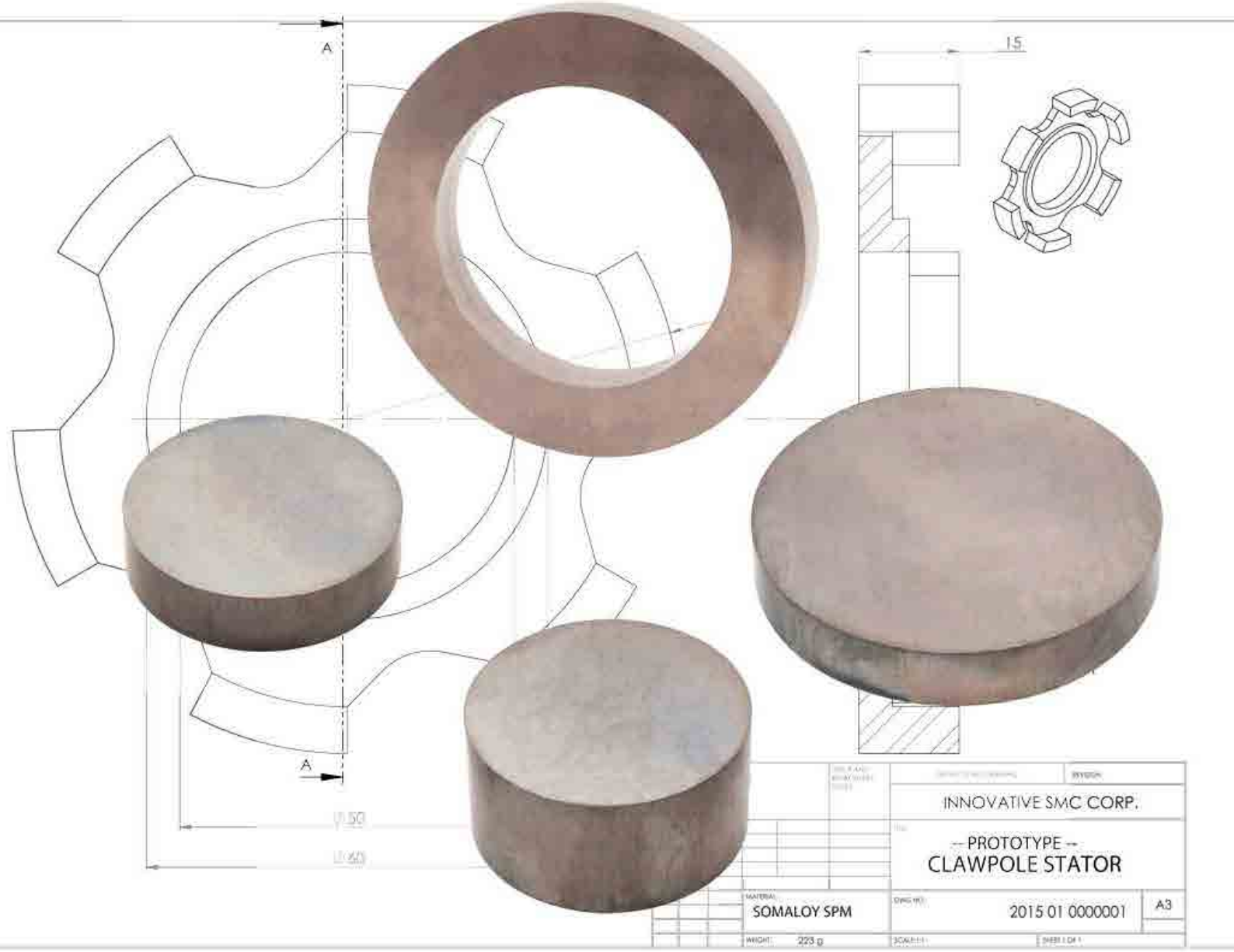
Somaloy®

Prototyping Material, SPM



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Quick and cheap with prototyping

Tooling is the preferred approach to manufacture prototype components with Somaloy® material. Using this method, the prototyped component will in all essential respects have the same properties as a mass produced component.

