STX SMC PROTOTYPE MATERIAL

Sintex develops and manufactures customised components in various different Soft Magnetic Composites (SMC). The choice of SMC material depends on many factors. We can help you evaluate your wishes and requirements, so that you choose the correct choice of material.

Prototypes

Powder compaction is the preferred approach to manufacture prototypes with SMC material. Using this method, the prototype will in all essential respects have the same properties as a mass produced component. Because of tooling costs for the compaction process, this is often not feasible.

A simplified approach is to machine the component from a pre-fabricated blank. This can be a fast, low-cost approach, but it also has the drawback that the properties will typically be different from those obtained by compaction. A special SMC Prototyping material with enhanced machinability has been developed in order to minimize these differences, but it may still not be possible to directly attribute the properties of the prototypes.

Machining prototypes - including recommendations:

SMC Prototyping material blanks can be machined by drilling, turning and milling. They exhibit stable mechanical properties up to 150°C. In order to machine larger components, SMC prototyping material blanks can be cut and glued together (epoxy glue) before machining. The recommendations on tooling and process for machining SMC prototyping material are:

DRILLING

- HSS self-centering drill
- Cutting speed: Vc = 30 m/min
- Feed speed: Vf = 60 mm/min
- No cutting fluid, but vacuum cleaning of chips

TURNING

- Cermet polished sharp inserts
- Cutting speed: Vc in the range 50 - 300 m/min
- Feed: f = 0.12 mm/rev recommended for a good surface finish
- • No cutting fluid

MILLING

- Hard metal or HSS milling cutter
- Cutting speed: Vc in the range 100-125 m/min
- • Feed per tooth: fz = 0.08 mm/tooth
- Feed per revolution: f = 1 mm/rev recommended both for face milling and peripheral milling
- No cutting fluid

After machining it is recommended to coat the material surface to prevent corrosion, because the material is comparable to raw iron.

Properties of STX SMC Prototyping material

SMC generally have good magnetic properties such as good relative permeability and high magnetic saturation combined with high electrical resistance. In addition, they have quite unique possibilities for conducting flux in all 3 dimensions. The prototyping material is in most properties comparable to STX M7 at a density of 7.5 g/cm^3.

B-H curve

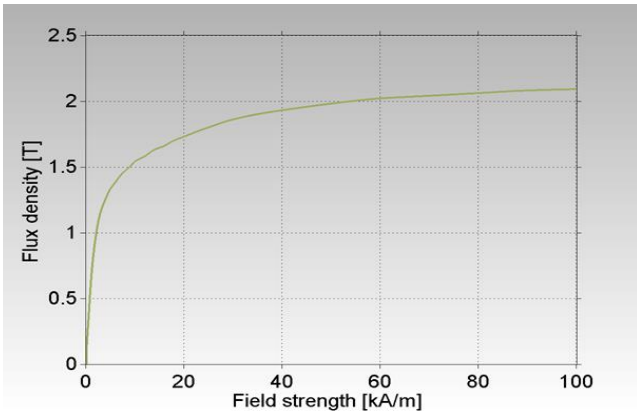

Figure 1: B-H curve for STX SMC Prototyping material - at a mechanical density of 7.45 g/m^3.

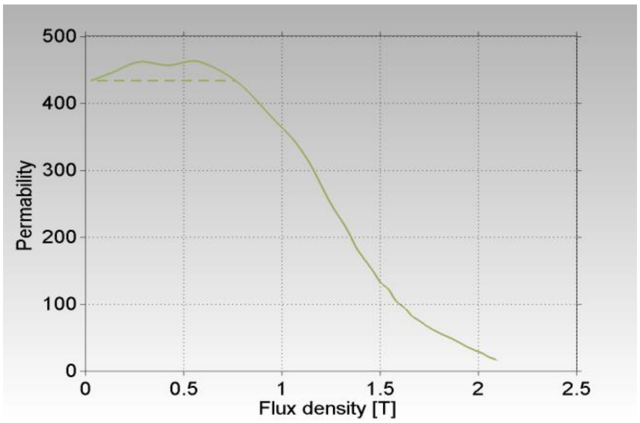

Figure 2: Permeability as a function of flux density for STX SMC material - at a mechanical density of 7.45 g/m^3.

