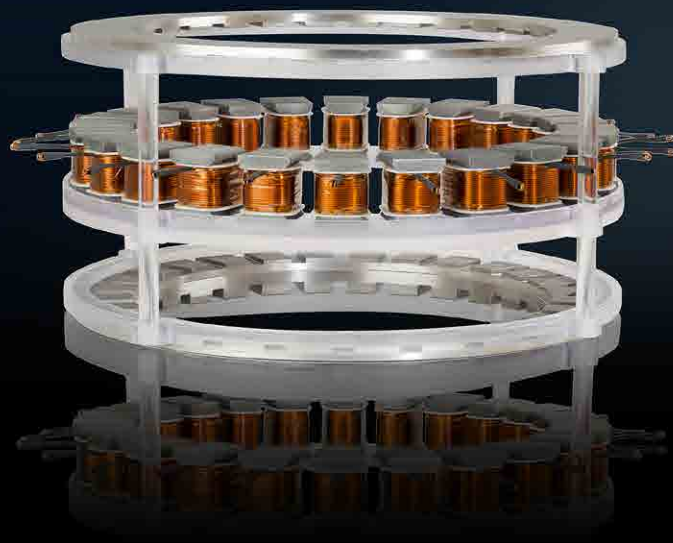


Somaloy[®] 5P

Material data

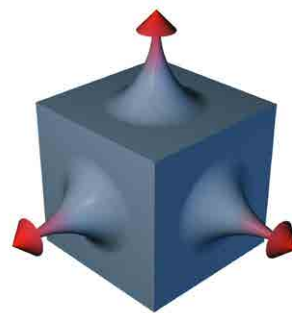


Every particle counts

Höganäs 
POWDER THAT EMPOWERS[®]

What is the most important property for your application?

Somaloy® is an isotropic, high resistive Soft Magnetic Composite (SMC) material for electromagnetic applications. Somaloy makes it possible to design innovative, compact and powerful components that match your specific application and future demands. The secret is the unique 3D flux properties and net-shaping opportunity.

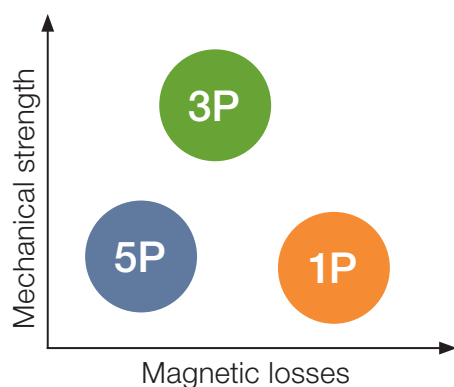


Höganäs develop and provide the Somaloy product range which comprises press-ready powder mixes. Each Somaloy product has properties that can be carefully tailored to ensure optimum performance in your specific component and application. We will help you with material selection that suits your specific needs in your development process.

The Somaloy product family

The Somaloy product family includes 3 groups; 1P, 3P and 5P with different performance levels (P):

- Somaloy 1P Baseline
- Somaloy 3P Mechanical strength, permeability
- Somaloy 5P Lowest losses



- **Cost-efficient**
- **Compact design**
- **High performance**

Comparing SMC data to electric steel-sheets

SMC data is measured on single ring components (OD55/ID45/H5 mm) via square cross-section. The measured SMC sample is a full magnetic core component that can be compared to a punched and stacked electric steel-sheet pack representing the same geometry. Data for electric steel-sheets are normally given for a single sheet, tested with an Epstein frame test. SMC is not tested by this method and thereby data is not directly comparable. Additional design factors aimed for electric steel-sheet stacks does not apply for SMC.

