KRUPP VDM

Magnifer® 8105

Material Data Sheet No. 9008
February 1999 edition

Magnifer 8105 is a soft magnetic nickel-iron alloy with about 81 % Ni. It has a saturation induction of about 0.7 T (7000 G), very high permeability and very low coercive force. The chemical composition results in a negative magnetostriction of about -1×10^{-6}. Typical applications of Magnifer 8105 are part for recording heads:

- Head cores
- Shielding parts
- Shielding cases

Magnifer 8105 So can be used for other magnetic applications as well (e.g. stamped rings for zero current transformers, EI transformer laminations or transformer laminations for modems; see data sheet for Magnifer 7904).

Magnetic properties

The following tables and figures show the magnetic properties of Magnifer 8105 as functions of various parameters. The properties shown in the diagrams are characteristic of the alloy in the heat-treated condition. The various heat treatments are described in the following sections. Variations in these heat treatments will result in changes in the properties of the alloy. The main factors in this respect are the annealing temperature and the cooling conditions. With respect to the applications of recording heads the influence of the resin moulding on the magnetic properties is described.
Two versions of Magnifer 8105 are produced - Magnifer 8105 and Magnifer 8105 So. The two alloys differ in their chemical composition, mainly in the Mo content. This results in a different behaviour with regard to the cooling parameters of the annealing, which influences the magnetic properties. Magnifer 8105 So has a higher electrical resistivity than Magnifer 8105 due to the higher Mo content, which results in higher permeability at higher frequencies.

Resin mould	μ_i	μ_{max}	H_C (Oe)	B_{10} (G)
before	100000	200000	0.01	6800
after	60000	120000	0.012	6200

μ_i: Initial relative permeability
μ_{max}: Maximum relative permeability
H_C: Coercive force
B_{10}: Induction at H = 10 Oe

Table 1 - Typical DC-magnetic properties of Magnifer 8105 measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

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Physical properties

	Magnifer 8105	Magnifer 8105 So
Saturation induction B_S	0.72 T (7200 G)	0.68 T (6800 T)
Curie temperature T_C	420 °C	400 °C
Saturation magnetostriction λ_S	-1×10^{-6}	-1×10^{-6}
Electrical resistivity	60 μΩm	64 μΩm
Specific gravity	8.7 g/cm^3	8.7 g/cm^3
Coefficient of thermal expansion (20 - 100 °C)	12×10^{-6}/°C	13×10^{-6}/°C

Table 2 - Physical properties of Magnifer 8105 and Magnifer 8105 So, typical values

Mechanical properties

		cold rolled (about 80 %)	*deep drawable soft annealed	after final annealing
Magnifer 8105				
Hardness	HV5	350	160	100
Tensile strength	Rm (N/mm^2)	1250	700	510
Yield strength	Rp 0.2 (N/mm^2)	1250	310	160
Elongation	A5 (%)	3	32	32
Magnifer 8105 So				
Hardness	HV1	365	170	105
Tensile strength	Rm (N/mm^2)	1300	730	540
Yield strength	Rp 0.2 (N/mm^2)	1300	340	175
Elongation	A5 (%)	1	33	32

* The required condition, deep drawable or soft annealed, should be stated when ordering.

Table 3 - Mechanical properties of Magnifer 8105 and Magnifer 8105 So, typical values

Chemical composition

Alloy	Ni	Mo	Mn	Fe
Magnifer 8105	81	5	0.4	balance
Magnifer 8105 So	81	6	0.4	balance