Rethinking Components of Tomorrow

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Permeability

The permeability shown in figure 2 is calculated as the flux density divided by the field strength and vacuum permeability.

Since the point of departure is the virgin curve, the permeability does not necessarily achieve its maximum value at 0 T. If a monotonously declining permeability is required, e.g. for finite element calculations, it is recommended that the top of the curve be cut off for values lying above the initial permeability (see dotted line in figure 2).

Iron loss

Iron loss occurs as a result of the material's resistance to being magnetised (hysteresis loss) and as a result of the electrical currents which counteract the changes in the magnetic field in the material (eddy current loss).

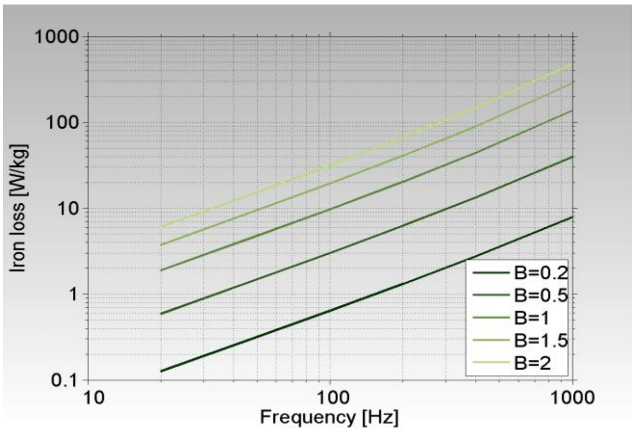

Figure 3: Iron loss as a function of frequency at different flux densities - at a mechanical density of 7.45 g/m³.

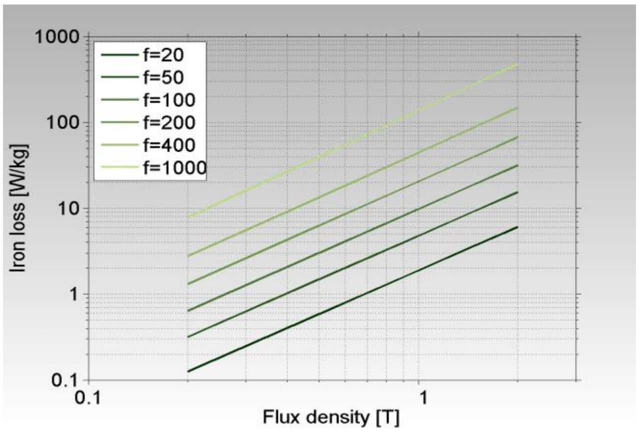

Figure 4: Iron loss as a function of flux density at differ-rent frequencies - at a mechanical density of 7.45 g/m³.

Figures 3 and 4 show the iron loss as a function of frequency and flux density respectively. Hysteresis loss is proportional to the frequency, whilst eddy current loss is proportional to the square of the frequency.

It is important to note that eddy currents can run both locally in individual particles (micro) and more globally in the cross section of the component (macro). Micro eddy currents normally dominate, but in the case of a large cross section, the macroscopic current can be highly significant. In such cases it is recommended to use STX B7 or S7B. This proto-typing material is again in this case more comparable to the STX M7 material.

Properties of STX SMC Prototyping material

	OD 80 mm - H20 mm	DI 80 mm - H40mm
Density [g/cm³]	7.45	7.30
TRS @ ambient [MPa]	80	75
Resistivity [μΩm]	280	280
Bmax @ 4000 A/m[T]	1.26	1.19
Bmax @ 10000 A/m[T]	1.53	1.46
Hc [A/m]	200	200
μ may	455	430

Figure 5: Properties of STX Prototyping material

Results

The data for STX SMC Prototyping material shown in this data sheet has been obtained in cooperation with Höganäs AB in accordance with applicable ISO standards. All properties are measured on toroids (OD55 ID45 H5 mm) machined from SMC Prototyping material blanks (OD80 H20 or OD80 H40 mm).

It is not possible to directly attribute all the results to specific components, as parameters such as powder flow, component size and geometry can have an effect on the properties of the individual components.

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