Find out more

Contact your local sales representative or visit www.hoganas.com/electromagnetic

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Detailed material data

Large particles #40

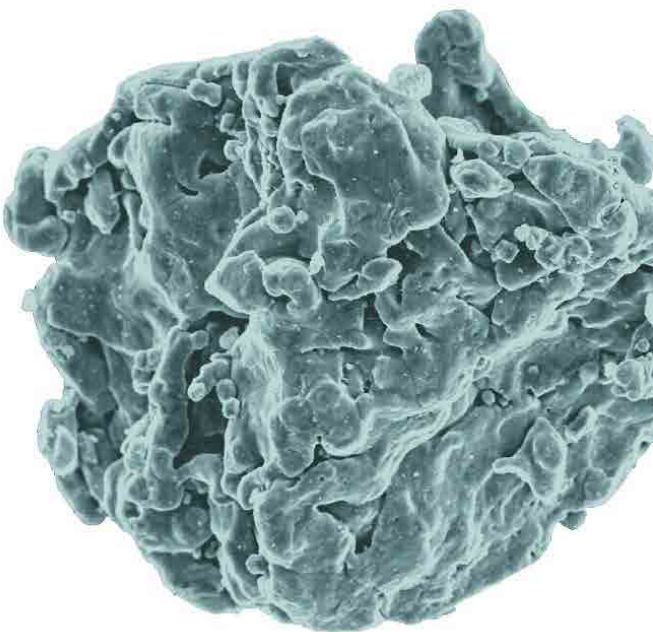
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Somaloy powder particle

Somaloy®

Product portfolio

Somaloy material	Density [g/cm³]	Resistivity [μOhm m]	TRS ambient [MPa]	B@ 10000 A/m [T]	μ _{max}	Core losses @ 1T [W/kg]				
						Cross-section 5x5 mm				15x15 mm
						100 Hz	400 Hz	1000 Hz	2000 Hz	1000 Hz
Large particles #40										
Somaloy 700HR 5P	7.50	700	60	1.57	600	6.6	30	92	241	106
Somaloy 1000 5P	7.52	90	65	1.59	720	6.6	31	103	-	217
Somaloy 700HR 1P	7.45	1000	35	1.53	440	10.0	43	125	307	136
Somaloy 700 1P	7.45	400	40	1.56	540	9.9	43	126	312	152
Somaloy 700HR 3P	7.52	600	120	1.57	770	10.4	45	130	319	147
Somaloy 700 3P	7.57	200	125	1.61	850	10.2	45	132	331	183
Somaloy 1000 3P	7.56	70	140	1.63	950	10.3	46	143	-	288

Somaloy material	Density [g/cm³]	Resistivity [μOhm m]	TRS ambient [MPa]	B@ 10000 A/m [T]	μ _{max}	Core losses [W/kg]				
						Cross-section 5x5 mm				15x15 mm
						100 Hz 1 T	1 kHz 1 T	5 kHz 0.5 T	10 kHz 0.1 T	1 kHz 1 T
Medium particles #100										
Somaloy 130i 5P	7.44	20000	35	1.47	350	8.0	93	205	24	94
Somaloy 130i 1P	7.35	8000	33	1.40	290	12.0	132	264	29	134
Somaloy 500 1P	7.37	70	50	1.51	500	12.6	156	387	-	305
Fine particles #200										
Somaloy 110i 1P	7.26	7600	34	1.33	220	14.4	153	276	27	155
Somaloy 110i 5P	7.30	18000	42	1.33	220	9.9	108	209	18	109

Typical product data 800 MPa compaction pressure, magnetic data measured according to CEI/IEC 60404

**For more information, please contact
your local sales representative.**

Somaloy® 700HR 5P

800 MPa

General			
Base material: Somaloy 700HR 5P	Additive(s): 0.3% 5P Lube	Compaction: Pressure: 800 MPa Die temperature: 100°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	60/60	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	20/20	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	650/110	ASTM E9-89a
Young's modulus	[GPa]	150	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	1.7	SS-EN 10045, SS-EN 25754