Table 4 - Chemical composition (%), typical values

Magnifer® 8105

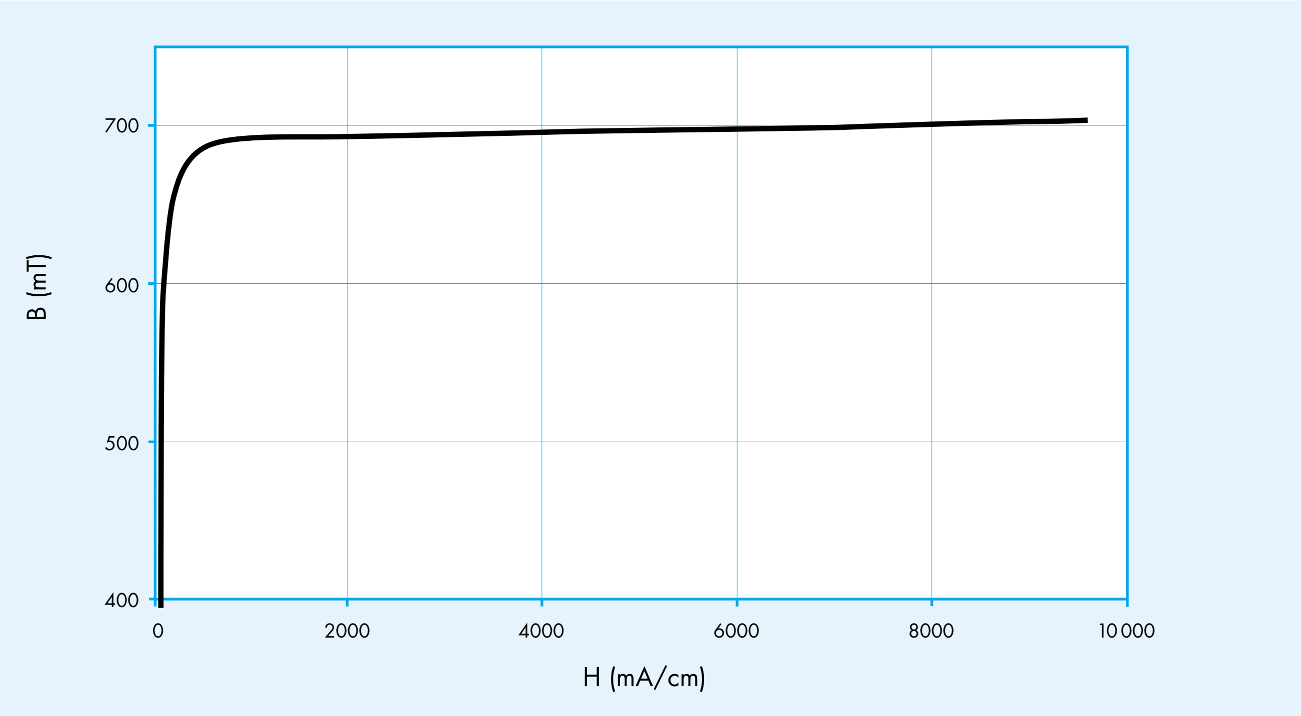

Figure 1 - Typical DC induction/field-strength curve of Magnifer 8105 measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

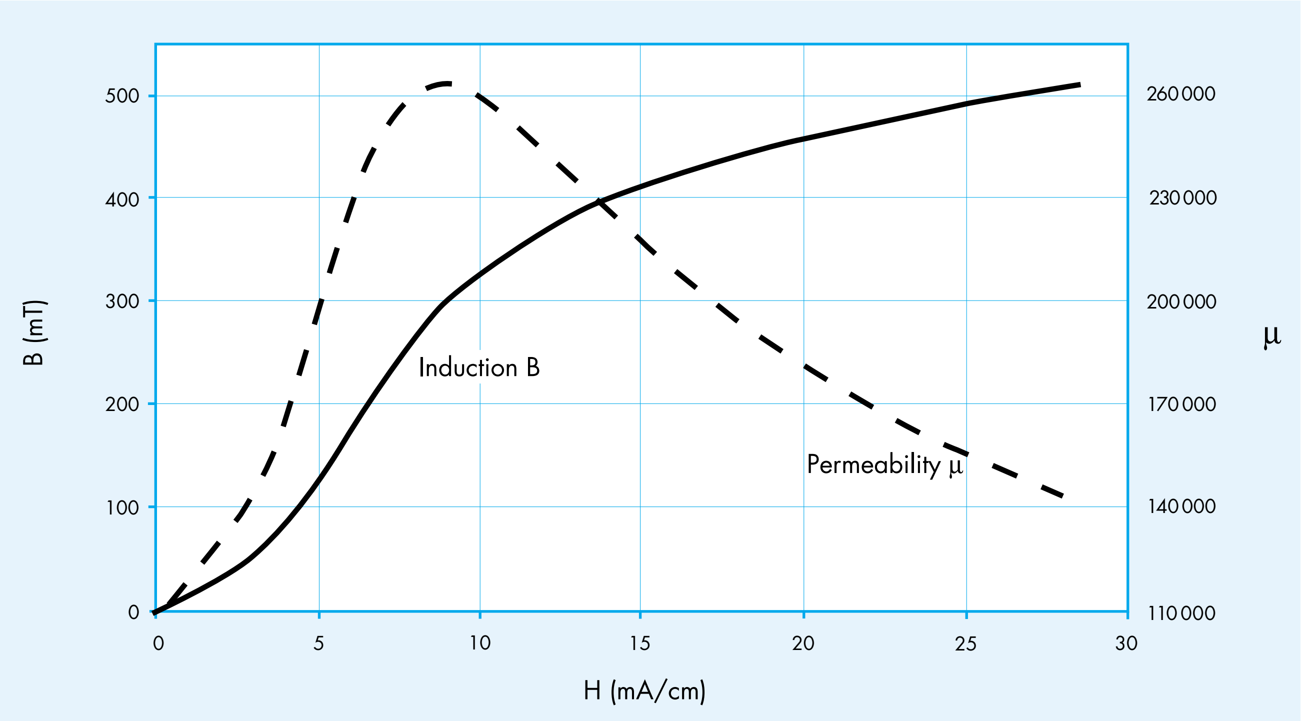

Figure 2 - Typical DC permeability and induction field-strength curves of Magnifer 8105 measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