A simplified approach is to machine the component from a pre-fabricated blank. This can be a fast, cost-efficient approach, but it also has the drawback that the properties will in most cases be different from those obtained by compaction. A special **Somaloy Prototyping Material** (SPM) with enhanced machinability has been developed in order to minimise these differences.

To manufacture prototype components for soft magnetic applications, the blanks should be machined using conventional machining techniques:

- Turning
- Drilling
- Milling

Please read the machining recommendations on the next page

Non conventional machining, such as Electro Discharge Machining (EDM) will deteriorate the material and therefore should be avoided.
Design with walls thinner than 2 mm should be avoided. Consider the radius on the edges and corners.

Design for manufacturing

To be successful with **Somaloy Prototyping Material**, it is important to design the prototype as close to the compacted component as possible.

1 2 3 4 5

1. **Design for manufacturing and prototype machining:** First step is to design for manufacturing and the prototype material is being machined
2. **Prototype initial testing:** Initial testing of the prototypes
3. **Prototype evaluation:** Measurements and evaluation of the component design and material performance
4. **Simulation:** Use the data from the evaluation to simulate the final properties of the compacted component
5. **Production:** Confirmation and production of compacted component

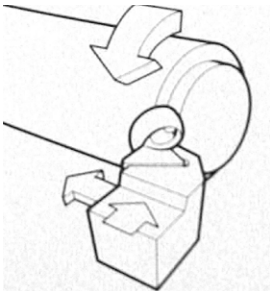
Machined component using SPM

Compacted component using Somaloy

Chipped edges and corners are normal appearances on the machined component.

There are differences between the machined prototype component (using SPM) and the compacted component (using Somaloy)

Machining recommendations for SPM

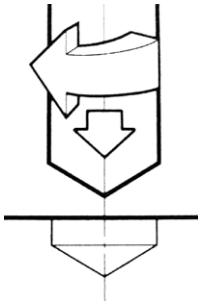


Turning

- Cermet-polished sharp inserts, for machining of aluminium and plastic materials
- Cutting speed: Vc in the range 170-200 m/min
- Feed: f = 0.1 mm/rev recommended for a good surface finish
- Cutting fluid can be used for better machinability

Tip! *Attach the blank gently to the machine.*

Tip! *Check for tool sharpness.*

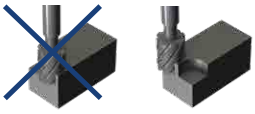


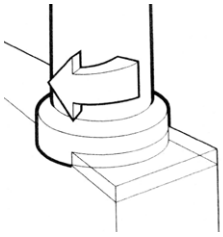
Drilling

- HSS self-centering drill
- Cutting speed: Vc = 30 m/min
- Feed speed: Vf = 60 mm/min

Tip! *Drill half way through the blank, then turn the blank and drill the other half.*

Tip! *Modify the cutter by decrease the height of the cutting surface.*





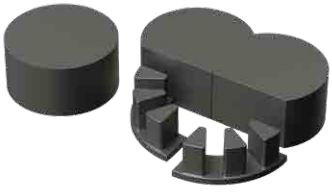
Milling

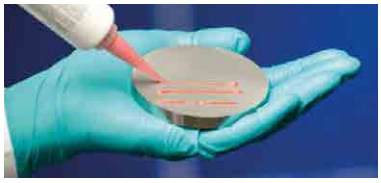
- Super sharp carbide milling cutter, for machining of aluminium and plastic materials
- Cutting speed: Vc in the range 100-200 m/min
- Feed per tooth: fz = 0.03 mm/tooth

Tip! *Work supportively towards the material - avoid moving towards the edge.*

Large components?

In order to machine larger components, **SPM** blanks can be cut and glued together (epoxy glue) before machining. Learn more about the adhesive in the information-sheet ”Adhesive joining of Somaloy components”.