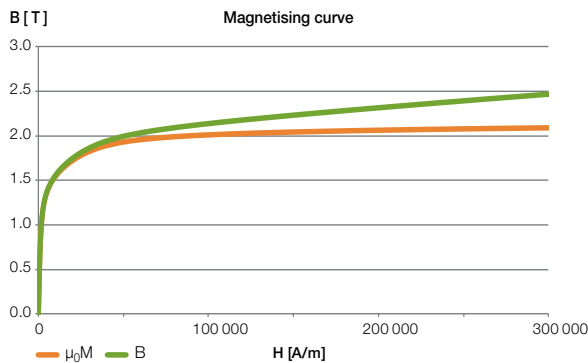
Physical properties			Standards
Density	[g/cm³]	7.50	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m²K]	21	ISO 22007-2
Resistivity	[μΩm]	700	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.33	IEC 60404-4
B@10000A/m	[T]	1.57	IEC 60404-4
H _c	[A/m]	120	IEC 60404-4
μ _r -max	-	600	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.30	ISO 3923/1
Flow	[s/50g]	33	ISO 4490
Green density	[g/cm³]	7.51	ISO 3927
Green strength	[MPa]	15	ISO 3995
Springback	[%]	0.16	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.09	ISO 4492, ISO 2740
Total dim. change	[%]	0.07	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	13228	1.61	1.63
63	0.03	0.03	27279	1.80	1.84
119	0.06	0.06	49771	1.93	1.99
214	0.14	0.14	74771	1.98	2.08
306	0.21	0.21	99771	2.01	2.14
608	0.45	0.45	124771	2.03	2.19
899	0.65	0.65	149771	2.04	2.23
1344	0.86	0.86	189771	2.06	2.30
1996	1.05	1.05	229771	2.07	2.36
3285	1.24	1.24	279771	2.09	2.44
6377	1.43	1.43	304771	2.091	2.47

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	1.0/1.2	1.9	4.0	6.0	9.0	11	14	17	20	23	26	66
1.0T	3.2/3.9	6.6	14	21	30	39	48	58	69	80	92	241
1.5T	6.6/7.9	13	28	44	62	80	100	121	144	168	193	516

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

Loss model			
K _h	0.063	K _{ep}	0.000027

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

Model is verified up to 1.5T and 5000Hz.

K_h Hysteresis loss coefficient
K_{ep} In particle eddy current coefficient
d Smallest cross section of component [mm]
f Frequency [Hz]
B Field strength [T]
ρ Density [g/cm³]
resistivity [μΩm]

Somaloy® 700HR 5P

600 MPa

General			
Base material: Somaloy 700HR 5P	Additive(s): 0.3% 5P Lube	Compaction: Pressure: 600 MPa Die temperature: 100°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	60/60	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	20/20	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	530/110	ASTM E9-89a
Young's modulus	[GPa]	150	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	1.7	SS-EN 10045, SS-EN 25754

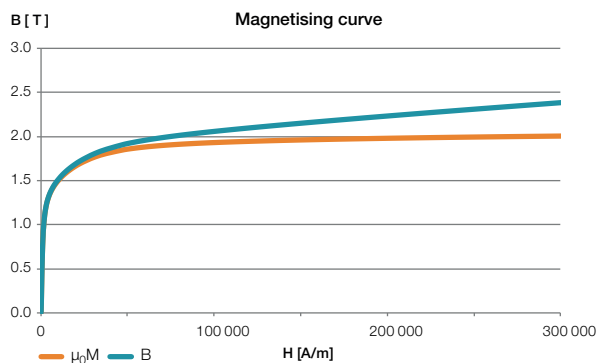
Physical properties			Standards
Density	[g/cm³]	7.40	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m·K]	26	ISO 22007-2
Resistivity	[μΩm]	600	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.28	IEC 60404-4
B@10000A/m	[T]	1.52	IEC 60404-4
H _c	[A/m]	120	IEC 60404-4
μ _r -max	-	600	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.30	ISO 3923/1
Flow	[s/50g]	33	ISO 4490
Green density	[g/cm³]	7.39	ISO 3927
Green strength	[MPa]	13	ISO 3995
Springback	[%]	0.14	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.08	ISO 4492, ISO 2740
Total dim. change	[%]	0.06	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	12476	1.54	1.56
63	0.03	0.03	26507	1.73	1.76
110	0.06	0.06	49591	1.85	1.91
197	0.12	0.12	74591	1.90	2.00
288	0.20	0.20	99591	1.93	2.05
559	0.43	0.43	124591	1.94	2.10
829	0.61	0.61	149591	1.96	2.15
1197	0.81	0.81	189591	1.97	2.21
1827	0.99	1.00	229591	1.98	2.27
3009	1.18	1.18	279591	2.00	2.35
5854	1.36	1.37	304591	2.002	2.39

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	1.0/1.2	2.0	4.0	7.0	9.0	12	15	18	21	24	28	73
1.0T	3.3/4.0	6.8	14	23	31	41	51	62	74	86	99	267
1.5T	6.8/8.2	14	30	47	65	85	107	130	155	181	209	572

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

Loss model			
K _h	0.065	K _{ep}	0.000032

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

Model is verified up to 1.5T and 5000Hz.