Magnifer® 8105

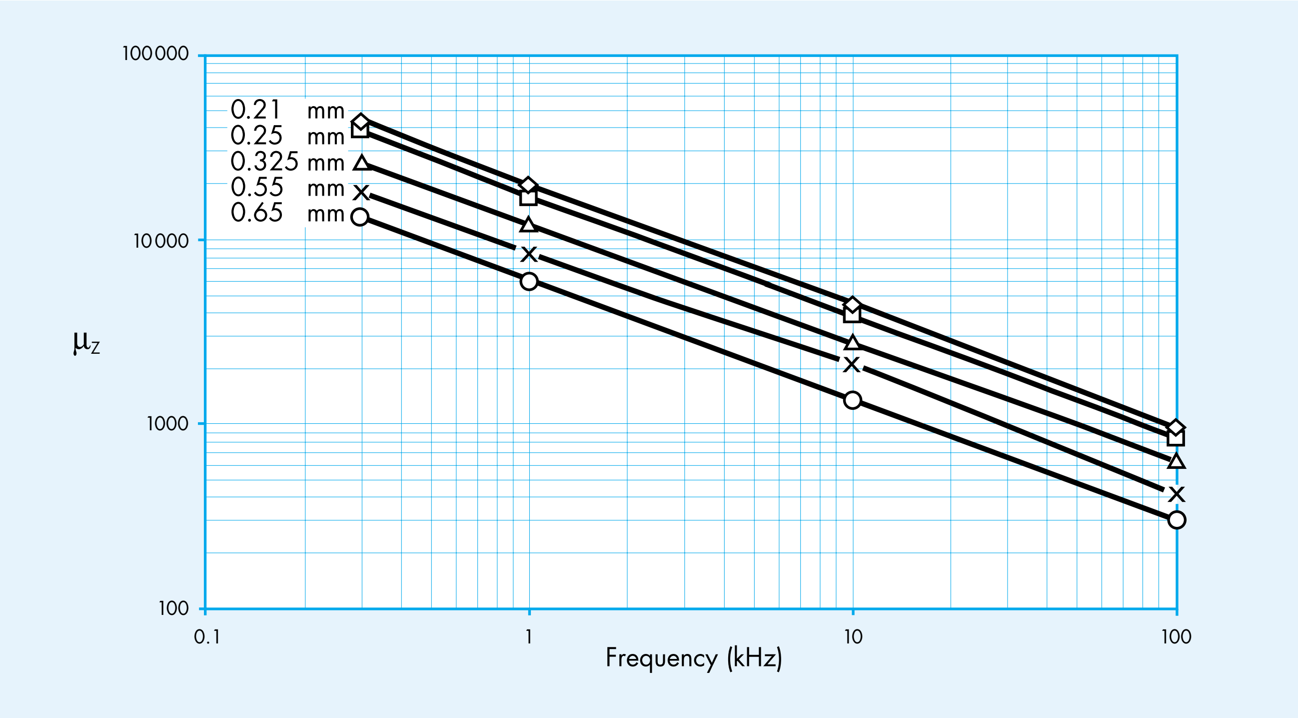

Figure 3 - Typical curves of the impedance permeability μ_z of Magnifer 8105 in relation to frequency and thickness.

