/m^3

[1] Calculated as the total, magnetic energy output divided with the total, magnetic energy input for one magnetization cycle, see Figure 1.
[2] Total energy loss is equal to total energy input minus total energy output. The loss is calculated with the data used in Figure 1.

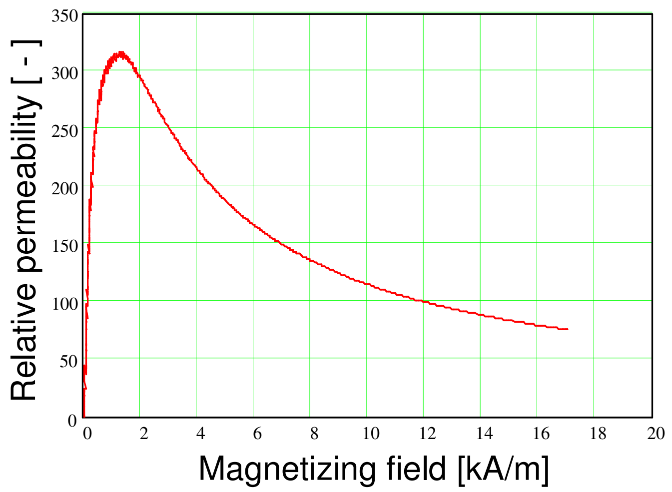

Figure 2. The relative permeability deduced from the virginal magnetization loop in Figure 1.

Dynamic magnetic parameters

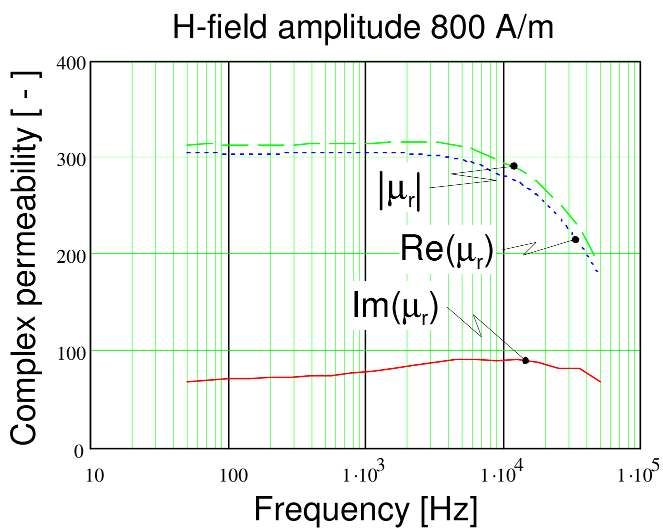

Figure 3. The complex, relative permeability as a function of the frequency ranging from 50 - 50000 Hz, measured at constant amplitude, 800 A/m, of the magnetizing field.

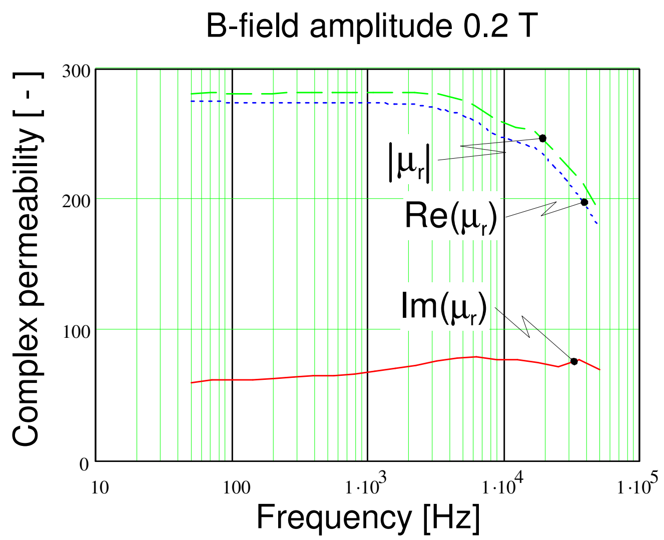

Figure 4. The complex, relative permeability as a function of the frequency ranging from 50 - 50000 Hz, measured at constant amplitude, 0.2 T, of the magnetic flux density.

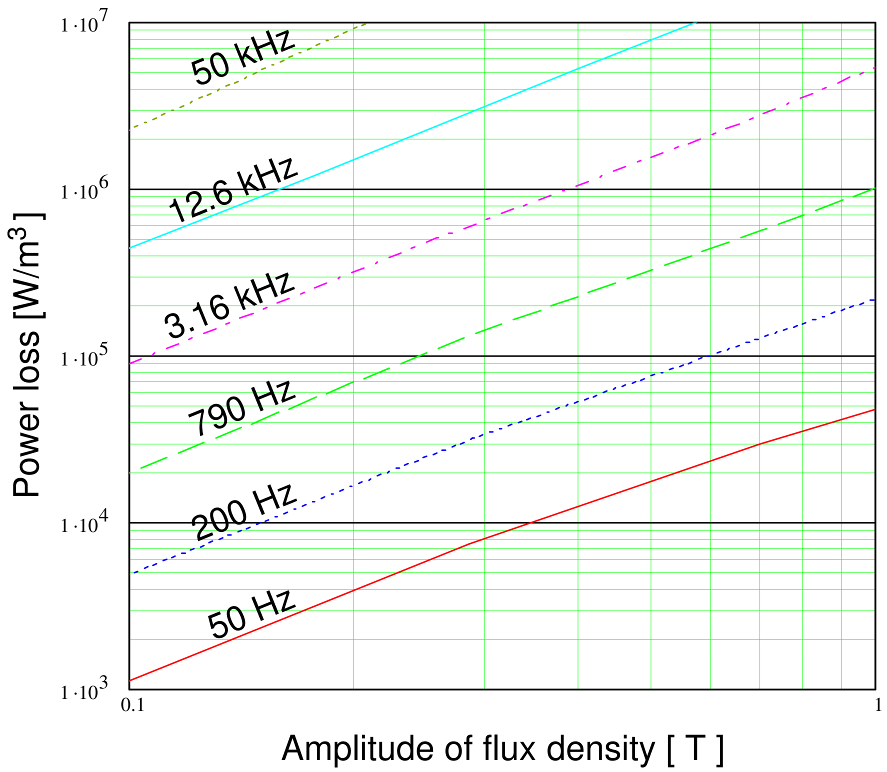

Figure 5. The total power loss as a function the magnetic flux density for six frequencies ranging from 50 Hz to 50 kHz.

All magnetic measurements have been conducted on toroid-shaped samples with inner diameter 45 mm, outer diameter 55 mm and thickness 5 mm.

Structural and thermal properties

Table 2. Typical values of structural, thermal and electrical properties.

Description	Symbol	Typical value	Unit
Density:	ρ	7450	kg/m^3
Yield stress, tension:	R_{eL}	80	MPa
Yield stress, compression	R_{eL}	300	MPa
Young's modulus	E	110	GPa
Heat capacitivity	C	410	J/(kg·K)
Thermal conductivity	λ	18	W/(m·K)
Maximum working temperature	T	170	^{o}C
Resistivity	ρ	$2.5 \cdot 10^{-3}$	Ωm