K_h Hysteresis loss coefficient
K_{ep} In particle eddy current coefficient
d Smallest cross section of component [mm]
f Frequency [Hz]
B Field strength [T]
ρ Density [g/cm³]
resistivity [μΩm]

Somaloy® 1000 5P

800 MPa

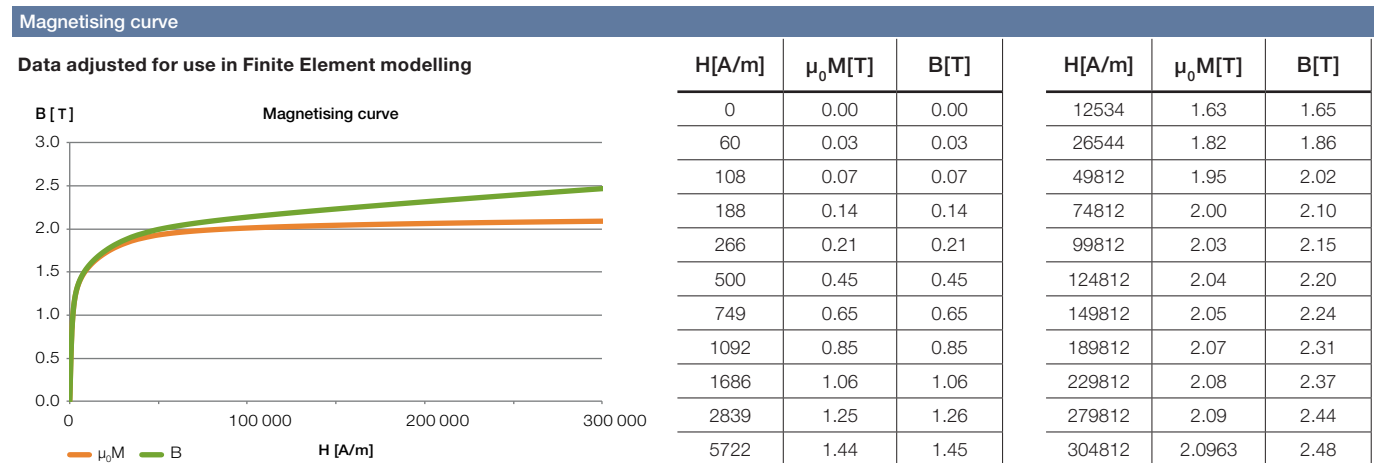
General			
Base material: Somaloy 1000 5P	Additive(s): 0.3% 5P Lube	Compaction: Pressure: 800 MPa Die temperature: 100°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	65/65	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	20/20	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	570/110	ASTM E9-89a
Young's modulus	[GPa]	140	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	1.8	SS-EN 10045, SS-EN 25754

Physical properties			Standards
Density	[g/cm³]	7.52	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m·K]	21	ISO 22007-2
Resistivity	[μΩm]	90	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.36	IEC 60404-4
B@10000A/m	[T]	1.59	IEC 60404-4
H _c	[A/m]	124	IEC 60404-4
μ _r -max	-	720	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.18	ISO 3923/1
Flow	[s/50g]	35	ISO 4490
Green density	[g/cm³]	7.52	ISO 3927
Green strength	[MPa]	17	ISO 3995
Springback	[%]	0.19	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.10	ISO 4492, ISO 2740
Total dim. change	[%]	0.09	ISO 4492, ISO 2740



Core loss							
[W/kg]	50/60 Hz	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz	600 Hz
0.5T	0.9/1.1	1.9	4.0	7.0	9.0	12	15
1.0T	3.2/3.9	6.6	14	22	31	41	52
1.5T	6.5/7.9	14	29	46	65	86	109

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

Loss model			
K _h	0.062	K _{ep}	0.000027

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

Model is verified up to 1.5T and 2000Hz.