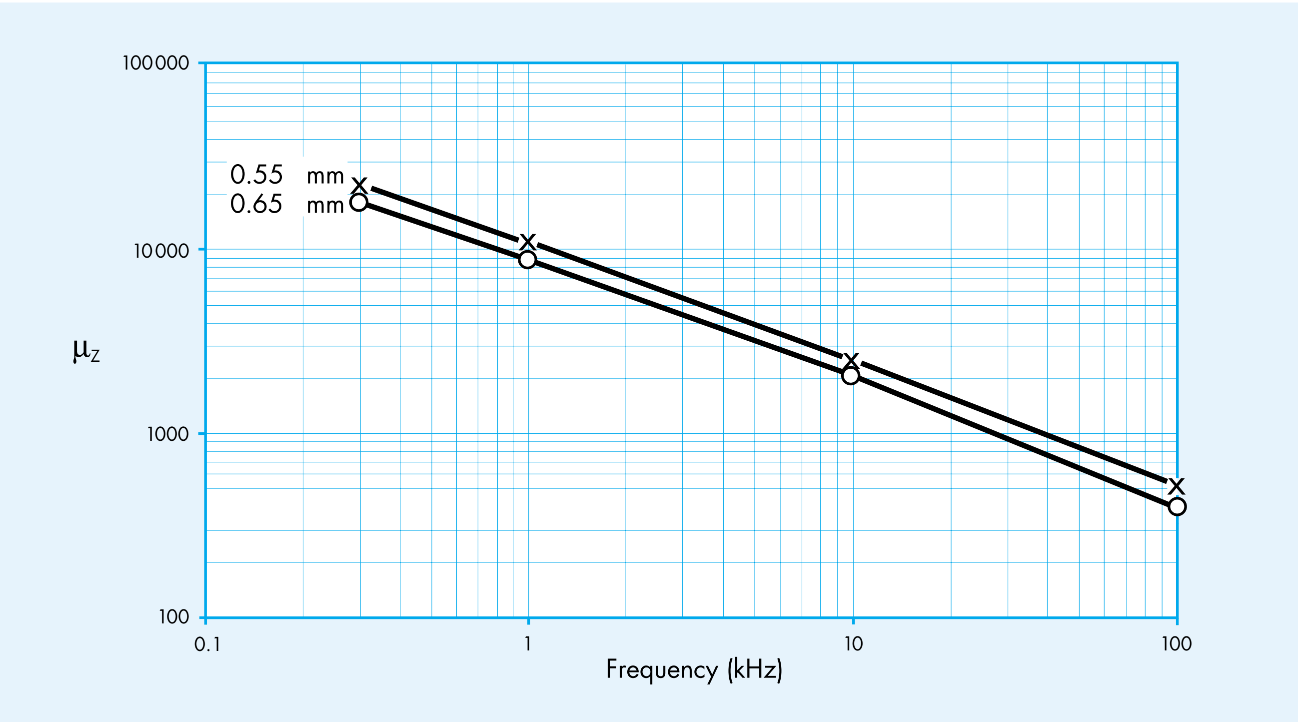

Figure 4 - Typical curves of the impedance permeability μ_z of Magnifer 8105 So in relation to frequency and thickness.

Magnifer® 8105

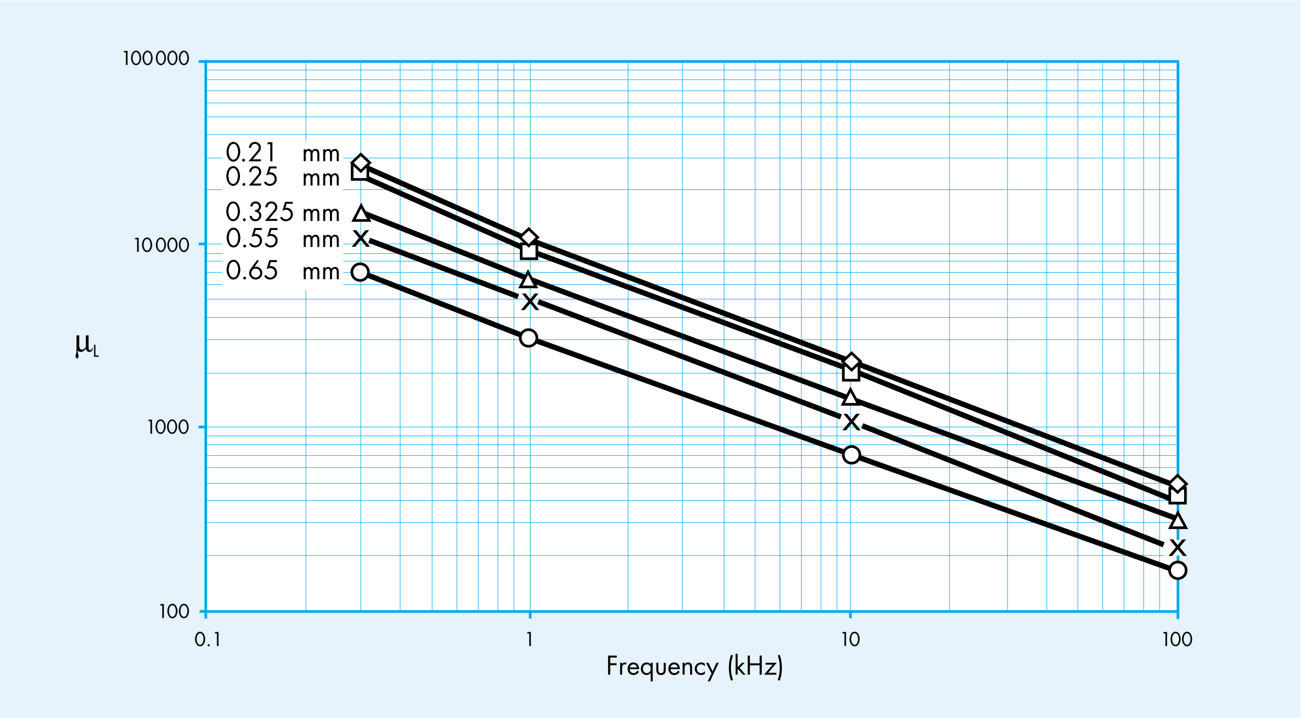

Figure 5 - Typical curves of the inductance permeability μ_L of Magnifer 8105 in relation to frequency and thickness.