General recommendations:

- When necessary, use a fixture to support the material
- Inspect the tool before machining
- Optimal tools to use when machining are coated carbide milling cutters
- Example of tool manufacturers suitable for this material: Alfa Tool and OSG

Watch the SPM-film here:

Somaloy® typical data

General	
Base material: Somaloy Prototyping Material	Somaloy Prototyping Material blanks exhibit stable mechanical properties up to 150ºC

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	60/60	SS-ISO 3325
Tensile strength	[MPa]	15*	SS-EN 10002-1, ISO
Yield strength	[MPa]	5*	SS-EN 10002-1, ISO
Young's modulus	[GPa]	100*	ASTM E 1876-99
Poisson's ratio	–	0.23	ASTM E 1876-99
Impact Energy	[J]	1.3	SS-EN 10045, SS-EN

* The machining quality may influence the expected mechanical strength.

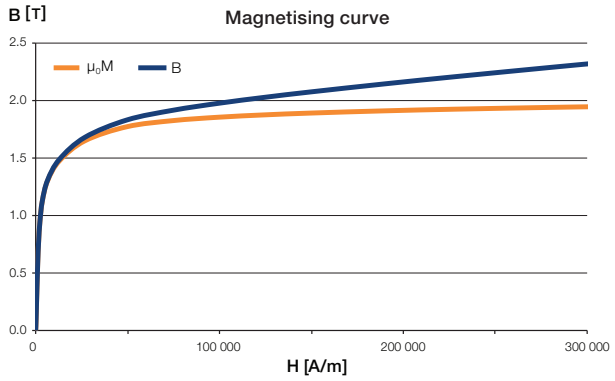
Physical properties			Standards
Density	[g/cm^3]	7.3	SS-ISO 2738
Thermal expansion	[K^{-1}]	11 e-06	ASTM E 228/MPIF 35
Resistivity	[µΩm]	300	Four point measurements on nominal size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.19	IEC 60404-4
B@10000A/m	[T]	1.46	IEC 60404-4
H_C	[A/m]	210	IEC 60404-4
μ_r-max	–	430	IEC 60404-4

Available blanks	Size
Cylindrical	OD 80/H20 mm
Cylindrical	OD 80/H40 mm
Cylindrical	OD 120/H20 mm
Ring	OD155/ID105/H20 mm

Magnetising curve

Data adjusted for use in Finite Element Modeling.



H[A/m]	μ_0M[T]	B[T]	H[A/m]	μ_0M[T]	B[T]
0	0.00	0.00	12904	1.47	1.49
93	0.03	0.03	26799	1.65	1.68
165	0.06	0.06	49770	1.77	1.83
284	0.13	0.12	74770	1.82	1.92
399	0.19	0.19	99770	1.85	1.98
457	0.23	0.23	124770	1.87	2.03
1104	0.58	0.58	149770	1.89	2.08
1594	0.77	0.77	189770	1.91	2.15
2306	0.94	0.95	229770	1.92	2.21
3606	1.12	1.13	279770	1.93	2.29
6468	1.30	1.31	304770	1.94	2.33

Core loss

[W/kg]	50/60 Hz	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz	600 Hz	700 Hz	800 Hz	900 Hz	1000 Hz	2000 Hz
0.5T	1.6 / 1.9	3.1	6	10	14	17	21	26	30	34	39	95
1.0T	5.2 / 6.3	11	22	34	47	60	74	88	104	120	136	339
1.5T	11 / 13	22	45	70	96	123	153	183	216	249	284	719

Measured according to CEI / IEC 60404 - 6:2003 on ring sample (OD55 ID45 H5 mm).

Loss model

K_h	0.103	K_{ep}	0.000027

Model is verified up to 1.5 T and 5000 Hz.

$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad (W/kg)$$

K_h	Hysterisis loss coefficient		**f**	Frequency	[Hz]
K_{ep}	In particle eddy current coefficient		**B**	Field strength	[T]
			ρ	Density	[g/cm^3]
d	Smallest cross section of component	[mm]	**resistivity**		[µΩm]

For more information on Somaloy and Somaloy Prototyping Material, please scan the QR code.