K_h Hysteresis loss coefficient
K_{ep} In particle eddy current coefficient
d Smallest cross section of component [mm]
f Frequency [Hz]
B Field strength [T]
ρ Density [g/cm³]
resistivity [μΩm]

Somaloy® 1000 5P

600 MPa

General			
Base material: Somaloy 1000 5P	Additive(s): 0.3% 5P Lube	Compaction: Pressure: 600 MPa Die temperature: 100°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	65/65	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	25/25	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	480/110	ASTM E9-89a
Young's modulus	[GPa]	130	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	1.8	SS-EN 10045, SS-EN 25754

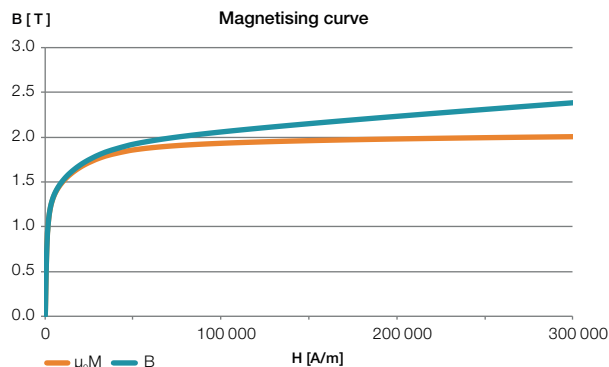
Physical properties			Standards
Density	[g/cm³]	7.40	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m·K]	26	ISO 22007-2
Resistivity	[μΩm]	80	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.31	IEC 60404-4
B@10000A/m	[T]	1.53	IEC 60404-4
H _c	[A/m]	125	IEC 60404-4
μ _r -max	-	700	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.18	ISO 3923/1
Flow	[s/50g]	35	ISO 4490
Green density	[g/cm³]	7.42	ISO 3927
Green strength	[MPa]	15	ISO 3995
Springback	[%]	0.17	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.09	ISO 4492, ISO 2740
Total dim. change	[%]	0.08	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	12277	1.55	1.56
47	0.02	0.02	26557	1.73	1.76
83	0.05	0.05	49779	1.85	1.92
158	0.11	0.11	74779	1.90	2.00
229	0.18	0.18	99779	1.93	2.05
491	0.45	0.45	124779	1.95	2.10
668	0.60	0.60	149779	1.96	2.15
988	0.79	0.80	189779	1.97	2.21
1557	0.99	1.00	229779	1.99	2.27
2703	1.18	1.19	279779	2.00	2.35
5537	1.37	1.37	304779	2.002	2.39

Core loss							
[W/kg]	50/60 Hz	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz	600 Hz
0,5T	1.0/1.2	2.0	4.0	7.0	9.0	12	15
1,0T	3.3/4.0	6.8	15	23	33	43	55
1,5T	6.8/8.3	14	30	48	68	90	114

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

Loss model			
K _h	0.064	K _{ep}	0.000032

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

Model is verified up to 1.5T and 2000Hz.

K_h Hysteresis loss coefficient
K_{ep} In particle eddy current coefficient
d Smallest cross section of component [mm]
f Frequency [Hz]
B Field strength [T]
ρ Density [g/cm³]
resistivity [μΩm]

Somaloy® 130i 5P

800 MPa

General			
Base material: Somaloy 130i 5P	Additive(s): 0.3% 5P Lube	Compaction: Pressure: 800 MPa Die temperature: 80°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties		Standards	
Transverse rupture strength/150°C	[MPa]	35/35	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	15/15	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	310/110	ASTM E9-89a
Young's modulus	[GPa]	100	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	0.6	SS-EN 10045, SS-EN 25754

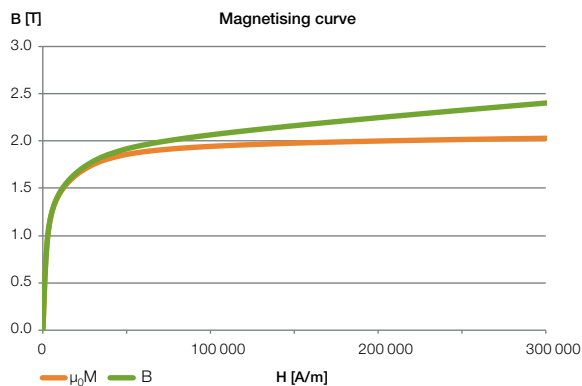
Physical properties		Standards	
Density	[g/cm³]	7.44	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m²K]	19	ISO 22007-2
Resistivity	[μΩm]	20000	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties		Standards	
B@4000A/m	[T]	1.14	IEC 60404-4
B@10000A/m	[T]	1.47	IEC 60404-4
H _c	[A/m]	153	IEC 60404-4
μ _r -max	-	350	IEC 60404-4