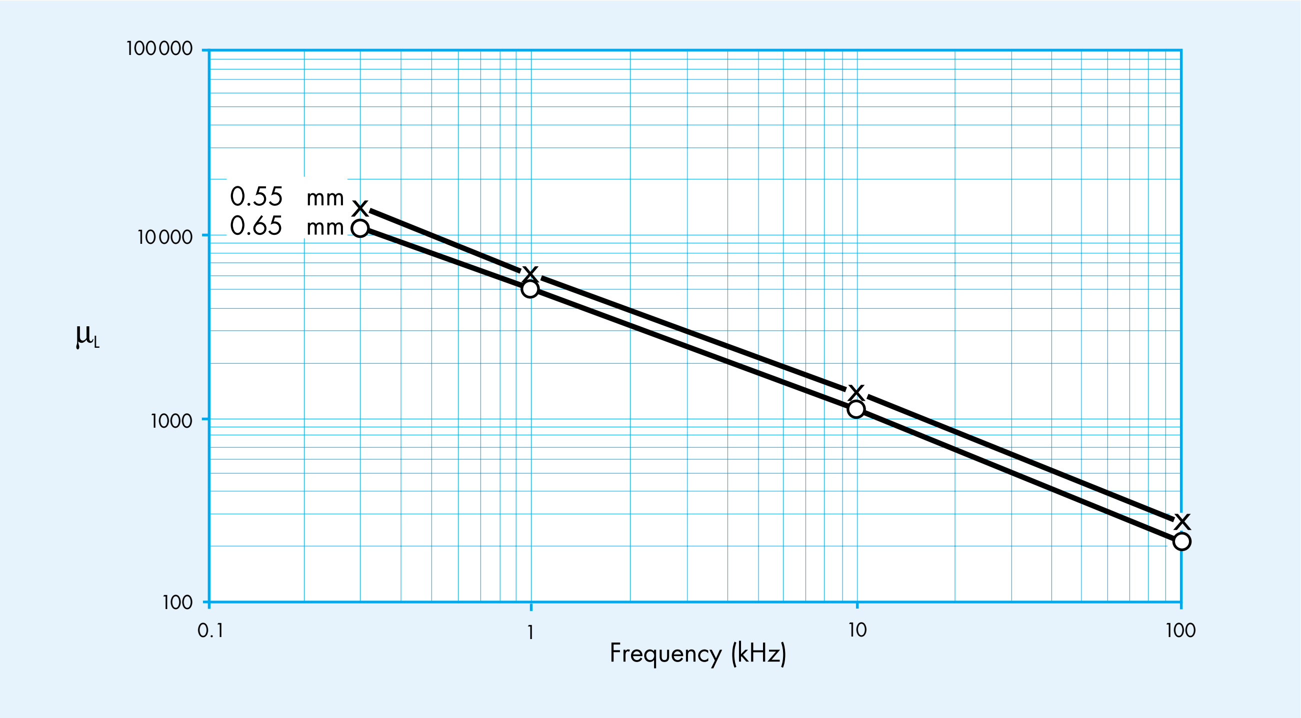

Figure 6 - Typical curves of the inductance permeability μ_L of Magnifer 8105 So in relation to frequency and thickness.

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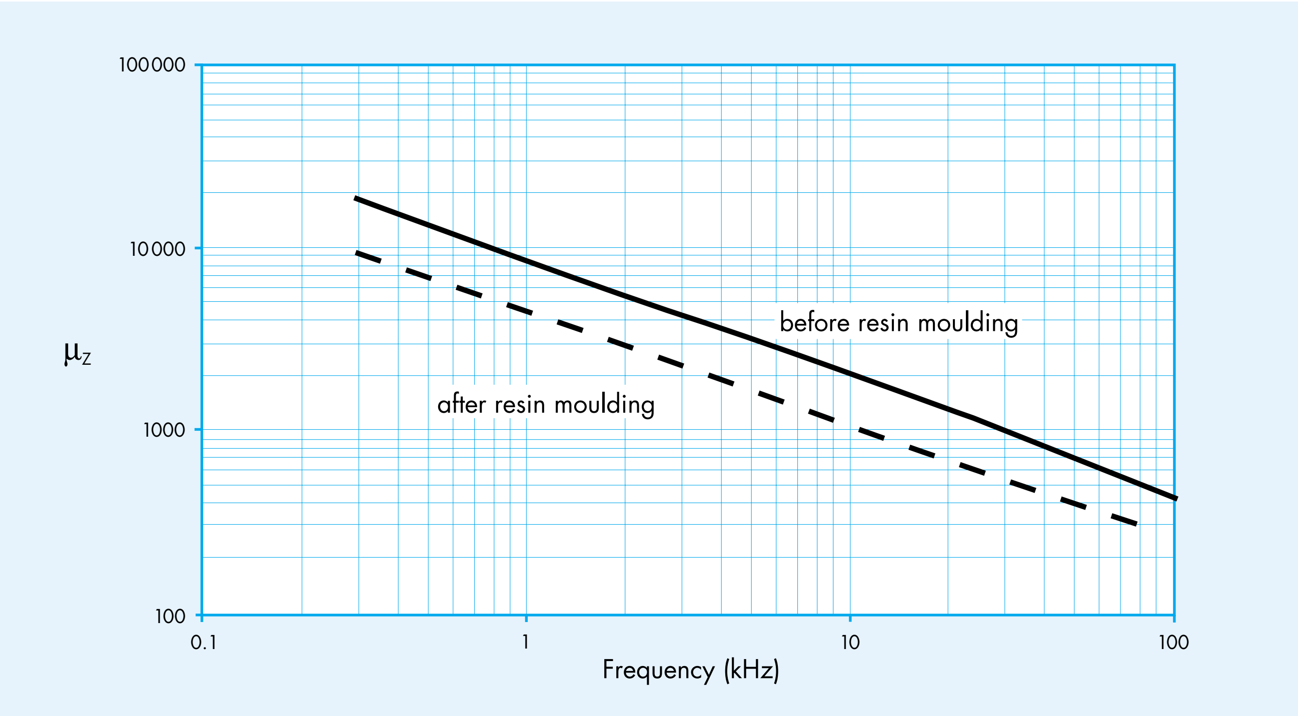

Figure 7 - Typical curves of the impedance permeability μ_z of Magnifer 8105 in relation to frequency before and after resin moulding measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

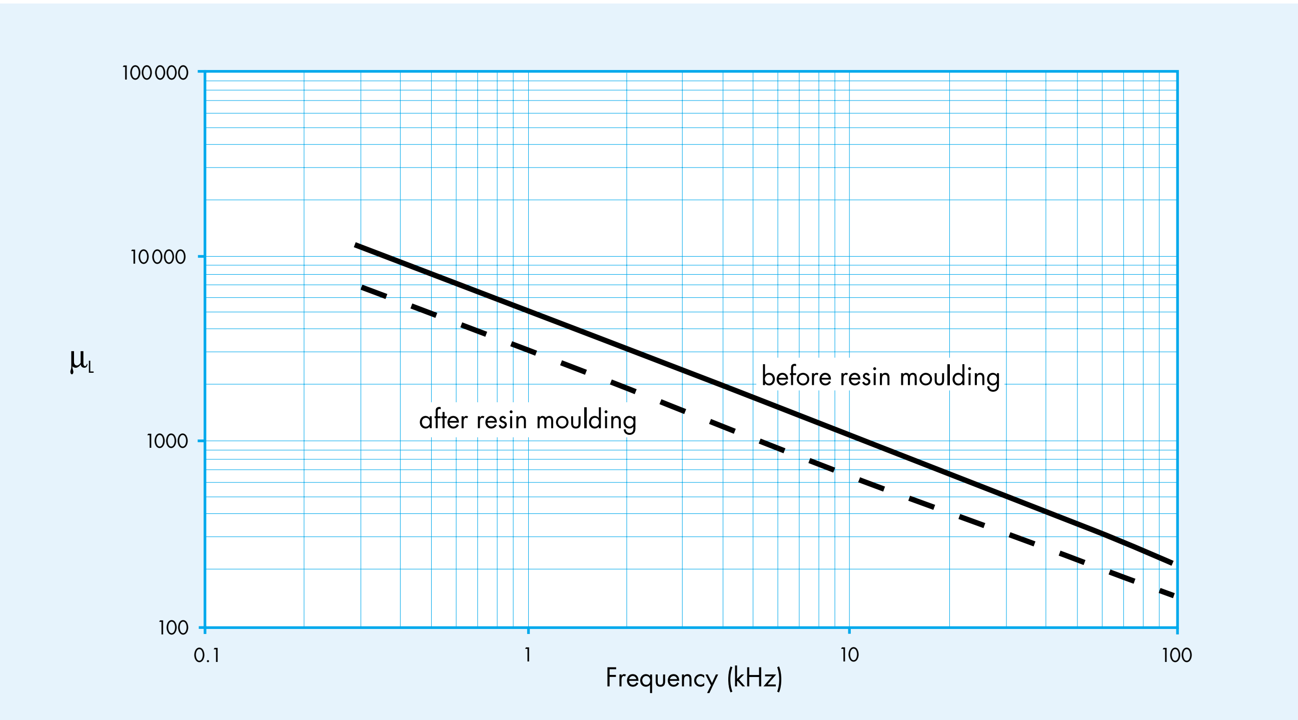

Figure 8 - Typical curves of the inductance permeability μ_L of Magnifer 8105 in relation to frequency before and after resin moulding measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

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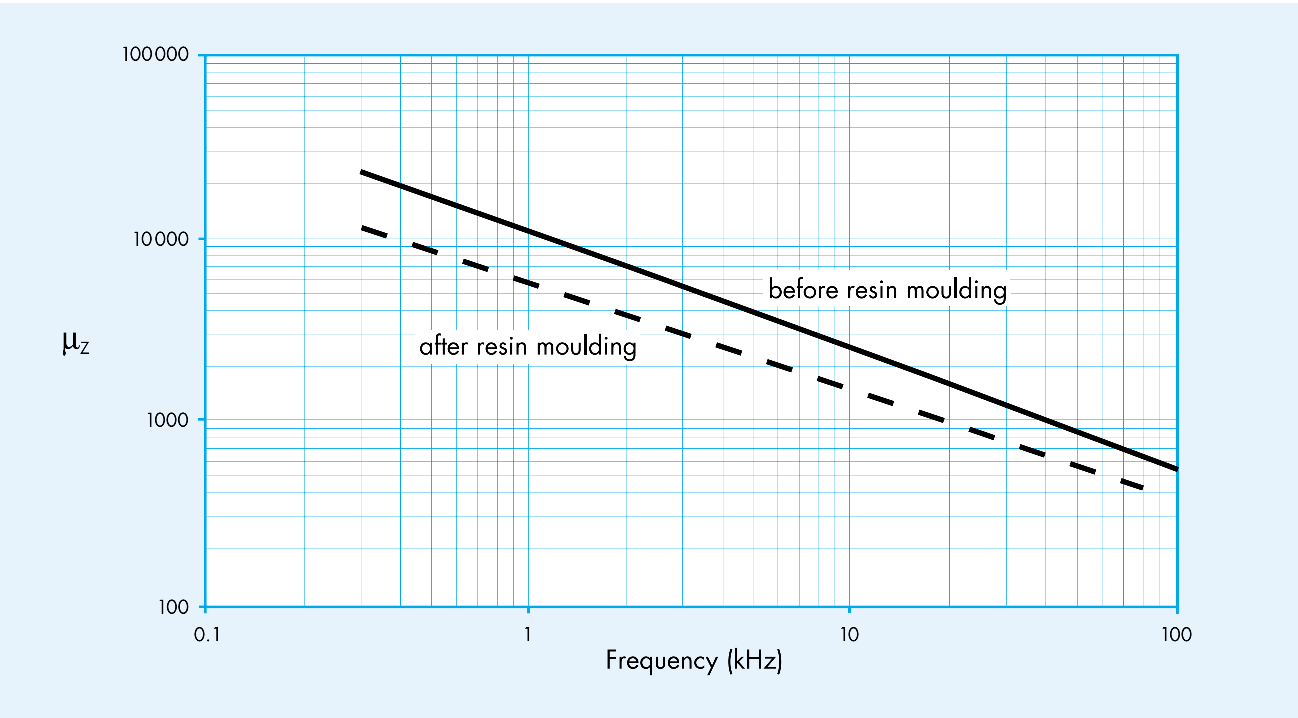