Powder properties		Standards	
Apparent density	[g/cm³]	3.58	ISO 3923/1
Flow	[s/50g]	22	ISO 4490
Green density	[g/cm³]	7.43	ISO 3927
Green strength	[MPa]	8	ISO 3995
Springback	[%]	0.22	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.10	ISO 4492, ISO 2740
Total dim. change	[%]	0.12	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	14364	1.55	1.57
116	0.04	0.04	27712	1.73	1.76
205	0.07	0.07	49770	1.86	1.92
361	0.14	0.14	74770	1.91	2.01
525	0.22	0.22	99770	1.94	2.07
1182	0.54	0.54	124770	1.96	2.12
1509	0.65	0.65	149770	1.98	2.17
2126	0.83	0.83	189770	2.00	2.23
3046	1.01	1.01	229770	2.01	2.30
4644	1.19	1.19	279770	2.02	2.38
7841	1.37	1.38	304770	2.030	2.41

Core loss												
[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz	[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.5T	1.2/1.4	2.4	6.1	13	20	27	61	0.05T	2.3	6.2	16	29
1.0T	4.0/4.8	8.0	21	43	67	93	214	0.1T	9.2	24	64	113
1.5T	8.1/9.8	16	42	88	138	192	448	0.2T	36	95	250	442

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

Loss model			
K _h	0.079	K _{ep}	0.000014

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

Model is verified up to 0.5T-1.5T and 5000Hz.

$$P_{tot} = 90 * B^{1.97} * f^{1.40}$$

Model is verified up to 0.05T-0.2T and 5-50 kHz.

K _h	Hysteresis loss coefficient	f	Frequency [Hz]
K _{ep}	In particle eddy current coefficient	B	Field strength [T]
d	Smallest cross section of component [mm]	ρ	Density [g/cm³]
		resistivity	[μΩm]
f	Frequency [kHz]		
B	Field strength [T]		

Somaloy® 130i 5P

600 MPa

General			
Base material: Somaloy 130i 5P	Additive(s): 0.3% 5P Lube	Compaction: Pressure: 600 MPa Die temperature: 80°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	40/40	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	20/20	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	310/120	ASTM E9-89a
Young's modulus	[GPa]	90	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	0.6	SS-EN 10045, SS-EN 25754

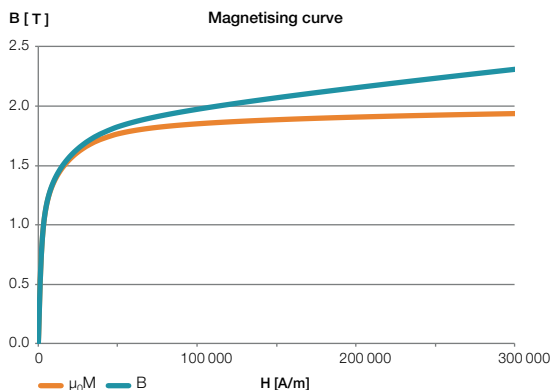
Physical properties			Standards
Density	[g/cm³]	7.30	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m·K]	26	ISO 22007-2
Resistivity	[μΩm]	17000	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.09	IEC 60404-4
B@10000A/m	[T]	1.41	IEC 60404-4
H _c	[A/m]	158	IEC 60404-4
μ _r -max	-	340	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.58	ISO 3923/1
Flow	[s/50g]	22	ISO 4490
Green density	[g/cm³]	7.33	ISO 3927
Green strength	[MPa]	7	ISO 3995
Springback	[%]	0.18	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.09	ISO 4492, ISO 2740
Total dim. change	[%]	0.09	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	14470	1.47	1.48
107	0.03	0.03	28127	1.64	1.68
194	0.07	0.07	49652	1.76	1.83
344	0.13	0.13	74652	1.82	1.91
501	0.21	0.21	99652	1.85	1.97
944	0.41	0.41	124652	1.87	2.02
1425	0.60	0.60	149652	1.88	2.07
2031	0.77	0.77	189652	1.90	2.14
2941	0.94	0.95	229652	1.92	2.20
4563	1.12	1.12	279652	1.93	2.28
7828	1.29	1.30	304652	1.935	2.32