Figure 9 - Typical curves of the impedance permeability μ_Z of Magnifer 8105 So in relation to frequency before and after resin moulding measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

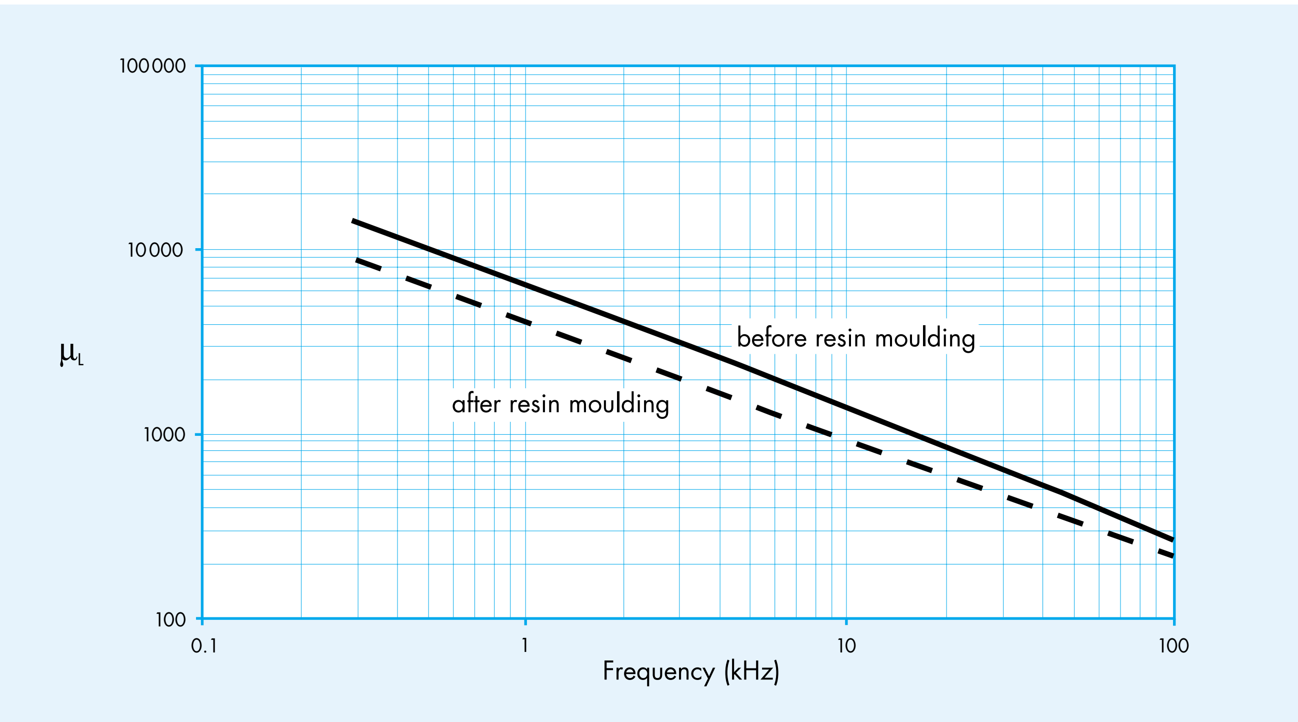

Figure 10 - Typical curves of the inductance permeability μ_L of Magnifer 8105 So in relation to frequency before and after resin moulding measured using stamped rings of thickness 0.55 mm annealed for 3h at 1050 °C.

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Final annealing for obtaining good magnetic properties

The magnetic properties quoted in this data sheet are obtainable only after special final annealing treatment. Annealing should be carried out in dry hydrogen or cracked ammonia (dew point below -40 °C). The appropriate annealing temperature for Magnifer 8105 is 1050 - 1200 °C with an annealing time of 1 to 6 hours.