Core loss

[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz	[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.5T	1.2/1.5	2.5	6.3	13	21	29	68	0.05T	2.9	7.9	22	39
1.0T	4.1/4.9	8.3	22	46	72	101	242	0.1T	11	31	84	151
1.5T	8.3/10	17	44	94	149	210	510	0.2T	43	119	324	583

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

Loss model

K _h	0.081	K _{ep}	0.000020
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * \text{resistivity} * 1000} \quad [\text{W/kg}]$$

Model is verified up to 0.5T-1.5T and 5000Hz.

$$P_{tot} = 97 * B^{1.95} * f^{1.45}$$

Model is verified up to 0.05T-0.2T and 5-50 kHz.

K _h	Hysteresis loss coefficient	f	Frequency [Hz]
K _{ep}	In particle eddy current coefficient	B	Field strength [T]
d	Smallest cross section of component [mm]	ρ	Density [g/cm³]
		resistivity	[μΩm]
f	Frequency [kHz]		
B	Field strength [T]		

Somaloy® 110i 5P

800 MPa

General			
Base material: Somaloy 110i 5P	Additive(s): 0.4% 5P Lube	Compaction: Pressure: 800 MPa Die temperature: 60°C	Heat treatment: Atmosphere: Nitrogen Temperature: 650°C

Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	42/42	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	25/25	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	270/110	ASTM E9-89a
Young's modulus	[GPa]	90	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	0.6	SS-EN 10045, SS-EN 25754

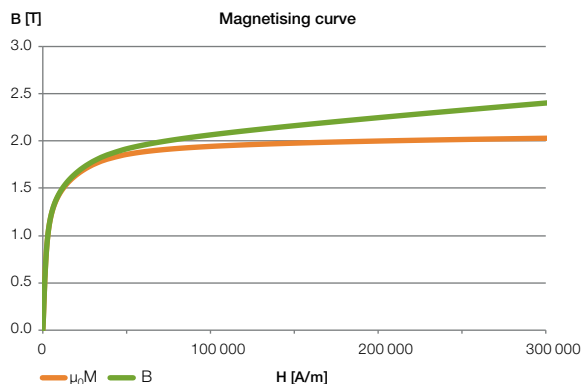
Physical properties			Standards
Density	[g/cm³]	7.30	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m²K]	15	ISO 22007-2
Resistivity	[μΩm]	18000	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	0.90	IEC 60404-4
B@10000A/m	[T]	1.33	IEC 60404-4
H _c	[A/m]	207	IEC 60404-4
μ _r -max	-	220	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.42	ISO 3923/1
Flow	[s/50g]	28	ISO 4490
Green density	[g/cm³]	7.33	ISO 3927
Green strength	[MPa]	9	ISO 3995
Springback	[%]	0.23	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.13	ISO 4492, ISO 2740
Total dim. change	[%]	0.10	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	17216	1.51	1.53
185	0.04	0.04	30659	1.69	1.73
321	0.08	0.08	50401	1.81	1.87
581	0.15	0.15	75401	1.88	1.97
828	0.22	0.22	100401	1.91	2.04
1232	0.34	0.34	125401	1.94	2.10
2434	0.63	0.63	150401	1.96	2.15
3361	0.80	0.81	190401	1.98	2.22
4638	0.98	0.98	230401	2.00	2.29
6674	1.16	1.16	280401	2.02	2.37
10343	1.33	1.35	305401	2.028	2.41

Core loss												
[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz	[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.5T	1.5/1.8	2.9	7.4	15	23	32	68	0.05T	1.7	4.4	11	19
1.0T	4.9/5.9	9.9	25	52	79	108	236	0.1T	7.0	18	46	79
1.5T	10/12	20	51	105	162	222	489	0.2T	29	74	188	326

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

Loss model

K _h	0.098	K _{ep}	0.000010									
$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000}$				[W/kg]								
Model is verified up to 0.5T-1.5T and 5000Hz.					K _h	Hysteresis loss coefficient	f	Frequency [Hz]	B	Field strength [T]	ρ	Density [g/cm³]
					K _{ep}	In particle eddy current coefficient	d	Smallest cross section of component [mm]	resistivity	[μΩm]		

$P_{tot} = 88 * B^{2.04} * f^{1.35}$				f	Frequency [kHz]	B	Field strength [T]
Model is verified up to 0.05T-0.2T and 5-50 kHz.							

Somaloy® 110i 5P

600 MPa

General			
Base material: Somaloy 110i 5P		Additive(s): 0.4% 5P Lube	
Compaction: Pressure: 600 MPa Die temperature: 60°C		Heat treatment: Atmosphere: Nitrogen Temperature: 650°C	

Mechanical properties		Standards	
Transverse rupture strength/150°C	[MPa]	44/44	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	25/25	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	300/130	ASTM E9-89a
Young's modulus	[GPa]	80	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	0.7	SS-EN 10045, SS-EN 25754

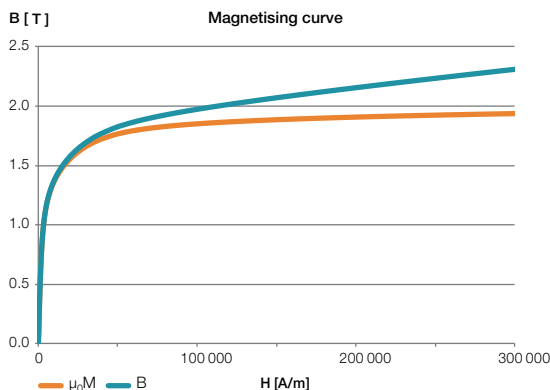
Physical properties		Standards	
Density	[g/cm³]	7.14	SS-ISO 2738
Thermal expansion	[K⁻¹]	11 e-06	ASTM E 228/MPF 35
Thermal conductivity	[W/m·K]	20	ISO 22007-2
Resistivity	[μΩm]	6000	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties		Standards	
B@4000A/m	[T]	0.85	IEC 60404-4
B@10000A/m	[T]	1.25	IEC 60404-4
H _c	[A/m]	210	IEC 60404-4
μ _r -max	-	210	IEC 60404-4

Powder properties		Standards	
Apparent density	[g/cm³]	3.42	ISO 3923/1
Flow	[s/50g]	28	ISO 4490
Green density	[g/cm³]	7.17	ISO 3927
Green strength	[MPa]	10	ISO 3995
Springback	[%]	0.18	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.14	ISO 4492, ISO 2740
Total dim. change	[%]	0.04	ISO 4492, ISO 2740

Magnetising curve

Data adjusted for use in Finite Element modelling



H[A/m]	μ ₀ M[T]	B[T]	H[A/m]	μ ₀ M[T]	B[T]
0	0.00	0.00	16748	1.38	1.40
171	0.03	0.03	30123	1.56	1.59
314	0.07	0.07	49799	1.68	1.74
581	0.13	0.13	74799	1.74	1.84
844	0.20	0.20	99799	1.78	1.91
1108	0.28	0.28	124799	1.81	1.97
2499	0.57	0.58	149799	1.83	2.02
3439	0.73	0.74	189799	1.86	2.10
4768	0.90	0.90	229799	1.88	2.17
6792	1.06	1.07	279799	1.90	2.25
10374	1.22	1.24	304799	1.909	2.29

Core loss												
[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz	[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.5T	1.5/1.8	3.0	7.6	16	24	33	71	0.05T	2.0	5.2	13	23
1.0T	5.0/6.0	10	26	53	81	111	245	0.1T	8.3	21	54	93
1.5T	10/12	21	52	108	167	229	509	0.2T	34	86	219	378

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

Loss model			
K _h	0.100	K _{ep}	0.000011

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

Model is verified up to 0.5T-1.5T and 5000Hz.

$$P_{tot} = 99 * B^{2.02} * f^{1.35}$$

Model is verified up to 0.05T-0.2T and 5-50 kHz.

K_h Hysteresis loss coefficient
K_{ep} In particle eddy current coefficient
d Smallest cross section of component [mm]
f Frequency [Hz]
B Field strength [T]
ρ Density [g/cm³]
resistivity [μΩm]

f Frequency [kHz]
B Field strength [T]



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