The cooling process after the final annealing operation is of special importance with high-nickel-alloys, as it greatly influences the magnetic properties. The best cooling parameters for obtaining good magnetic properties differ for the two alloys Magnifer 8105 and Magnifer 8105 So. Figure 11 shows that Magnifer 8105 reaches maximum permeability when rapid cooling starts at higher temperatures around 600 °C, whereas Magnifer 8105 So reaches maximum permeability when rapid cooling starts at temperatures lower than 450 °C.

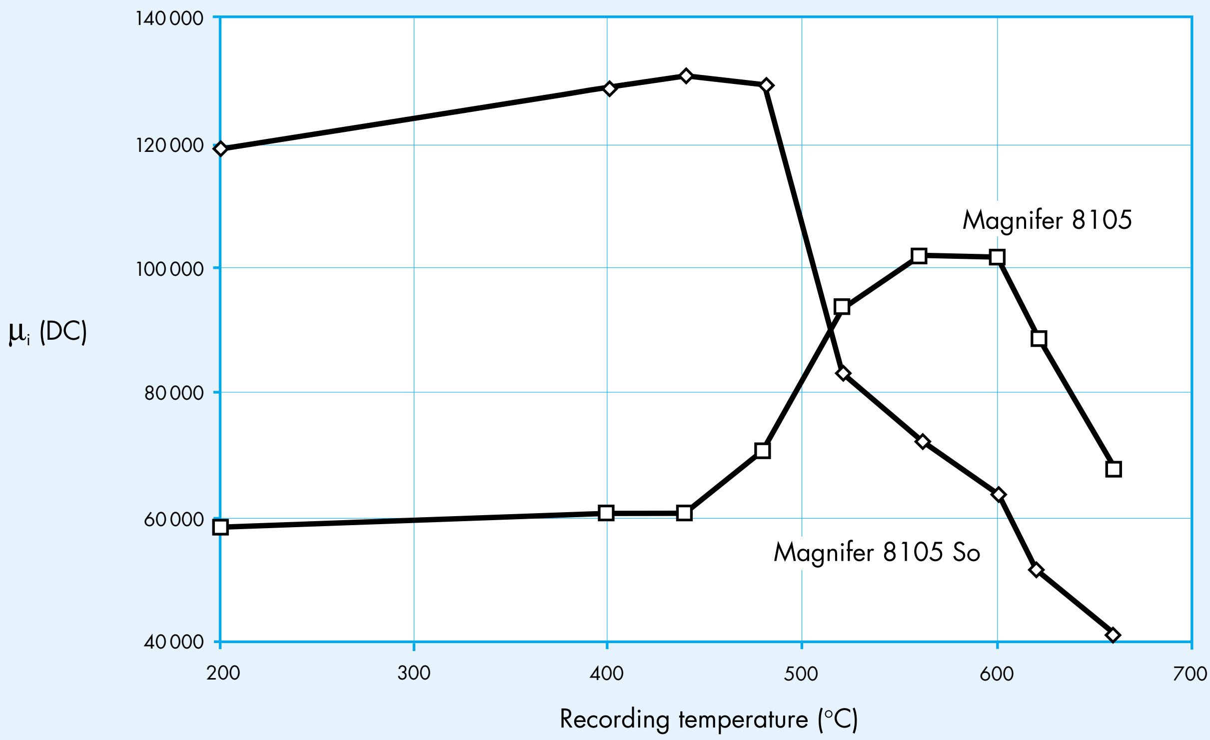

Figure 11 - Explanation of the different behaviour of Magnifer 8105 and Magnifer 8105 So depending on the temperature at which rapid cooling starts.

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Fabrication

Heat treatment
Heavily worked material should preferably be soft annealed before any further deformation. This annealing operation should be carried out around 1100 °C. The annealing time - not longer than 1 h - can be shorter at higher temperatures. The temperature and annealing time are guided by the desired final condition. Annealing should be carried out in hydrogen, cracked ammonia or a clean inert gas atmosphere.

Working
All conventional processes can be used. The hard-rolled state is the most suitable for stamping. The soft annealed condition ist best suited for deep drawing operations. The magnetic, final annealed, condition is only the final condition for the fabrication of certain parts. It is not suitable as the initial condition for any working operation, as the magnetic properties would be drastically lowered.

Machining
The cold-worked condition is best suited for machining operations. Alloy properties are similar to those of stainless steels. Low cutting speeds, cooling cutting oils, and carbide or high-speed steel tools are necessary. The latter must be kept sharp. After machining is completed, residual oil, grease or dirt films must be entirely removed before annealing the parts.

Welding
The best process is usually resistance spot welding, although other welding processes are also suitable in principle.

Corrosion resistance
Corrosion resistance in humid atmospheres is good, but not so in aggressive media.

Forms supplied
Strip

Current as of February 1999

Krupp VDM GmbH
Postfach 18 20
D-58778 Werdohl/Germany
Phone: + 49 (23 92) 55-0
Fax: + 49 (23 92) 55-22 17
Internet http://www.kruppvdm.de

A company of the
Krupp Hoesch Industries group.